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Facilitating social learning through learning design: A perspective of collaborative academic development

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In the field of technology-enhanced learning design, the rise of Web 2.0 has been the filip needed to accelerate the emergence of socially-connected global learners. These highly social learners now use the web to engage with knowledge and skill development and as such, online education has moved irrevocably beyond simply the finding and sharing of information among learners.

The higher education sector is responding to this learning landscape. This is particularly relevant to the massive open online courses (MOOCs) environment where there is the potential for thousands of participants to learn through multiple open source tools with minimum intervention from educators. This social learning perspective can present a challenge for some educators.

In this paper we present a work-in-progress collaborative project designed to respond to the professional development of teaching academics newly engaged in designing and teaching from a social learning perspective. We, in a central learning and teaching unit, designed and developed a professional development (PD) course that sought to build the capacity of academics going through this change: they were about to teach on a MOOC platform. Our purpose was to model the social learning framework as a method of capacity-building, but we also aimed to distil authentic social learning for the academics themselves. This resulted in creating a community of practice among educators. Further research is required to measure the impact of this capacity-building course in order to further enhance the learning experiences of academics preparing to teach on a MOOC platform.

Introduction

The work-in progress professional development (PD) project described in this paper arises out of three key higher education curricula challenges for online learning:

- Developing replicable learning design that effectively delivers learning outcomes at scale and learning environments which facilitate active and collaborative learning (Laurillard, 2012; Toetenel & Rienties, 2016)
- Enabling technology-enabled strategies that transform learning experiences rather than replicate or merely enhance existing strategies (Kirkwood & Price, 2013)
- Building staff capability across each of these dimensions

We outline the learning design underpinning a PD course on facilitating social learning. This course was developed to support a large university-wide strategic project that delivered a suite of postgraduate degree courses through a MOOC platform (called FutureLearn) as a world first initiative. The Deakin Degrees at FutureLearn project offers postgraduate degrees through the global social learning platform with an innovative business model where the first component of a course is offered as an open, free taster course introducing the degree program. This provides new pathways into the university's courses and allows our fee-paying degree students to learn with a large cohort of global learners across sections of their course. This project seeks to position the university as an international provider of postgraduate education but it was also conceived as a way of triggering further growth and addressing the challenges outlined above.

New approaches to learning design have recently attracted increased attention within higher education (Bennett, Agostinho, & Lockyer, 2016; Johnson et al., 2016). Toetenel and Rienties (2016) for example reported on how the implementation of a visual learning design at the start of a unit design process successfully impacted on educators incorporating a variety of learning activity types

into their units. Re-investigating the role of learning design is particularly important given the exponential development of educational technology which has transformed the boundaries of what and how learners learn in digital learning environments (Selwyn, 2016; Siemens, 2014). The advancement of Web 2.0 tools for the purpose of creating and cultivating meaningful social networks for all users is a key part of this change. As Toetenel and Rienties (2016) have noted, “social media support forms of knowledge consumption and knowledge construction that are very different to the epistemological principles of formal education and individualized instruction (p. 3)”. Effective use of these tools therefore demands a social design for learning. The concept of social learning is not new and is at the heart of social constructivist approaches to learning and early theories of online and distance learning which emphasised communities of practice. However, social learning needs to be rethought in the context of both the new digital learning environment and new Web 2.0 teaching and learning tools. It is particularly relevant now for universities seeking ways to harness the potential of Massive Online Open Courses (MOOC) where thousands of learners are enrolled and engaged in (social) learning.

In moving to this new model of learning and teaching, we identified the need to build the capacity of our academics teaching in these new courses on FutureLearn. In responding to this need, we, the university central learning and teaching unit, developed a PD course within the same platform that aimed at building capacity of academics to move from a standard teaching delivery model to one that emphasises ‘facilitating social learning’. In developing this course, we employed the same principles of learning design that we applied to our other degree courses within this project. This was not only to model the practice and principles that we were advocating as an innovation for learning design, but also to test the model's effectiveness first hand.

Why adopt the FutureLearn MOOC platform? – context to the PD course

A decision to evaluate and select educational technology ought to be motivated by pedagogical reasons (Toetenel & Rienties, 2016). So why then, was FutureLearn chosen to deliver this curriculum innovation? This is largely due to the fact that the platform itself already has robust learning design built-into the platform which promote social learning as part of their call to authentic and active learning. Some good examples of this include:

- Simple and clear step-by-step interface design which leads to better learner experiences and creates a clear course narrative
- Learner and educator profiles which participants can ‘follow’– cultivating connected networks among large numbers of learners
- Comment/discussion section in line with every step where content is presented - provoking timely conversations with others at the point of learning

The role of educators as facilitators of learning is a critical component not only in digital but all learning environments. This is of particular interest in MOOC environments where potentially the balance of learning opportunities shift for educators where thousands of global learners with diverse backgrounds engage more among themselves, compared to a limited number of educators.

A variety of ways to facilitate social learning have been identified by Ferguson, Sharples, and Beale (2013), academics working at FutureLearn, who report various types of social learning observed within the platform:

- Direct learning: one learner replies to another’s note/question
- Knowledge sharing: a learner shares knowledge via a note
- Conversational learning: happens via notes and replies and group discussion
- Vicarious learning: through seeing conversation on delivered content and in the activity feed and by following others
- Implicit learning: taking part in activity groups
- ZPD (Zone of Proximal Development): following and learning from learners with more knowledge or experience.

Literature review and conceptual frameworks – learning design

A strategy to build the social learning design knowledge of teaching academics “is to sharpen focus on students’ activity’ in order for them to take greater control over the design of their own learning tasks and learning environments” (Goodyear, 2015, p. 27). This is not unlike Bigg’s view of quality teaching and learning in that it is what the students are doing that is important to learning (2007) and this perspective provides a critical, familiar scaffolding for academic developers and teaching staff in approaching the innovative learning design practices we find ourselves exploring in highly social digital spaces. Schon (cited in Cross, p. 46) emphasised the messy problematic situations that exist in the world of design and technology, and in this context, practitioners working and teaching in this world benefit from a community membership engaged in reflective practice. So while university academics are “obligated to help students locate, access and configure the (…) resources they need for the activity in which they are engaging, and to help them find good ways of working with their peers” (Goodyear 2015, p.33), those who are responsible for assisting academics to develop their capacity to design and facilitate MOOCs need to mirror those same obligations. In other words, we aim to engage academics as collaborative learners and in learning contexts “where pedagogies are made visible through dialogue” (McLoughlin, 2010, p. 117). This is consistent with the idea that ‘academic learning involves a continuing and iterative dialogue between teacher and student’ (Laurillard, 2002, cited in Krause and Coates 2008, p.501), though, who takes the role of teacher is a purposefully fluid concept of facilitation in highly social learning contexts.

Our learning design model for this PD course (and the FutureLearn courses we were developing) drew on Diana Laurillard’s conceptualization of “teaching as a design science” (2012) that builds on the relationships between teachers, students and peers. Our project further extends on her work that effective learning designs must provide opportunities for inquiry, discussion, practice, collaboration and production beyond just presenting information (acquiring). Laurillard proposes that teachers capture their design as “pedagogic patterns” that can be created, shared and refined as a community of practitioners working together.

> This type of pattern format is semi-structured, where the headings are used to elicit text and diagrams from the teacher-designer to represent their pedagogy for others…. Some kind of structured and formalizable design pattern is needed for expressing pedagogic ideas, as the basis for the teaching community to collaborate in building its own knowledge of what learners need, how to teach, and what to demand of the technology. (Laurillard 2012, p.8)

Shared patterns simplify design and allow teachers to re-allocate their time and creativity. Laurillard argues this is more important than ever because rapid uptake of technologies for learning often lead to default (transmission) learning designs being adopted.

> Because technology is changing both what and how students learn we can only lead educational innovation by being clear about the principles of designing good teaching and learning, and therefore what education needs from technology. (Laurillard 2012, p.8)

Shared education design patterns, or learning routines, situated within social learning principles and practices, ensure courses provide a varied, rich social learning experience that focuses on collaborative activity rather than content provision and consumption. This notion of "sharing pedagogic patterns" is critical to both the design and implementation of this PD course as it is designed to enable academics and other members of teaching teams to share and reflect on their practice within an explicit pedagogical framework.

What particular pedagogical challenge for educators was addressed in the PD course?

The notion of facilitator in social learning might come as a challenge to some academics - to step back and allow learners to engage with (social) learning with minimum interventions. The idea of educators providing and transmitting knowledge at all times as a primary mode of teaching in a MOOC does not work for two reasons. Firstly, it is simply impossible to monitor, intervene, connect and respond to thousands of learners and their comments in MOOC environments with a limited number of educators. Secondly, the continuous and prominent intervention of educators may not model what happens in real-world. In this rapidly changing global society, the capacity to work collaboratively with peers and to apply evaluative judgement in making decisions independently with minimum guidance from experts or supervisors is a highly desirable trait in 21st century citizens.

Based on this, we identified the need to develop a PD course that transformed educators driving social learning with their learners in the specific context of FutureLearn courses. The course had multiple purposes:

- To create an immersive environment where academics are learners within the new platform while learning quick tips and pointers for facilitating social learning themselves
- To learn further about the theories and principles of social learning
- To establish a space for the community of practice where academics currently involved with the FutureLearn project could safely share their own experiences and insights with other educators

The development process of ‘Facilitating social learning: Enlivening Deakin FutureLearn degrees’ for new teaching academics

In order to develop our PD course, we have applied the same learning design principles and techniques that we employed in designing and developing FutureLearn degree courses with academics. This was intended to be a just-in-time crash course on facilitating social learning within FutureLearn with expected completion time being no more than three hours. The approaches we incorporated were highly iterative and collaborative in nature. First, we adopted the same 'Learning Design Map' (Figure 1) template used for Deakin FutureLearn courses to outline the design of sequenced learning with well-balanced learning activity types.

Learning Activity Type	Watch: Video Step	Read: Text Article Step	Collaborate: Groupwork Step	Investigate: Active Learning Step	Produce: Artefact Creation Step	Practice: Assessment Step	Additional Activity Types within other steps	Discuss Discussion Step	Reflect Integration Step

Course 1	Course 2	Course 3	Course 4	Course 5
Week 1	Week 1	Week 1	Week 1	Week 1
Activity 1: Introduction	Activity 1: Introduction	Activity 1: Introduction	Activity 1: Introduction	Activity 1: Introduction
1.1 Let's get started • Introduction to the big question • Meet the team • Certificates and PD	1.1 Let's get started • Introduction to the next big question • Moving from open course to closed course	1.1 Let's get started • Introduction to the next big question • Placing the next section of the course in the context of journey so far	1.1 Let's get started • Introduction to the next big question • Placing the next section of the course in the context of journey so far	1.1 Let's get started • Introduction to the next big question • Placing the next section of the course in the context of journey so far
1.2 Learning online with Deakin • Standardised text for all open courses	1.2 Assessment Preview • Brief introduction to Assessment 1 • signaling how the following sections will equip you to complete it	1.2 Study Group • Checking in with your own learning plan, reflecting on progress. • Share with your study group what have you found most challenging and most interesting so far. What are your key open questions?	1.2 Assessment Preview Brief introduction to Assessment 2 signaling how the following sections will equip you to complete it	1.2 Study Group • Checking in with your own learning plan, reflecting on progress. • Share with your study group what have you found most challenging and most interesting so far. What are your key open questions?
1.3 Discovery Discussion • What do you already know? • how can we link this course content to things learners already know and experience. • Or how can we test out myths and facts in the area.	1.3 Developing your own learning plan. • Why are you here and what do you hope to achieve? • What are your key open questions? Share in Study Group	1.3 Discussion Share common themes and questions from study group	1.3 Study Group • Checking in with your own learning plan, reflecting on progress. • Share with your study group what have you found most challenging and most interesting so far. What are your key open questions?	1.3 Discussion Share common themes and questions from study group
	1.4 Discussion Share common themes and questions from study group		1.4 Discussion Share common themes and questions from study group	

Figure 1: The Deakin FutureLearn 'Learning Design Map' template

This allowed us to map out and consult with others on the overall design of learning that took place within the PD course. The colour-coding of each activity type helped us identify the balance and weighting of learning activities that academics undertook in achieving the learning outcomes.

To further reinforce and model social learning, we incorporated key design techniques. Firstly, we created a number of high quality videos of the two authors/educators engaging in a conversation about the key topics. These dialogic videos were designed to encourage prolonged learning conversations between the academics. Secondly, we modelled best practice use of various external digital tools (e.g. Padlet, WordCloud) that the enrolled academics could practise using during the course. Thirdly, as a method to encourage participation and the cultivation of a community of practice, we designed the PD course to elicit gradually emerging action plans created by each academic, thereby providing a scaffolded, authentic task to support the academics' learning. At the end of the course, academics were asked to share their action plans through Padlet.

Once the PD course development was completed, a total of 40 educators involved with developing and teaching degree courses with FutureLearn were invited to enrol in the course. Predominantly, they were academics and academic developers from all faculties teaching in the postgraduate courses about to launch in Deakin FutureLearn (e.g. IT, diabetes education, humanitarian assistance).

This PD course then became a digital hub or community of practice bringing academics across all faculties together. By embedding plenty of opportunities to share their current practice and experiences this PD course encouraged educators to come together to learn about facilitating social learning with more knowledgeable others (such as ourselves from the central learning and teaching unit), but also with others who were going through similar challenges. Even though this PD course was only recently delivered to a limited number of 40 academics, there is evidence in the course postings of shared practice and offers of support for each other as members of a community of practice.

Conclusion and future implications

In this paper, we have reported on a work-in-progress professional development collaborative project concerned with building the capacity of academics going through a curriculum transformation project with a newly implemented MOOC platform. Given the increased importance on learning design and its relationship with social learning, we have identified the need to address possible gaps in some academics' capacity to enact their teaching as social learning facilitators. In so doing, we modelled the social-learning design framework and highly collaborative processes of developing FutureLearn courses. While the observations and findings we outline here are preliminary, the approach we took is applicable and relevant to other tertiary institutions thinking about or developing social digital learning and teaching experiences with MOOC platforms.

Our future work will extend this project. Firstly, there will be a larger enrolment for this PD course as more academics come on board to teach through FutureLearn in the next trimester. We aim to gather explicit feedback from participating academics to better understand what worked from a learning design perspective and what can be improved for the next iteration of the PD course. We also intend to expand this PD course by creating a subsequent course targeting learning design. This new course will focus on how design thinking may influence learning design and how its principles work within the context of this project in transforming our degree courses.

References

Bennett, S., Agostinho, S., & Lockyer, L. (2016). The process of designing for learning: understanding university teachers' design work. *Educational Technology Research and Development*, 1-21.

Biggs, J. B., & Tang, C. S.-k. (2007). *Teaching for quality learning at university : what the student does* (3rd ed.). Maidenhead: McGraw-Hill/Society for Research into Higher Education & Open University Press.

Ferguson, R., Sharples, M., & Beale, R. (2013). Enabling social learning on FutureLearn Retrieved from https://ugc-partners.futurelearn.com/wp-content/uploads/2013/06/2.-Social-Learning-in-MOOCs.pdf

Goodyear, P. (2015). Teaching as design *HERDSA Review of Higher Education, 2*, 27-50.

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., & Hall, C. (2016). *NMC Horizon Report 2016 Higher Education Edition* (0989733556). Retrieved from http://cdn.nmc.org/media/2016-nmc-horizon-report-he-EN.pdf

Kirkwood, A., & Price, L. (2013). Missing: evidence of a scholarly approach to teaching and learning with technology in higher education. *Teaching in Higher Education, 18*(3), 327-337. doi:10.1080/13562517.2013.773419

Krause, K. L., & Coates, H. (2008). Students' engagement in first-year university. *Assessment & Evaluation in Higher Education, 33*(5), 493-505.

Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*: Routledge.

McLoughlin, C. (2010). Creating partnerships for generative learning and systemic change: Redefining academic roles and relationships in support of learning. *International Journal for Academic Development, 5*(2), 116-128.

Selwyn, N. (2016). *Education and technology: Key issues and debates*: Bloomsbury Publishing.

Siemens, G. (2014). Connectivism: A learning theory for the digital age. Retrieved from http://www.itdl.org/journal/jan_05/article01.htm

Toetenel, L., & Rienties, B. (2016). Learning Design– creative design to visualise learning activities. Open Learning: The Journal of Open, Distance and e-Learning, 31(3), 233-244.

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Developing a technology enhanced learning framework to gain a snapshot of institutional successes and challenges

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Across higher education, institutions continue to invest in technology enhanced learning (TEL) as it has the potential to transform and improve the quality of learning, teaching and the student experience. Despite the investment, many still struggle to identify and address the elements that are essential to enabling institutional success. This paper focuses on the iterative development of a TEL Framework that aims to provide a fast and efficient snapshot of institutional challenges and successes in TEL, alongside a set of actionable recommendations to move the institution forward.

The Framework is based on a set of 8 themes the authors have identified as critical to the success of TEL. The themes are used as part of dialogic process, designed to gather perspectives on how TEL is being used across an institution. By June 2017, the TEL Framework was trialled in 6 institutions. Using a workshop format, participants engaged in a three-step guided process known as DIP – Discover, Interpret and Pitch. At the core of this process were cards that represented the 8 TEL theme. These were used to surface participant's perceptions. Overall, most participants agreed, that the TEL Framework was a valuable process to use to uncover institutional successes and challenges in TEL and that the theme cards were useful in stimulating these insights.

The TEL Framework is still a work in progress and so its effectiveness is still being determined. However, early indications are that it is a useful instrument for gathering perceptions, and in identifying TEL challenges and successes.

Introduction

There is a growing realisation that Technology enhanced learning (TEL) has the potential to transform and improve the quality of learning, teaching and the student experience (Walker et al. 2016; Marshall, 2010). Additionally, when done well, TEL can help institutions access new student markets especially via online learning. Together, these factors have weighted the priority of TEL more heavily than in the past. While higher education institutions continue to invest in TEL, many still struggle to identify and to address the essential elements that enable institutional success. This paper focuses on the development of a TEL Framework that aims to provide a fast and efficient institutional snapshot of institutional challenges and successes in TEL alongside a set of actionable recommendations for institutions to respond to challenges in a focused way.

The motivation to develop the TEL Framework was to enable institutions to identify areas where they need to focus to address influential challenges and others where they can celebrate their successes to celebrate and disseminate these across and beyond their own institutions. The discovery process, uses conversational and deep listening approaches, to gather different perspectives on key elements that influence the success of TEL and Return) especially in terms of academics and students themselves. The Framework itself is based on a set of 8 themes that we believe are essential to the success of TEL. The themes are represented through a set of theme cards that form the basis of a largely dialogic and scaffolded discovery process during a 90-120 minute workshop. The decision to adopt a dialogical method was based on previous experiences using the Assessment and Feedback cards developed as part of the JISC Viewpoints Project (http://wiki.ulster.ac.uk/display/VPR/Home). The Assessment and Feedback cards trigger powerful conversations and enable participants to easily construct, visualise and share ideas. They also encourage interaction, participation in important conversations about learning and teaching (Nicol, 2012).

These days a growing focus on quantitative user activity and usage data often excludes important perspectives that represent ‘people’ and ‘culture’. Arguably, hard data offers credible evidence however failure to surface and then address cultural assumptions, beliefs and local pedagogical contexts can hamper institutional transformation. After all, cultural frameworks exist within all organisations. They influence how people enact their practices, interpret their views, share assumptions and express their identity (Tierney, 1999) even in relation to TEL. Equally, the local pedagogical context represents ‘the relationship between a setting and how participants interpret that setting, including the meaning of practices’ (Moschkovich & Brenner 2000, p.463). For these reasons, the TEL Framework was designed to surface a range of perspectives that encompass participants’ cultural and pedagogical contexts.

At the time of writing, the work on the TEL Framework was a work-in-progress that was evolving through an iterative development process. Adaptions are made based on lessons learnt through implementing the framework in varying institutional contexts. These lessons are based on our own experiences, participant responses and feedback. This paper elaborates on the development process, peer input and discussion that are informing improvements in the TEL Framework. The paper also outlines why these themes are key to TEL, describes and justifies the dialogic process, and presents the participant feedback gathered so far.

Development of the TEL framework

The TEL Framework relies on eight themes that are intended to surface different, and sometimes contrasting, institutional perspectives on TEL successes and challenges. A TEL Discovery Workshop was developed that uses cards that represent these themes and scaffolds interaction, reflection and discussion using a dialogic method. In this way, the workshop is a critical mechanism for gathering individual and collective perspectives on TEL. The perspectives gathered from the workshop are analysed to produce an institutional snapshot and set of recommendations to assist the institution in addressing the challenges that arise. Together the theme cards, the workshop process and the report are interrelated components of the overall TEL Framework.

Prototyping and initial iterations

In late 2016, the first prototype was implemented in 3 workshops using 7 TEL themes in New Zealand. Prototyping proved to be an effective way to test the themes as the initial part of the TEL Framework. Learning from observations made during these workshops alongside verbal feedback received afterwards, the development of the themes was iterated. Some of the key areas addressed included wording, number of themes, guiding statements, the type of scales used, and the layout and visual design of the cards. The length and format of the workshop was also considered. Subsequently, and with input from peers across Australia, New Zealand and internationally, eight themes were derived to carry through to the first iterations of the TEL Framework and workshops.

TEL framework themes

At the time of writing, an additional theme, making a total of 8 interrelated themes were used in the TEL Framework. There were ‘strategy’, ‘Technologies’, ‘Functionality’, ‘Usability’, ‘Learning design’, Academic Adoption’, ‘Learner Impact’ and ‘Assessment and Feedback’ (see Figure 1). This section provides a short justification for each theme.

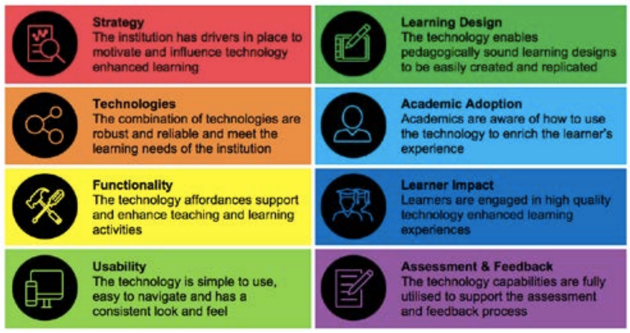

Figure 1: The 8 themes used in the TEL Framework

Strategy was deemed as critically important as Higher education institutions without a clearly defined Institutional strategy for TEL lack a clear vision for what they want to achieve and thus find it difficult to influence TEL and determine its effectiveness (Graham, Woodfield & Harrison 2013). Related to a TEL strategy, institutions need to ensure they have the right *combination of technologies* and that these provide the *functionality* and *usability* required to enable users to enact their pedagogical goals and vision (Chowdhry, Sieler & Alwis, 2014; Graham, Woodfield & Harrison 2013). Furthermore, the technologies must provide the pedagogical affordances required to enable different *learning designs.* Of course, the *adoption* of technologies by academics is essential to TEL. However academic adoption is dependent on internal and external factors. External factors include support, training and professional learning experiences. Teachers also need to be aware of how the technologies available can be used, particularly when designing courses to enhance learning and the learner experience (Chowdhry, Sieler & Alwis, 2014; Demian & Morrice, 2012). Adequate supports too, need to be in place to influence academic and learner adoption levels to fully utilised to enhance and improve the learning experience of students (Kirkwood & Price, 2014; Demian & Morrice, 2012). Steel (2013) found that teachers’ pedagogical context was another highly influential factor in shaping teachers’ technology experiences and pedagogical application of technologies. Internal factors include teacher beliefs, their pedagogical preferences and their internal reasoning and decision-making. The *Learner impact* is another critical aspect of TEL. For technologies to have a positive impact, learners need to be supported and aware of how to use the technologies. Equally, institutions need to gather and respond to student feedback on satisfaction and quality of use of TEL. Understanding learner engagement in the TEL environment can work to ensure TEL has a positive impact on the student learning experience (Chowdhry, Sieler & Alwis, 2014). Finally, the use of TEL in *Assessment and Feedback* is critical in terms of shaping and influencing student learning, making judgements about the standards of student work and certifying learning (Boud, 2010). In the context of TEL, technologies can also assist teachers with efficient administrative workflows around grading and marking.

The 8 theme cards have a similar visual design represented by a specific colour and icon. On the front of the card is the theme, a brief description and key question to be considered to help participants become familiar with the theme. On the back of the card (see example in Figure 2), guiding statements are provided to encourage deeper individual and collective reflection and discussion around institutional successes and challenges. There is space for individual comments and a square box to make an overall individual judgement on whether the theme is an overall success or challenge. In this way, these 8 theme cards have been developed to scaffold each theme to trigger discussion, reflection and a prioritisation process.

Figure 2: Front and back view of strategy theme card

The TEL Discovery Workshop involves a 90-120 minute face-to-face process with two facilitators. The workshop is a key element of the TEL Framework. It provides an opportunity for educational institutions to listen to participants' individual and collective reflections and perceptions of successes and challenges around TEL. The 8 theme cards scaffold a three-step dialogic process (Figure 3). The acronym DIP (Discover, Interpret, Pitch), represents the steps in the process. First cards are introduced so that individuals become familiar with the themes. Next, one-by-one, guiding statements on each card are used to stimulate individual written responses via scales and comments (on the back of the card). These are shared in group conversations that help participants delve deeper into interpreting the themes. Finally, once all 8 themes have been considered, groups must build consensus on their successes and challenges and develop a pitch around their number one institutional challenge and success. Individual and group perceptions are gathered through individual responses to scales, comments, and a structured justification used in their pitches. After the workshop, perceptions are analysed to form a short report that documents the institutional successes and challenges and offers a set of actionable recommendations to move TEL forward in the institution.

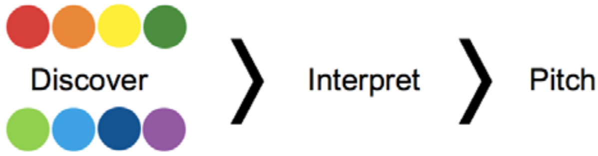

Figure 3: The *three-step process* of the *TEL Workshop*

The approach used to deliver the TEL Framework is time efficient for institutions and provides a valuable snapshot of what is occurring across the institution. The value of gathering different perspectives on these themes is the potential to locate insights from different institutional and cultural perspectives (e.g. leadership, students, academics in different disciplines, central learning and teaching areas, etc.), to see how challenges can be addressed and successes can be celebrated and disseminated.

Of course, there are a number of ways to 'take the institutional pulse' in terms of institutional TEL. Benchmarking is one method that is commonly accepted and encouraged these days (ACODE, 2014). However benchmarking processes can be quite time consuming and resource intensive. While benchmarking is most certainly important and based on hard evidence, the TEL Framework design offers a more agile process that can be used to quickly to identify the challenges, successes and recommendations needed for immediate action. Responsiveness is key when, in Australia, government organisations like TEQSA demand that "TEL delivers high quality education, positive student experiences and credible qualifications, in the same way as other modes of delivery and participation." (TEQSA, 2016, p.2)

Piloting the framework

At the time of writing, the TEL Framework has been delivered 7 times in 6 institutions across Australia and New Zealand, with another 5 workshops confirmed in the Asia Pacific region (not including the initial 3 pilots). While most of these have been delivered as face-to-face activities, in 2 instances, participants have participated via video conferencing. To actively gain more feedback to inform future iterations, feedback forms, containing 3 questions were distributed at the end of for the last 3 workshops (all participants responded). When asked if the

TEL Framework was a valuable process to use to uncover the successes and challenges in TEL across the institution, 62% agreed, some strongly (see Table 1). Participants found the process to be very illuminating, enjoyable and informative because it provided an opportunity to compare notes with the different groups that were involved, although some would have liked students to be involved. Participants also thought the card system was great and the themes used were comprehensive. For example, one participant commented on the experience as "A unique approach to gathering data. Encouraged interaction and thinking."

Table 1: Feedback responses (n=42)

Question	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
The TEL Framework was a valuable process to use to uncover the successes and challenges in TEL across the institution	1	4	11	17	9
The theme cards were useful in stimulating insights into these successes and challenges	0	2	4	19	17

When asked if the theme cards were useful in stimulating insights into these successes and challenges, 86% agreed, 40% strongly (see Table 1). Participants felt the cards worked well to structure the session and keep participants focussed so they could use the opportunity to voice their concerns and suggestions. One participant remarked "This was an extremely useful instrument and the themes were appropriately considered". Finally, when we asked how the workshop could be improved, some participants felt that more explanation about the themes could be provided as well refining some of the wording used in the guiding statements to ensure immediacy of understanding. While many felt, the workshop component was well structured and time efficient, one or two others thought an online process would help efficiencies and a few, who participated via video conferencing, felt the medium lessened the experience. The authors are reviewing all this feedback and using it to develop the next iteration.

Next steps

Since the initial prototyping, significant progress in the development of the TEL Framework has been made but it is still a work in progress. Consequently, its effectiveness is still being determined. However, early indications are that it is a useful instrument for gathering perceptions and sharing concerns/successes about TEL with others. Institutional reports from each TEL Framework activity were in production at the time of writing. Feedback from each workshop sponsor will also be sought to determine the value of the Framework and process. While the theme cards were useful in stimulating insights into these successes and challenges, there is still a need to determine whether the TEL Framework is useful in helping drive institutional change. Subsequent work and feedback will be presented at the ASCILITE 2017 conference.

References

ACODE. (2014). *Benchmarks for Technology Enhanced Learning*. Retrieved from: http://www.acode.edu.au/pluginfile.php/579/mod_resource/content/4/TEL_Benchmarks.pdf

Boud, D. and Associates (2010). Assessment 2020: Seven propositions for assessment reform in higher education. Sydney: Australian Learning and Teaching Council.

Chowdhry, S., Sieler, K. & Alwis, L. (2014). A Study of the Impact of Technology-Enhanced Learning on Student Academic Performance, *Journal of Perspectives in Applied Academic Practice*, 2*(3)*, 3-15.

Demian, P. & Morrice, J. (2012). The use of virtual learning environments and their impact on academic performance. *Engineering Education*, **7**, 1, 11–19.

Graham, C. R., Woodfield, W., & Harrison, J. B. (2013). A framework for institutional adoption and implementation of blended learning in higher education. *The Internet and Higher Education*, *18*, 4–14.

Kirkwood, A. & Price, L. (2014) Technology-enhanced learning and teaching in higher education: what is 'enhanced' and how do we know? A critical literature review, *Learning, Media and Technology*, 39*(1)*, 6-36, DOI: 10.1080/17439884.2013.770404.

Marshall, S. (2010). A Quality Framework for Continuous Improvement of e-Learning: The e-Learning Maturity Model, *Journal of Distance Education*, 24*(1)*, 143-166.

Moschkovich, J. N., & Brenner, M. E. (2000). Integrating a naturalistic paradigm into research on mathematics and science cognition and learning. In A. E. Kelly & R. A. Lesh (Eds.), *Handbook of research design in mathematics and science* *education* (pp. 457-486). Mahwah NJ: Lawrence Erlbaum Associates.

Nicol, D. (2012). Transformational Change in Teaching and Learning Recasting the Educational Discourse: Evaluation of the Viewpoints Project. Retrieved from http://www.reap.ac.uk/Portals/101/Documents/PEERToolkit/VIEWPOINTS%20EVALUATION_Final_dn.pdf

Steel, C. H. (2013). *University teachers' beliefs and practices: Pedagogy and technology*. Saarbruken, Germany: LAP Lambert Academic Publishing.

TEQSA. (2016). Guidance Note: Technology-Enhanced Learning. Retrieved from http://www.teqsa.gov.au/sites/default/files/GuidanceNote_Technology-EnhancedLearning1.0.pdf

Tierney, W. G. (1999). Building the responsive campus: Creating high performance colleges and universities. Thousand Oakes, CA: Sage.

Walker, R., Voce, J., Swift, E., Ahmed, J., Jenkins, M. & Vincent, P. (2016). 2016 Survey of Technology Enhanced Learning for higher education in the UK. Oxford, UK: Universities and Colleges Information Systems Association. Retrieved from https://www.ucisa.ac.uk/-/media/files/publications/surveys/tel%20survey%202016_nov16.ashx?la=en

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Using virtual and augmented reality to study architectural lighting

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This paper presents industry stakeholder insights from the implementation of a dual modality intervention using virtual and augmented reality simulation to study complex lighting theory in architecture design. Using a design based research method the aim is to evaluate these insights and inform a pilot study to educate first year architectural design students on the complexities of lighting the built environment and methods to improve architectural workflow. The aim is to enable learners to experience natural and artificial lighting methods comparatively in real-time through multiple comparative visualisation methods. This is important to make informed evaluations regarding architectural designs in terms of spatial quality, character, performance, and user-comfort levels. This in turn allows architects to rapidly modify their designs to accommodate or mitigate the environmental effects. Outcomes from the initial usability test highlight the ability to switch back and forth between the virtual and augmented reality simulation technology, and between lighting visualisation modes as a huge step forward by the industry stakeholders. Additionally, the idea of representing the physical building where the simulation took place virtually using a detailed mapping gave a real-world anchor that made the simulations easy to navigate, leading to improved satisfaction and engagement. However, the study also highlighted improvements in the delivery of the simulation is required to improve simulation learnability and efficiency.

Introduction

The subject of lighting is considered fundamental in built environment education yet remains a complex learning topic (Webb, 2006). This can be attributed to the fact that light, and its effects, are better expressed experientially rather than theoretically. It is also difficult to teach about light before first educating about the effects of light (e.g. luminance or light intensity). In architectural education, the conventional way of teaching novice students about lighting effects is through a series of static 2D renders, photographs, and in-situ examinations (Descottes & Ramos, 2013). However, this pedagogical method lacks navigation, manipulation and visualisation at human scale (Birt, Horvoka & Nelson, 2015). This aligns with the learner view of Jones, Ramanau, Cross, and Healing (2010), who report that learners expect to be engaged with participatory, interactive, sensory-rich, experimental activities (either physical or virtual) and opportunities for input. These learners are more oriented to visual media than previous generations and they prefer to learn visually by doing rather than by telling or reading. Mayer (2014) and Bernard at al. (2014) also advocate the use of dual modality (multiple modes of presentation) delivery and content as this improves learner outcomes and recall leading to deeper learning. Therefore, this paper presents a rationale for a pilot study to answer the question, “How do learners perceive the multiple modes of presentation delivery of virtual and augmented reality technology to support learning of complex lighting theory?”.

Background literature

As educators, we are increasingly surrounded by a new breed of individual that tackles problems in new and different ways through technology (Corrin, Bennett, & Lockyer, 2013). This has led to much discussion about the potential of digital technologies in higher education to influence teaching culture (Lai, 2011) and enhance (Kirkwood & Price, 2014) classroom pedagogy. Kirkwood & Prince (2014), explain that technology has significant and interrelated impacts upon student learning and potential to transform learning practice but most studies focus only on reproducing or reinforcing existing practice and not transforming learning. This aligns with Ayres (2015), who indicates that most prior work in multimedia learning (Mayer, 2014) and blended learning (Bernard at al., 2014) has been formed around explanatory words and pictures with less attention to complex learning environments such as interactive visualisations, games and simulations. Connolly et al. (2012), also indicates games and the underlying technology as emerging and significant tools to enhance classroom pedagogy, to assist in transforming learning and improving learner motivation.

Architectural education has seen increased pedagogical use of video game technology (game engines) to study specific learning outcomes such as building information modelling workflow (Yan, Culp & Graf, 2011), spatial understanding (Valls, Redondo, Garcia-Almirall & Subirós, 2016) and environmental experience design (Kosmadoudi et al., 2013). Kosmadoudi et al. (2013), explains that the game technology offers immersion, curiosity, communication strategies to explain complex information, and relationship with the instruction content being presented which is novel and links back to the core outcomes as highlighted by Connolly et al. (2012). More recently, this use of game technology has been used to develop multisensory evaluations of urban spaces (Luigi et al., 2015) using virtual reality (VR) simulations which allow navigation and spatial understanding at human scale, this has also been highlighted in Birt, Horvoka & Nelson (2015) who explored the fundamental perceptions of learners and the use of virtual reality in spatial navigation of built environments. Augmented reality (AR) simulations have also been used to understand whole scale building sites on architectural plans (Lee at al., 2012) which allows for the whole system to be evaluated within the physical environment space under examination. This allows for a whole system view and conceptual understanding that is often missing in the human scale approaches.

Prior research in the use of interactive visualisation and game technology (Birt, Horvoka & Nelson, 2015) has revealed strengths and weaknesses in the impact of any single modality on learning, and those learners themselves have different styles (Mayer, 2014), needs and capabilities (Höffler, 2010). Additionally, architectural pedagogy benefits from visualisations allowing navigation of complex scenes, multiple perspectives and the ability to experience space at both a system level (whole model) (Lee at al., 2012) and at human scale (Birt, Horvoka & Nelson, 2015). To date most studies in the use of visualisations or game technology have focused on a single *silver bullet* method to visualise the learning artefact and have not embraced multiple visual modes of modality. The fundamental assumption(s) of the proposed simulation are: no technology offers a silver bullet for students to grasp specific concepts; multiple visual representations must take advantage of the differences between the technology representations and students learn through a variety of approaches. This reflects the general proponents of blended learning (Bernard et al., 2014) and multimedia learning (Mayer, 2014) that long appreciated and advocated for multiple modes of presentation, delivery and content.

Lighting simulation

Based on the literature review in particular the fundamental lighting theory of Webb (2006) and Descottes & Remas (2013), and the considerations of mixed reality (Birt, Horvoka & Nelson, 2015) and multimodal multimedia learning (Ayres, 2015; Bernard et al., 2014; Mayer, 2014) a simulation was developed to help answer the research question about "How do learners perceive the multiple modes of presentation delivery of virtual and augmented reality technology to support learning of complex lighting theory". The simulation was built using Rhino (rhino3d.com), Maya (autodesk.com/products/maya/) and Unity3D (unity3d.com) (see Figure 1) and is representative of an existing built environment space on the authors university campus (shown in Figure 1 left hand side). The intended thought of the authors is that in using the physical building as an anchor this would lead to improved understanding of the simulation and situate the user within the simulation environment. It was therefore important to have the virtual VR and AR representation(s) be as close too accurate as possible, to ground the learners within the familiar context.

Figure 1: Images of lighting simulation used in the physical building on the authors campus during industry and academic stakeholder critique. Shown are images from the VR (top row) using the HTC VIVE and AR (bottom row) using the Microsoft HoloLens

The intent is the VR simulation would provide a human scale representation allowing for spatial understanding as per the work of Birt, Horvoka & Nelson (2015); Kosmadoudi et al., 2013; Valls, Redondo, Garcia-Almirall & Subirós, 2016; and Yan, Culp & Graf, 2011. The AR simulation would allow for orientation at scale situated within the backdrop of the physical building as seen through the augmented overlay as per the work of Lee at al. (2012). The conditions chosen for this simulation can be loosely described as a sunny morning in the summer. For accuracy, the actual coordinates (28.073S, 153.416E), orientation (5^0W), and date (20 Dec, 2016) were used to gather the proper altitude and azimuth of the sun along its path. The real-time simulation covers all 24 hours in the day, and can be sped up or slowed down to allow users to vary their experience. The simulation also allows learners to switch between natural light conditions (shown in Figure 1 centre), and luminance (light intensity) mapping overlays (shown in Figure 1 right hand side). By visualising the effects of sun through simulated natural light and luminance mapping to visualise light intensity transfer, the simulation enables learners to experience this important comparison in real time in both the human and whole system scale. This in turn allows informed evaluation regarding the design in terms of spatial disposition, function and user-comfort levels. This is further enhanced by allowing users to spatially navigate (move around) both the virtual and physical building to experience all aspects of the built environment.

Research method

The theoretical framework underpinning this work is design-based research (DBR) methodology. Specifically, Reeves (2006, p. 59) four step model for planning design-based research will be followed through two-three feedback loops, with the first loop beginning with analysis of the problem, development of the solutions informed by existing design principles and technological innovations as discussed in the presented literature review, followed by an evaluation by three independent industry critics (presented in this paper). This first loop will then be followed by the proposed second loop pilot study that will involve an iterative implementation of the new solution using the feedback from the first loop experts (presented in this paper). This will be delivered into the classroom by a discipline expert practitioner positioned to evaluate the effectiveness of the solution who will provide detailed feedback on the re-design from the student stakeholder perspective. This will then result in a loop back for design refinement and further iterative testing and evaluation if required.

For the first loop, three industry critics were recruited as part of a final semester masters by coursework thesis presentation where the simulation was presented for evaluation and grading. Categories were developed for both the observation as well as the data collection for surveys. These are based on previous work of Birt, Horvoka & Nelson, (2015). For the proposed second loop pilot study, an undergraduate class at the lead authors institution will be recruited as per the studies ethics to perform the testing. Specifically, a small sample of students (*n <= 30*) will be selected for this initial student usability test in line with common first phase software usability testing practice (Nielsen, 2012), so that it would be possible for a single research assistant to interact with these students in depth and collect rich feedback on their use of the tool. Participants will be given a primer on the skills to be covered, and then asked to complete three survey instruments on the applicability of the lighting method using traditional 2D methods, VR and AR. Students will be given access to the simulation tools before completing the survey on the use of the mixed reality interventions. Details of the results of data collection for the first loop are included below.

Results and discussions

The first loop DBR testing of the intervention was conducted using three independent industry stakeholders and data was collected and analysed through a research assistant. The results of the quantitative survey with the industry critics are presented in (Table 1), with each item ranked on a Likert Scale of 0 to 5, where 0 is not relevant and 5 is very relevant. During the intervention, a video recording was taken of the industry stakeholders including technology use, questions and answers.

Specifically, and in terms of the positive outcomes, the experts rated the dual modality simulations positively (*table 1 >= 4.00*), in regards to satisfaction 4.00(VR)/4.33(AR), memorability 4.33, manipulability 4.33(VR)/4.67(AR), navigability 4.33, real world 4.00(VR), communication 4.67, creativity 4.33(VR)/4.67(AR) and engagement 4.00. The ability to “switch back and forth between the AR and VR simulations, and between the natural lighting and luminance mapping simulations”, was commented on by the industry stakeholders as “a huge step forward in design”.

Table 1: Average industry stakeholder usability assessment survey results for the VR and AR simulation

Question	Average		StdDev	
	VR	AR	VR	AR
1. Accessibility: Visualisation is readily accessible	3.33	3.33	0.47	0.58
2. Learnability: Visualisation is easy to learn	2.67	2.67	0.47	0.58
3. Efficiency: Visualisation is efficient to use	3.67	3.33	0.47	0.58
4. Satisfaction: Visualisation provides (confidence) of the design	4.00	4.33	0.82	0.58
5. Memorability: Visualisation is memorable in support of the design	4.33	4.33	0.47	0.58
6. Error Free: Visualisation is free from visual and design errors	3.33	3.33	0.47	0.58
7. Manipulability: Visualisation variables can be manipulated	4.33	4.67	0.94	0.58
8. Navigability: Visualisation allows the user to change their viewpoint	4.33	4.33	0.94	1.15
9. Visibility: Visualisation provides clear detail to interpret the design	3.67	3.67	0.47	0.58

Question	Average VR	Average AR	StdDev VR	StdDev AR
10. Real world: Visualisation provides a match to the real world	4.00	3.67	0.00	0.58
11. Communication: Visualisation aids stakeholder communication	4.67	4.67	0.47	0.58
12. Creativity: Visualisation allows user creativity with the design	4.33	4.67	0.47	0.58
13. Engaging: Visualisation is meaningful	4.00	4.00	0.82	1.00
14. Motivating: Visualisation aids acceptance of the design	3.67	3.67	0.47	0.58

Additionally, “the idea of using a detailed and furnished space gave a real-world anchor that made the simulations easy to navigate through”. Because of the increased level of immersion and interactivity, the stakeholders showed a higher level of curiosity and engagement. As such, they were active in their own pedagogical process. This is in line with results by Birt, Horvoka & Nelson (2015), Lee et al. (2012) and Luigi et al. (2015) and highlights the positive outcomes the technology provides especially in regards to users ability to manipulate variables within the simulation and the real world understanding imparted.

In terms of the mixed outcomes (*table 1 >= 3.00 < 4.00*), the experts noted that the current simulation implementation(s), “required expensive equipment and significant setup and space”, which was also highlighted in the average accessibility response of 3.33, “time to use”, which resulted in an efficiency response of 3.67(VR)/3.33(AR) and general “differences between the real world and simulation”, which resulted in a visibility of 3.67, real world 3.67(AR) and error free of 3.33. The authors will address these by improving the simulation experience in terms of the real-world nature and exploring the use of cheaper more accessible mobile phones to capture the simulation pedagogy in both the VR and AR form. This will be compared to and contrasted with the HTC VIVE (VR) and Hololens (AR) simulations. This is in line with the study by Lee at al. (2012) that performed the building simulations using a mobile device and a simple image marker to improve accessibility to the simulation.

Finally, the area that needs most improvement (*table 1 < 3.00*) was learnability. The reviewers noted that “the technology takes time to get used to” and “requires assistance” which was highlighted in the average response of 2.67. This is not satisfactory and the authors will need to address this before student trials by firstly providing a picture in picture video tutorial to ground the learner and then scaffolding and supporting the learner through a guided tutorial within the simulation environment. This is in line with common game (Connolly et al., 2012), blended (Bernard et al., 2014) and multimedia (Mayer, 2014) learning design.

Conclusion

Students learn in different ways with evidence suggesting that multiple forms of media are useful tools of instruction for active learners. Combined with this is a push towards simulation and mixed reality to teach complex concepts in architectural design, including the concept of dynamic lighting, which is currently taught using static 2D renders. This paper presents results from a study looking at the use of multiple modes of visualisation methods to teach lighting concepts, using a combination of VR, AR, grounded within a real world physical representation. Using a design based research methodology, the first loop of a usability study was conducted with three industry experts and results provided.

Results showed that the experts valued the ability to switch between different modes, and gave a positive rating to the memorability, manipulability, navigability, real world aspects, communication, creativity and engagement of the multiple simulations. However, they also acknowledged that the system was expensive to set up and not very accessible, and that the learnability of multiple systems was difficult. From the perspective of the authors, much additional work is needed to simplify the currently cumbersome workflows between software platforms and discipline-specific methodologies toward these platforms. A simplified workflow will facilitate increased uptake in both educational and professional setting, further adding to the value of these mixed reality visualisation methods. It is intended that these issues will be addressed in future work.

References

Ayres, P. (2015). State-of-the-art research into multimedia learning: A commentary on Mayer's handbook of multimedia learning. *Applied Cognitive Psychology, 29(4)*, pp 631-636. doi:10.1002/acp.3142

Bernard, R. M., Borokhovski, E., Schmid, R. F., Tamim, R. M., & Abrami, P. C. (2014). A meta-analysis of blended learning and technology use in higher education: from the general to the applied. *Journal of Computing in Higher Education*, *26*(1),87-122. doi:10.1007/s12528-013-9077-3

Birt, J., Horvoka, D., & Nelson, J. (2015). Interdisciplinary translation of comparative visualisation. *Proceedings of the 26th Australasian Conference on Information Systems, Adelaide, Australia.* doi:10765/117415

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education, 59*(2), 661-686. doi:10.1016/j.compedu.2012.03.004

Corrin, L., Bennett, S., & Lockyer, L. (2013). Digital natives: Exploring the diversity of young people's experience with technology. In R. Huang, Kinshuk, & J. M. Spector (Ed.) *Reshaping learning: Frontiers of learning technology in a global context* (pp. 113-138). Berlin, Germany: Springer. doi:10.1007/978-3-642-32301-0_5

Descottes, H., & Ramos, C. E. (2013). *Architectural lighting: designing with light and space.* Princeton Architectural Press.

Höffler, T. N. (2010). Spatial Ability: Its influence on learning with visualisations - a meta-analytic review. *Educational Psychology Review, 22*(3), 245-269. doi:10.1007/s10648-010-9126-7

Jones, C., Ramanau, R., Cross, S., & Healing, G. (2010). Net generation or digital natives: Is there a distinct new generation entering university? *Computers & Education, 54*(3), 722-732. doi:10.1016/j.compedu.2009.09.022

Kirkwood, A., & Price, L. (2014). Technology-enhanced learning and teaching in higher education: what is 'enhanced' and how do we know? A critical literature review. *Learning, media and technology, 39*(1), 6-36. doi:10.1093/oxrep/grw028

Kosmadoudi, Z., Lim, T., Ritchie, J., Louchart, S., Liu, Y., & Sung, R. (2013). Engineering design using game-enhanced CAD: The potential to augment the user experience with game elements. *Computer-Aided Design, 45*(3), 777-795. doi:10.1016/j.cad.2012.08.001

Lai, K. W. (2011). Digital technology and the culture of teaching and learning in higher education. *Australasian Journal of Educational Technology, 27*(8), 1263-1275. doi:10.14742/ajet.892

Lee, G. A., Dünser, A., Kim, S., & Billinghurst, M. (2012) CityViewAR: A mobile outdoor AR application for city visualisation, *IEEE International Symposium on Mixed and Augmented Reality* (pp. 57-64). Atlanta, GA, USA. doi:10.1109/ISMAR-AMH.2012.6483989

Luigi, M., Massimiliano, M., Aniello, P., Gennaro, R., & Virginia, P. R. (2015). On the Validity of Immersive Virtual Reality as tool for multisensory evaluation of urban spaces. *Energy Procedia*, *78*, 471-476. doi:10.1016/j.egypro.2015.11.703

Mayer, R. E. (Ed.). (2014). *The Cambridge Handbook of Multimedia Learning* (2nd ed.). Cambridge: Cambridge University Press. doi:10.1017/CBO9781139547369

Nielsen, J. (2012). How many test users in a usability study? *Nielsen Norman Group, 4* Retrieved from https://www.nngroup.com/articles/how-many-test-users/

Reeves, T.C. (2006). Design research from a technology perspective. In J. van den Akker, K. Gravemeijer, S. McKenney & N. Nieveen (Eds.), *Educational design research* (pp. 52-66). London: Routledge.

Valls, F., Redondo, E., Fonseca, D., Garcia-Almirall, P., & Subirós, J. (2016). Videogame technology in architecture education. In M. Kurosu (Ed.), *Human-Computer Interaction. Novel User Experiences* (pp. 436-447). Toronto, ON, Canada: Springer. doi:10.1007/978-3-319-39513-5_41

Webb, A. R. (2006). Considerations for lighting in the built environment: Non-visual effects of light. *Energy and Buildings*, *38*(7), 721-727. doi:10.1016/j.enbuild.2006.03.004

Yan. W., Culp, C., & Graf, R. (2011). Integrating BIM and gaming for real-time interactive architectural visualisation, *Automation in Construction, 20*(4), 446-458. doi:10.1016/j.autcon.2010.11.013

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OER based capacity building to overcome staff equity and access issues in higher education

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Open educational resources (OER) have already impacted educational systems around the world. In higher education more specifically, it has benefited learners, and has influenced institutional strategic plans and policies. Additionally, the benefits of OER also extend to staff in higher education, such as academic staff. For this group, OER can provide opportunities for collaboration, promote curriculum innovation and student led content development, as well as contribute to university teachers' much needed continuing professional development. In this paper, we examine the potential of OER to build capacity of academic staff in higher education, in particular to overcome some equity and access issues that they may face. It also examines some existing activities and strategies for professional development in higher educational institutions and provides some recommendations for academics, academic developers, institutions, and the sector in general.

Introduction

Open Educational Resources (OER) is a recent phenomenon in higher education, but has already benefited many universities around the globe, providing learners with the opportunity to learn through freely available materials. Some institutions have also enhanced their reputations, increased student enrolment and developed innovative ways to produce learning materials (Wiley & Gurrell, 2009). For clarity, OER are defined here as:

> educational materials which are licensed in ways that provide permissions for individuals and institutions to reuse, adapt and modify the materials for their own use. OER can, and do include full courses, textbooks, streaming videos, exams, software, and any other materials or techniques supporting learning (OER Foundation, 2011).

The fast growth of OER "is a response to the rising costs of education, the desire for accessing learning in areas where such access is difficult, and an expression of student choice about when and how to learn" (Johnson, Levine, Smith, & Stone, 2010, p. 6). Following the example set by the developed countries where substantial increases in participation rates are considered essential for sustained development, managing an identified burgeoning worldwide demand for higher education in the developing world poses an enormous challenge which needs to be undertaken rapidly and with reasonable quality (Daniel, Kanwar, & Uvalic-Trumbic, 2009). Despite the fact that the philosophy underpinning OER is noble – being used to increase access to education, improve quality, reduce costs of education, and to promote collaboration among learners, teachers and institutions – most OER are developed in English, by educational institutions from developed nations, and consequently benefiting western learners and teachers the most (Willems & Bossu, 2012). However, it is important to note that developed nations can also experience various equity and access issues in OER.

In the field of higher education, while the focus of OER in this sector has been on enhancing student access and learning, academic staff in particular, are in need of further and targeted learning opportunities for their professional development and capacity building, including learning, teaching and research. In Australia for example, where higher education plays an important role in the economy, with revenues exceeding AU$ 27 billion in 2013 (Norton & Cherastidtham, 2014), funding to support professional development of academic staff has reduced in recent years. This reduction in funds could impact directly and indirectly on institutional support for professional learning programs for academic staff, including casual and contract-based academics (Marginson, 2013). This trend suggests that individual academics will increasingly need to manage their own careers and professional learning, including evidencing their performance against specified metrics and frameworks (Gibbs, 2013). This condition points to a greater need for, and reliance upon, open learning and relevant OER for professional development in different higher education contexts (Bossu & Fountain, 2015).

This paper examines the potential of OER to build capacity of academic staff in higher education, in particular to overcome some equity and access issues. It will also examines existing activities and strategies for professional development and provide some recommendations for the academics, academic developers, institutions, and the higher education sector in general.

Beyond the students – staff equity issues in higher education

In higher education, equity issues faced by academic staff in general can range from Indigenous representation and gender disparities through to full participation in academia. A case in point is the sessional teaching workforce. These staff are often the backbone of higher education teaching practices. In Australia, the higher education sector is the third largest employer of a casualised workforce (Ryan et al., 2013). Yet in spite of their contributions to the sector, sessional staff are often excluded from processes that would enhance their teaching, such as professional learning and development opportunities (Savage & Pollard, 2016). A key issue is that contract and/or part-time staff (such as the sessional academic) are paid piecework according to their planned workload. For these academics, participation in professional development may need to be undertaken in their personal (unfunded) time and/or adds to their time pressures in the work environment.

Overlaying these realities, for academic staff in general, equity issues in terms of their capacity to undertake their roles are broad, and their needs can easily fade into the background. Willems (2015) identified potential digital equity issues for academic staff in higher education. These include technological access, diversity of technology itself, hardware and software, diversity in knowledge and skills, disability, geographical dispersion, and so on. Skilling staff in the rapid changes in the landscape of digital technology is a case in point and it is a social justice issue to pursue for staff who are underempowered (or disempowered) to gain the requisite knowledge and skills (Marullo & Edwards, 2000).

Bandura (1989) suggests that through personal agency, solutions can be found to change what one can. The social justice goal for those who are digitally underempowered, or even disempowered, is to facilitate empowerment. Through personal agency, there are things that staff can do to change their situation both reactively and proactively to empower themselves and others in spite of the factors external to one's control or influence. One solution for an academic staff-led approach to address such issues and empower others is through capacity building by robust professional development so that marginalized academics can participate in the workplace fully and equitably. OER may be the means by which this can be accomplished.

The role of capacity building to support equity in higher education

Capacity building for university teachers is not a new concept or activity in higher education. Such processes have been used by universities and other educational and non-educational organisations for decades to prepare and train staff to adopt new procedures, new technologies, new policies and so forth (Brew & Cahir, 2014). Capacity building can be key to raising understanding and awareness and empowering educators to make informed decisions about enhancing learning and teaching within their contexts. It is important to understand that transformation and change, particularly within the higher education landscape, can occur very slowly and can attract many sceptics. Academic staff professional development and capacity-building are important and influential instruments to empower academic staff to embrace and participate in change (Healey, Bradford, Roberts, & Knight, 2013).

However, as mentioned above, significant changes in government funding coupled with pressures and changes in the work and careers of academics have impacted on their practice and the way they perceive professional development. Their workloads have increased dramatically leaving very little time for building their own capacity themselves (Brew & Cahir, 2014). The higher education sector in Australia is also under a lot of pressure, as universities have to comply with government quality standards and frameworks, compete with each other for students, as well as an ever decreasing government funding. Universities are aware that they must provide their staff with opportunities for building capacity in areas that they need most, but the challenge for them is how to provide equal professional development opportunities at a low or no additional cost to them or to their staff. Added to this issue of access is a related issue of scalability of programs (Cochrane & Narayan, 2016).

One solution for this question is to access existing or develop new OER based fit-for purpose capacity building programs for academics. It is also important to build capacity in OER, so that they understand and take full advantage of the opportunities of such open content. These programs can be offered using a diverse range of formats and tend to be freely available for use, re-use adaptation and distribution. Some of them offer the opportunity for micro-learning, defined by Hug (2006) as teaching and learning delivered to a learner in small chunks and/or in very short bursts.

Universities and staff can access these resources and turn into a development opportunity that would fit the need of a particular group of academics, for example. The next section will explore opportunities of existing capacity building practices and theories for university teachers. An additional overlay is to provide programs that can quickly respond to staff need, in manageable pieces.

Existing opportunities to build capacity through OER

As discussed, OER has the potential to provide equitable professional development opportunities to academic staff in higher education. Examples of free and open short courses, programs and resources that target university teachers and their needs can be found spread across the Internet. These include inter-governmental organisations such as the Commonwealth of Learning (COL) (https://www.col.org/news/news/col-releases-oer-course), professional associations such as the Joint Information Systems Committee (JISC) (https://openeducationalresources.pbworks.com/w/page/24836480/Home), specific research groups such as the OER Hub (http://oerhub.net/), and universities' websites (http://www.teaching-learning.utas.edu.au/content-and-resources/open-educational-resources), to name a few. Another important development in this space is the OER Universitas (OERu), which is a consortium of like-minded tertiary institutions and organisations around the world working in collaboration to provide free and open short courses through a diverse range of pathways to learners worldwide, including university teachers (McGreal, Mackintosh & Taylor, 2013). In the OERu website (https://oeru.org/courses/), learners can find a whole range of full and short-courses that are for formal credit or not. As OER are still a novelty in curriculum innovation in learning and teaching, free professional development opportunities have been developed to build capacity specifically in OER such as these two short courses: Learning to (Re)Use Open Educational Resources (http://www.open.edu/openlearncreate/course/view.php?id=2500) and Curriculum design for open education (CD4OE) (http://wikieducator.org/course/Curriculum_design_for_open_education/).

In addition, there is a substantial amount of free and openly licensed educational resources that could be used by academics developers and academics to support their own, and their students', learning. Example of these resources are openly licensed videos (https://vimeo.com/creativecommons), photographs (https://pixabay.com/), open textbooks (http://open.umn.edu/opentextbooks/), open source Learning Management Systems (http://blog.capterra.com/top-8-freeopen-source-lmss/), full courses (https://www.saylor.org/), video lectures (http://oyc.yale.edu/), repositories of academic and government publications (https://oerknowledgecloud.org/), Open Access Journals (https://doaj.org/), and much more.

OER developments have also occurred in the theoretical front, as scholars, researchers and practitioners continue finding ways to maximise the potential of OER to build capacity and improve learning and teaching in higher education. One example is the *Open Empowered Learning Pedagogy* (Smyth, Bossu, & Stagg, 2016) framework, which focused on developing further understanding in and around adopting OER within learning and teaching. This framework is an adaptation of Smyth's (2011) previous work, which explored learner-centred pedagogies and the possible interactions between learners and their peers, the teacher, the content and technology. This adapted model supports academics as participating actors in the learning and teaching process and adds other dimensions that are only possible through openly licensed content, including student co-creation of resources (Smyth et al., 2016). The model consists of five principles. These are:

1. Control rests with learners who navigate their own journey through content to achieve desired learning outcomes using both informal and formal pathways, which include recognition of prior learning and credit transfer.
2. Open, re-useable content is the preferred source of information for shared, co-creation [content created in collaboration with other academics and students] of knowledge, which also values informal learning.
3. Learners are supported to be increasingly autonomous and to develop critical social consciousness in an open ecosystems.
4. Teachers facilitate discovery, co-creation and learning engagement for transformation through open pedagogy where they become less visible as learning progresses.
5. [Open practices that] support social transformation, sharing and co-creation of knowledge in fully open ecosystems, where benefit for social good is expected (Smyth et al., 2016, p. 211).

This model has the potential to support and underpin the development and design of a diverse range of OER based capacity building programs to meet the needs of current academics and therefore support equity and access to professional development to university teachers not only in Australia, but globally.

Conclusion and final considerations

As discussed before, open educational resources (OER) are recognised globally by the benefits they can bring to a diverse range of stakeholders in formal and informal education, particularly to those who need the most by closing the equity and access gap in education. However, there is still much work to be done as the large majority of OER are available in English and are heavily western centric (Willems & Bossu, 2012). It was also mentioned here that equity and access issues in higher education go beyond student, reaching academics, including contract and sessional ones, and their needs to access professional development that would assist them to meet their career needs, as well as to improve their learning and teaching practices. Capacity building through staff professional development has been a well-regarded strategy to promote and support change in education through knowledge building, empowerment and support for educators.

One of the alternatives is to provide flexible and cost effective capacity building opportunities to staff is by taking advantage of the full potential of free and openly license educational resources such as OER to provide academics staff with adequate professional development opportunities. However, develop OER course and resources alone is not the answer to this problem. OER are mostly digital resources and are stored in many different websites and repositories globally. Therefore, build digital literacy skills in the current academic workforce is a key to increase access to OER.

In addition, professional development activities should also meet the needs of minority groups within academia, such as indigenous and sessional academics, through flexible programs and mentoring opportunities. Importantly, professional development programs should promote personal reflection on learning, support the creation of communities of learning within universities and encourage transformational change, so that academics are empowered to continue their lifelong learning journeys with the assistance of OER or not. Continue professional development is the key to unlock good practice in higher education. It also provides alternative lenses, so that educators see learning strategies and opportunities differently, including opportunity for collaborating with colleagues within their own institution and beyond, creating efficiency in content development, enhance existing pedagogical approaches or create new ones.

In this paper we have argued that the development of OER for academic staff professional development must be driven from a consideration of educational equity. It must be for the people who need it the most. As Olcott (2013, p. 15) notes, “the future of open education is at a crossroads that must be driven by those core values that define education as an essential human right with a commitment to expanding access and strengthening academic quality”.

References

Bandura, A. (1989). Human agency is social cognitive theory. *American Psychologist*, 44(9), 1175-1184.

Bossu, C., & Fountain, W. (2015). Capacity-building in open education: an Australian approach. *Open Praxis*, 7(2). doi:http://dx.doi.org/10.5944/openpraxis.7.2.197

Brew, A., & Cahir, J. (2014). Achieving sustainability in learning and teaching initiatives. *International Journal for Academic Development*, 19(4), 341-352. doi:10.1080/1360144X.2013.848360

Cochrane, T., & Narayan, V. (2016). Evaluating a Professional Development cMOOC: Mosomelt. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), Show Me The Learning. *Proceedings ASCILITE 2016* Adelaide (pp. 139-150).

Daniel, J., Kanwar, A., & Uvalic-Trumbic, S. (2009). Breaking Higher Education's Iron Triangle: Access, Cost, and Quality. *Change: The Magazine of Higher Learning*, 41(2), 30-35.

Gibbs, G. (2013). Reflections on the changing nature of educational development. *International Journal for Academic Development*, 18(1), 4–14. http://dx.doi.org/10.1080/1360144X.2013.751691

Healey, M., Bradford, M., Roberts, C., & Knight, Y. (2013). Collaborative discipline-based curriculum change: applying Change Academy processes at department level. *International Journal for Academic Development*, 18(1), 31-44. doi:10.1080/1360144X.2011.628394

Hug, T. (2006). Microlearning: A New Pedagogical Challenge (Introductory Note). In T. Hug, M. Linder, & P.A. Bruck (Eds.), *Microlearning: Emerging Concepts, Practices and Technologies after e-Learning* (pp. 7-12). Innsbruck: Innsbruck University Press. https://www.researchgate.net/publication/246822097

Johnson, L., Levine, A., Smith, R., & Stone, S. (2010). *The 2010 Horizon Report*. Retrieved from Austin, Texas:

Marginson, S. (2013). *Tertiary Education Policy in Australia*. Centre for the Study of Higher Education, University of Melbourne, Australia. Retrieved 17 February 2015 from http://www.cshe.unimelb.edu.au/research/policy_dev/docs/Tert_Edu_Policy_Aus.pdf

Marullo, S., & Edwards, B. (2000). From charity to justice. *American Behavioral Scientist*, 43(5), 895-912.

McGreal, R., Mackintosh, W., & Taylor, J. (2013). Open Educational Resources University: An assessment and credit for students initiatives. In R. McGreal,

W. Kinuthia, & S. Marshall (Eds.), *Open educational resources: Innovation, research and practice* (pp. 47-59). Vancouver: Commonwealth of Learning and Athabasca University.

Norton, A., & Cherastidtham, I. (2014). *Mapping Australian higher education*, 2014-15. Retrieved from http://grattan.edu.au/wp-content/uploads/2014/10/816-mapping-higher-education-20142.pdf

Olcott, D. (2013). Access under siege: Are the gains of open education keeping pace with the growing barriers to university access? *Open Praxis*, 5(1), 15-20.

OER Foundation. (2011). OER Foundation FAQs - What are OERs? Retrieved from http://wikieducator.org/WikiEducator:OER_Foundation/FAQs/Open_Education_Resources/

Ryan, S., Burgess, J., Connell, J., & Egbert, G. (2013). Casual Academic Staff in one Australian university: marginalised and excluded. *Tertiary Education and Management*, 19(2), 161-175.

Savage, J., & Pollard, V. (2016). Taking the Long Road: a Faculty Model for Incremental Change Towards Standards-based Support for Sessional Teachers in Higher Education. *Journal of University Teaching & Learning Practice*, 13(5), 1-18. http://ro.uow.edu.au/jutlp/vol13/iss5/14

Smyth, R. (2011). Enhancing learner-learner interaction using video communications in higher education: Implications from theorising about a new model. *British Journal of Educational Technology*, 42(1), 113-127. doi:10.1111/j.1467-8535.2009.00990.x

Smyth, R., Bossu, C., & Stagg, A. (2016). Toward an Open Empowered Learning Model of pedagogy in higher education. In S. Reushle, A. Antonio, & M. Keppell (Eds.), *Open Learning and Formal Credentialing in Higher Education: Curriculum Models and Institutional Policies* (pp. 205 - 222). Hershey, PA, USA: IGI Global.

Willems. J. (2015). Digital equity: A social justice issue for staff, not just students. In T. Reiners, B.R. von Konsky, D. Gibson, V. Chang, L. Irving, & K. Clarke (Eds.), Globally connected, digitally enabled. *Proceedings ASCILITE 2015* in Perth (pp. CP:257-CP:260).

Willems, J., & Bossu, C. (2012). Equity considerations for open educational resources in the glocalization of education. *Distance Education*, 33(2), 185–199. doi:10.1080/01587919.2012.692051

Wiley, D., & Gurrell, S. (2009). A Decade of Development. Open Learning: *The Journal of Open, Distance and e-Learning*, 24(1), 11-21. doi:10.1080/02680510802627746

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Defining "data" in conversations with students about the ethical use of learning analytics

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In any conversation about the development of ethical standards for practice, it is vital that all stakeholders have a shared understanding of the main concepts in order to reach agreement. In the context of higher education and learning analytics, while many conversations are underway, it is less clear that such a shared understanding exists around the concept of "data". In order to understand this situation more fully we conducted a study to investigate students' perceptions of the ethical and privacy considerations related to the data that universities collect and use about them for the purposes of learning analytics. In this paper, we focus specifically on the understandings students have of the types of data that can be collected about them within the educational environment. The outcomes showed that there was a diversity of understandings, but that five main data types emerged. In developing a better understanding of the ways students understand data, it can assist institutions to have more effective conversations with students about the ethical use of learning analytics.

Introduction

The growing development of teacher- and student-facing learning analytics systems has prompted new discussions around the ethical use of student data in higher education. Specifically, the innovative nature of learning analytics and rapid increase in variety of student data being used means that new and complex questions are emerging for institutions about appropriate use of those data. In an age of big data and decision making based on ever-increasingly sophisticated algorithms it is not always clear how such uses fit within existing legal and ethical frameworks. Ensuring the ethical use of student data in this environment requires discussions involving all stakeholders in the implementation of learning analytics systems. However, it is only relatively recently that the student voice has been added to these conversations.

In this paper, we report on the initial outcomes of a study conducted across two Australian universities on students' perceptions of the use of their data for learning analytics. In particular, we explore the understanding that students have of what is meant by the word "data" in the context of their educational experience in universities. The outcomes show that there is a diversity of understandings, what data is and what is actually collected in the learning context. This research is important to inform the ways that we frame our conversations with students about data and the ethical considerations surrounding the use of such data by universities.

Background

As learning analytics initiatives gain momentum in the higher education sector, institutions are investing in technological approaches that collect, aggregate and utilise various data collected about students, through processes including enrolment and their use of institutionally-hosted learning technologies. Such use has complex implications for students in relation to ownership, reciprocity, privacy, and transparency of data. Within this environment, it is critical to consider students' perspective on the collection and use of data pertaining to them. However, to date there are few studies that have included students in the conversation about the data they are willing to share and their understanding about how data are used.

Despite the ubiquity of data mining in everyday online contexts (e.g., social networking sites displaying personalised ads based on users' Internet or Search Engine history or location), it is not evident whether students are aware of the extent of data collection and data mining occurring in educational settings (Slade & Prinsloo, 2013). In addition, Crawford and Schultz (2013) posit that when institutions make decisions based on a person's data, the person has the right to question how their data informed that decision. For students to give informed consent for their educational institutions to collect and use their data, they should know what data is collected, its source, how it will be used, whether it will be shared with third parties, and how students' identity will be preserved (Slade & Prinsloo, 2013; Sclater, 2014).

To date, there have been limited studies that investigate students' understanding of the types of data collected of them and any issues they have concerning their privacy (Drachsler et al. 2015). A comparative study involving students from the USA and UK found that the majority of students in both countries were happy for their data to be used to help improve their grades, although the percentage in agreement was smaller in the UK groups (Arnold & Sclater, 2017). This could be attributed to the fact that the US students had already been exposed to learning analytics tools in their institutions and therefore could more easily understand the type of data included and the benefit they can receive from such systems, whereas students in the UK did not have the same experience. In Germany, a study of 330 students found that students had mixed views about the data they were comfortable allowing learning analytics systems to use (Ifenthaler & Schumacher, 2016). While they were happy for data such as grades and course enrolment to be used, they didn't want log trail/clickstream data or personal information to be made available for learning analytics systems. In the Australian context, Roberts and colleagues (2016) investigated students' attitudes towards the use of their 'big data' for learning analytics purposes at one institution. Through focus groups with 41 undergraduate and graduate students it was found that students had limited knowledge about educational data and learning analytics. Further, despite recognising that the data could personalise their educational experience, students were concerned about invasions of their privacy and that data would be used without their informed consent (Roberts et al., 2016).

Consistent across these three studies is the fact that students were given a definition of data and learning analytics at the start of the research and, in the case of the German and Australian studies, also exposed to examples of learning analytics systems. Providing such definitions and examples provides a similar baseline for all student participants' understanding in order to respond to certain questions in an 'informed' manner. However, as a result, it also obscures any understanding of students' previously held definitions of data as well as their knowledge of what data is collected and used about them by educational institutions. This is important to consider as students often don't receive such a formal introduction to learning analytics and the scope of data collection before having to give consent to policies governing the use of their data for learning analytics systems.

What is 'data'?

The Oxford English Dictionary defines data as "facts and statistics collected together for reference or analysis" ("Data", 2017). In the context of education there are many facts and statistics that could potentially be collected about a student as they move through their degree. From the information that students provide in order to secure entry to the institution through to the information they give as they leave the institution and become an alumnus, the scope of data within higher education can be extensive. Added to this is the ever-increasing ability for data to be collected on students' activities in a multitude of online learning systems. The challenge that faces institutions implementing learning analytics is for students to be able to appreciate and understand the range of types of data that can be collected about them and how such data can be used. Such usage could be at the level of an individual or anonymised and aggregated to provide broader understandings of trends across student groups.

Typically, the statements written into student charters or statements on student privacy about the types of data that are collected and used are quite vague. This can include statements as broad as "data used in teaching and learning", "data for the provision of student services" or "personal information … (collected) for a number of purposes". Although accurate, these broad definitions do not make clear to students the detail of the exact data that are collected or how they can be used across various university contexts. In contrast, in their *Policy on ethical use of student data for learning analytics*, the Open University (OU) in the UK provide a more specific definition for data. They explain that "data used for learning analytics typically falls into one of two categories: that captured at registration or at later points as a result of the student supplying information to the University (typically labelled as Student characteristic data), and that derived from ways in which the student engages with University systems as a result of their ongoing study (typically summarised as Study behaviour data)" (Open University, 2014, p.3). In the Australian context, Charles Sturt University (CSU) use a very similar definition to the OU, but add that data can also be collected from "information we are authorised to collect from other organisations (e.g. government agencies)" (Charles Sturt University, 2015a, p.1). As part of CSU's Learning Analytics Code of Practice the detail on the exact data is extended through the principle that "All users of the University's learning and teaching systems will have access to clear explanations of their rights and obligations with respect to data from those systems" (Charles Sturt University, 2015b, p.7).

The current study

The current study provided an opportunity for participants to share and collaboratively discuss their knowledge of the term “data” and what they perceive the university collects and potentially uses about them. The study was driven by the research question: What do students understand about what, how and why their data is collected and used in higher education? In this paper, we focus on the first part of this question which considers what data students know and/or think is being collected and used about them. This enabled us to explore the ways students understand and define “data” within the higher education context. This is important to help maximise the effectiveness of conversations with students about learning analytics implementation and to use when designing institutional policies and procedures that provide an ethical environment for learning analytics.

Method

Six student focus groups were conducted at two Australian universities: four focus groups were conducted at institution A (a metropolitan university in Victoria) and two focus groups were conducted at institution B (a regional university in NSW). A convenience sampling approach was taken to recruit participants with participation open to all students at the two institutions. Each focus group included between 5 and 10 participants. Participants in the focus groups represented a range of academic disciplines (e.g., Nursing, Science, Engineering, Education, Psychology, Arts), year levels (undergraduate/postgraduate), genders and enrolment types (domestic/international). The focus group sessions were structured around three main discussion questions: (1) What data do you think the University collects about you? (2) What do you think the University uses this data for? and (3) What (if any) are the responsibilities of the University, when using your data?. The focus group facilitators did not give a definition of data at the beginning of the sessions, instead they allowed this to emerge throughout the discussion between student participants. The facilitators also did not use the term “learning analytics” as it was felt that students may not be familiar with this term and that giving a definition for this may influence students understanding of the definition of data. Where possible, the facilitators tried to control for bias that often emerge in focus group situations, such as dominance bias, by directly addressing quieter participants. A thematic analysis of the focus group transcripts was conducted to identify the main issues raised by participants.

Findings

Students’ understandings of the data collected by universities were varied and often lacked certainty. There were five broad types of data that students recognised that the University collected about them. In some focus groups, these types of data emerged organically as part of the students’ discussion (e.g., “What we do in Moodle”). In others, they emerged in response to the facilitators’ prompting when it was clear that students were struggling to think of data beyond that explicitly given (e.g., “what about when you come to the library?”). The five types of data were:

1. Personal information

The most frequently identified type of data across all focus groups related to personal details provided by the student to the institution during enrolment, examinations, and other schemes such as scholarships or student support. This personal information included health information (“vaccination records”, “details of health care”), identifiable information (“our photos”, “address, emergency contact, phone number”), and official documentation (“police checks”, “my birth certificate”). Ambiguity around this type of data emerged in various contexts where data were collected. For instance, international students disagreed with each other about whether information about their financial circumstances were collected as part of their enrolment or as part of their visa application process. There was also uncertainty around whether and how personal, identifiable information was connected to other data sources.

2. Online activity

Students agreed that their university collected data about their use of online learning management systems and university-lead social media platforms (e.g., “What we are doing on Moodle”, “online revision tasks or just opening, reading the lecture slides”). They were less sure about the nature or detail of the data that was collected in these forums. Some students believed that every element of online work was collected, analysed and used by university services (e.g., “they check, I suppose, whether we’re accessing the test at the same time as someone else and giving similar answers”); whereas others believed that online activity were automatically collected into a databank but were not directly monitored (e.g., “it just like automatically collects in their database”).

3. Student feedback

In two discussion groups, there was strong consensus among student participants that the main data collected by their university was through feedback from students. They felt they provided a lot of feedback (e.g., "feedback for everything pretty much"). When prompted, they described providing feedback about their enrolment experiences, orientation week, their subjects, online support services, academic support services, and in research projects such as the current project. An ambiguity around providing feedback was whether and how feedback offered voluntarily was connected to students’ personal information. Some students were certain that feedback was anonymous (e.g., “they say we remain anonymous, yeah"), others were sure that it was identifiable (e.g., "actually they have our names … because where you log in the LMS") and others were not sure (e.g., "I'm not sure if it's anonymous or not because it's linked to our LMS"). This was especially the case when students provided feedback online via their learning management system. Consequently, some students said they restricted feedback in order to avoid being targeted by their teachers. This was reflected in the following student's reservations about providing qualitative feedback in the online Student Experience Survey:

> "I think maybe a lot of [students] would actually be reluctant to put any further comments … [they] might think "oh that might get a bit personal" or "so-and-so might recognise me" so I'll just do the numbers [rating scales]. So that might actually count against that input and improving things."

4. Academic information

Academic information collected about the student included academic history (e.g., "transcripts", "previous study", "what school we came from") and information about current academic progress (e.g., "what subjects we're doing and our results"). Some students also identified the assignments themselves as data, and described instances where teachers had used their assignments as examples to show other cohorts of students, along with the grade and feedback. Students were comfortable with the way that universities collected and used their academic information, although they were unsure who had access to that data, for instance, whether teachers in other subjects could see their grades.

5. Resource usage

Students recognised that universities collected information about the resources and infrastructure that students use on campus. Often discussions around resource usage were initiated by the facilitator (e.g., "What about around campus?" "What about in the library?"). Most students readily identified activities with log recording such as using services accessed by their student ID cards (e.g., "using photocopiers and printers", "what books we borrow"). Only a few students identified university logs of location/usage of Wi-Fi networks as another form of data (e.g., "when you log into uni wireless", "when we connect to the Internet"). The students' discussions around these data logs were not straightforward. Some students were not sure about how or why log data was collected (e.g., "browsing on the uni WiFi, I am not sure to what extent that's monitored"); whereas others knew data were collected, but were not sure why (e.g., "they won't be interested in looking at my browser history, but like they do gain access to it"). Some felt that the data logs were for censorship purposes (e.g., "they block things like Peer-to-Peer [software] so you can't pirate"), whereas others believed the data logs had no effect on their behaviour (e.g., "as long as you're not doing anything [wrong] you shouldn't, no reason to be worried really").

Discussion and conclusion

The outcomes of the focus groups offer a more nuanced understanding of what students understand about the various data collected about them. Students didn't always easily or readily come up with these data definitions - for some groups it took time. Sometimes, there was strong consensus about the types of data collected in different contexts (e.g., personal information given during enrolment). Although there was often less certainty about how some of this data was used in practice (e.g., log data from resources usage or their online activity on the LMS). There was also confusion about whether some forms of data could or should be collected and used. Whether and to what extent activity traces were collected through online learning systems prompted a variety of views across the focus groups. Occasionally, the students came to consensus on these understandings, but other times no such consensus was found. The ability for students to come to a consensus (or not) was a feature of the focus group environment and highlights that, in the current climate, the understanding of data by individual students may remain quite varied. With such variety within this small sample, we anticipate that further large-scale studies of students' perceptions will reveal even greater diversity in their understanding.

This work-in-progress paper reports the emerging themes from the first question of a broader study. As we investigate the rest of students' discussions, we anticipate that the types of interaction between them will continue to shape their understanding of more complex issues around the ways that universities use their data. However, the diversity of their understanding suggests that ongoing discussions with students about this issue need stronger clarification of data. This is to ensure that when students, teachers and administrators are engaging in more in-depth discussions about the best and most ethical ways to use data, that there is a shared understanding of what that data is.

References

Arnold, K. E., & Sclater, N. (2017). Student perceptions of their privacy in learning analytics applications. In *Proceedings of the Seventh International Learning Analytics & Knowledge Conference* (pp. 66-69). ACM.

Charles Sturt University (2015a) *Statement of Student Data Rights and Responsibilities.* Retrieved from https://www.csu.edu.au/__data/assets/pdf_file/0010/2160487/Statement-of-Student-Data-Rights-and-Responsibilities_final.pdf.

Charles Sturt University (2015b) *CSU Learning Analytics Code of Practice.* Retrieved from http://www.csu.edu.au/__data/assets/pdf_file/0007/2160484/2016_CSU_LearningAnalyticsCodePractice.pdf.

Crawford, K., & Schultz, J. (2014). Big data and due process: Toward a framework to redress predictive privacy harms. *BCL Rev.*, *55*, 93-128.

Data. (2017). In *English Oxford Living Dictionaries.* Oxford University Press. Retrieved from: https://en.oxforddictionaries.com/definition/data.

Drachsler, H., Hoel, T., Scheffel, M., Kismihók, G., Berg, A., Ferguson, R., ... & Manderveld, J. (2015, March). Ethical and privacy issues in the application of learning analytics. In *Proceedings of the Fifth International Conference on Learning Analytics and Knowledge* (pp. 390-391). ACM.

Open University (2014). *Policy on ethical use of student data for learning analytics*. Retrieved from https://learn3.open.ac.uk/mod/url/view.php?id=85812.

Roberts, L. D., Howell, J. A., Seaman, K., & Gibson, D. C. (2016). Student Attitudes toward Learning Analytics in Higher Education: *"The Fitbit Version of the Learning World". Frontiers in Psychology*, *7*, 1959. http://doi.org/10.3389/fpsyg.2016.01959.

Sclater, N. (2014). Code of practice for learning analytics: A literature review of the ethical and legal issues (pp. 1–64). Jisc. Retrieved from http://repository.jisc.ac.uk/5661/1/Learning_Analytics_A-_Literature_Review.pdf.

Slade, S., & Prinsloo, P. (2013). Learning analytics: Ethical issues and dilemmas. *American Behavioral Scientist*, *57*(10), 1510-1529.

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Us and IT: Capacity-building for blended learning: An intersection between educator, pedagogy, and technology

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When Victoria University (VU) Australia, adopted a new learning management system (LMS) as part of its Blended Learning Strategy and Operational Plan in 2014, it introduced a range of support structures including a staff support and training program. Complementing this, the *Graduate Certificate in Higher Education* (the course providing professional development for early career academic staff) offered an elective AET4010 *Blended Learning Design and Development* fusing the pedagogical and theoretical aspects of blended learning to foster teaching as a design science.

In this study we investigate the effectiveness of AET4010 in developing participants' capacity to design and, develop blended learning. In this paper we report on the data from the first stage of this investigation. Data is derived from assessment rubrics. Complementary qualitative data will be collected in the second stage via interviews conducted after the participants complete the unit. We analyse our findings against the JISC Building Digital Capability Framework mapped to the UK Professional Standards Framework. This Framework identifies early career academics' capabilities (Associate Fellows). The emerging findings indicated the value of capacity building through a structured unit of study enabling participants to experience learning from their own learner's standpoint while reflecting on pedagogical perspectives and 'teaching as design'.

Introduction and context

Victoria University (VU) Australia, has principally been an on-campus institution. It has no history of distance learning for large-scale off-campus study, nor extensive use of educational technology. In 2014 VU implemented a blended learning strategy as part of its institutional vision to offer flexibility of time, place and pace of learning and to personalise learning. Specifically, the strategy aims to:

- enhance student access, experience, engagement and outcomes through an effective blend of face to face and digitally enabled learning opportunities; and
- apply and maximise blended learning opportunities in making our offer to students flexible across pace, place and mode (Victoria University 2014, p. 1).

While the strategy uses proven technology such as a learning management system (LMS) and associated tools, it acknowledges that successful implementation requires staff to "improve and extend digital literacies through engagement with authentic formal and informal professional development" (Victoria University 2014, p. 2). This points to a need for a specific skills set that facilitate "the organic integration of thoughtfully selected and complementary face-to-face and online approaches and technologies" (Garrison & Vaughan, 2008, p. 148). The development of these teaching design capabilities in staff is a key factor of successful adoption of learning technologies (Laurillard, 2012). Garrison and Vaughan add that blended learning designs must "be informed by evidence based practice and the organic needs of the specific context" (2013, p. 14). This underscores the need for a purposeful approach that focuses primarily on VU's student cohort and the transformation of teaching for learning.

Specialised staff were hired and assigned to Colleges across the university to facilitate the implementation of institution-wide blended learning. Complementing this, a variety of ongoing training and professional development sessions continue to be offered on a range of topic areas including operational training of the LMS, drop-in sessions, guest speakers in lunch time show-and-tell sessions, and showcasing of 'exemplary' practice – all supporting the adoption process delivering 'just in time' support (Wilson & Stacey, 2004) grounded in the VU context.

Formal study via a Graduate Certificate

Complementing such timely support, VU offers a *Graduate Certificate in Tertiary Education* (GCTE). This is a practice-orientated accredited course, embedded into the VU professional development program (free for all VU academics) that contextualises capacity building within a higher education learning and teaching / pedagogical framework. The GCTE includes an elective unit, AET4010 *Blended Learning Design and Development*, addressing theoretical concepts and technology based approaches in education. This unit builds upon a design science understanding of teaching through the application of the backward design curriculum model (Wiggins & McTighe, 2005). Participants develop their foundation for 'teaching as design' (Laurillard, 2012) through engagement with activities and assessment in the unit. This design approach is an intentional complement to the technical skills development undertaken elsewhere in the University.

The GCTE participants, largely early-career academics consisting entirely of VU staff, mirrors the university's student cohort; they are drawn from diverse backgrounds (in 2017, 47% were born outside Australia and 35% speak in a language other than English in their home). A large proportion of the GCTE participants are likely to be the first in their immediate family to hold a teaching position in this sector as 59% of their parents did not complete a university course. These two facets combine to indicate limited cultural capital in a new professional domain, as these participants are yet to develop the "long-lasting dispositions" (Bourdieu, 1997, p.47) embedded within the wider academic community. More critically, these early career academics, (those with less than seven years teaching experience (Bexley, Janes, & Arkoudis, 2011)) represent the future of VU and therefore our collective priority. Growing the cultural capital of early career academics through continuing professional development (CPD) "is likely to lead to a more lasting and progressive impact" than those who are already established in academe (Englund, Olofsson & Price, 2017, p.84). Our goal therefore is to connect their staff development to current institutional needs and leverage appropriate use of technology through CPD.

Most GCTE participants complete two core units before commencing AET4010. These units provide a foundation for teaching practices, designing curriculum and assessing learning. A student-centred approach is recommended as a foundation for effective educational technology integration (Englund, et.al., 2017). AET4010 explicitly focuses on blended learning and promotes deliberate engagement with CPD opportunities within and beyond the unit. The unit requires participants to engage with a conceptual framework and pedagogy before working with the technology.

The rise of institutionally sponsored educational innovations has been a catalyst for many institution-specific CPD models (Graham, Woodfield & Harrison, 2013). For AET4010, the most pertinent aspects of these models is to (a) focus on participant challenges, and (b) support justified modifications as a basis for re-examination of the institutional model. These two factors increase the individual relevance of the CPD to each participant, as well as providing an evidence-base to increase institutional relevance to develop a context-dependent maturation of the innovation.

The AET4010 model of capability development mirrors aspects of the Concerns Based Adoption Model (CBAM) (Hall & Hord, 2001) and echoes Laurillard's advocacy of setting feasible goals where educators are "able to discover how to exploit its [technology's] potential more effectively" (2012, p.84). Participants elaborate and contextualise the blended learning innovation suitable for *their* students; in effect, they configure the institutional innovation for their discipline in recognition of their student backgrounds and learning needs (based on CBAM). Individual capacity building is based on identified personal challenges. The task is designed to be collaboratively addressed with a colleague (not necessarily seen as an expert, emulating a zone of proximal development (Vygotsky, 1978)), following Laurillard's (2012) Inquiry model.

This purposeful institutionalised approach to CPD in the GCTE ensures that it is an ongoing activity, not undertaken only if there is spare time from regular teaching duties. The AET4010 curriculum deliberately extends participants' limited cultural capital in this new professional domain enabling direct links to their teaching practices through scaffolded assessment tasks that require them to plan, design and develop a constructively aligned blended learning module for an identified context.

Connections to international frameworks

In this paper we locate AET4010 blended learning capacity building within the UK Joint Information Systems Committee (JISC) Digital Capability Framework (JISC, ca. 2015) against which the UK's Professional Standards Framework (UKPSF) has been mapped - see Tables 1 and 2. This Framework is used in the UK and in a number of Australian universities to enhance educator capabilities in the sector.

The JISC among other things attempts to

- develop the capacity to support and develop others in digitally-rich settings, to teach/work in a teaching or curriculum team, to design learning opportunities, to support and facilitate learning, to be pro-active in peer learning, all while making effective use of the available digital tools and resources. An understanding of the educational value of different media for teaching, learning and assessment; an understanding of different educational approaches and their application in digitally-rich settings (JISC, ca. 2015).

Method

The capacity building process was investigated through a two-phased, mixed methods research approach. It involved examining AET4010 through multiple approaches to maximise the strength and accuracy of all data as advised by Ayiro (2012). Ethics approval was granted for this study under the University Ethics Committee (reference number HRE17-002). This paper reports on phase 1, the quantitative aspect of the study.

Data for this phase of the study was drawn from the whole class (33 participants). Initially we examined assignment rubrics to identify criteria related to the Digital Learning and Technology Framework (Table 1). After students had completed the relevant assessment tasks, we examined their rubrics to determine patterns of capability development across the class. This data was then extracted from the rubrics and mapped against the Framework (Table 2). In the second phase of the study, this data will be complemented by qualitative information obtained from interviews conducted after the participants complete the semester.

Findings

The data derived from the three AET4010 rubrics for assessment tasks were mapped against each of the corresponding Digital Learning and Teaching elements of the JISC Digital Capability Framework. Linking to CPD within and beyond the unit is a key AET4010 outcome. Tables 1 and 2 draw attention to aspects relevant to early career academics as identified in the United Kingdom Professional Standards Framework (UKPSF). Table 1 illustrates how participants engage with the three JISC-identified criteria for CPD as "Building digital capability for new digital leadership, pedagogy and efficiency" (JISC, ca. 2015).

Table 1: Digital learning and CPD (learning) - Maps to UKPSF: Areas of Activity –A5

JISC statement	AET4010 support of blended learning capacity-building
1. Use digital networks and resources to undertake professional development as a teacher.	The unit provides a community of inquiry in a blended learning environment. It requires structured peer feedback on developing blended learning modules (Assignment 3.) *Findings: All resources including synchronous and asynchronous communication are available via the LMS, complemented by three optional face-to-face workshops.*
2. Identify and take up opportunities for professional development in digital learning, teaching and assessment.	Participants identify learning goals in relationship to blended learning and are directed to take advantage of the wide range of informal professional development available within the University (Assessment 3). *Findings: 82% gained a 'credit' or above for this activity*
3. Reflect on personal learning, teaching and assessment practices with technology, using digital tools to support reflection where appropriate	Participants reflect on how collaboration enriched their personal learning in respect to technology-based teaching and assessment (Assessment 2) *Findings: 88% gained a 'credit' or above for this activity.*

Evidence of how AET4010 builds capability for blended learning is mapped in Table 2, based on the assessment rubrics. Findings indicate that AET4010 builds capabilities in nine of the 14 JISC elements.

Table 2: Findings - Digital teaching practices mapped to UKPSF: Core Knowledge - K1-K5

JISC statement	AET4010 support of blended learning capacity-building
1. Design and plan courses of study to include digital issues, activities, opportunities and outcomes.	Participants design and develop a course-based module (Assignment 3), informed by bended learning (BL) frameworks (Assignment 1). *Findings: 75% gained a 'credit' or above for justified BL framework with an additional 16% gaining a pass.*
3. Design and plan digital learning and assessment activities within courses of study.	Participants design a constructively aligned module of study including learning activities and assessment tasks. The strengths and limitations of their selected blended learning approach are argued (Assessment 2 Part B). *Findings: 62% gained a 'credit' or above for this activity with an additional 30% gaining a pass.*
6. Use digital technologies to support in-class learning (eg polling tools, live curation/	Participants propose appropriate digital tools (eg. polling and learning analytics) to support online and face-to-face components (Assessment 2 Part A and Assignment 3). *Findings: 83% gained a 'credit' or above for the design, and 74% gained a 'credit'*

JISC statement	AET4010 support of blended learning capacity-building
sharing tools, digital presentation).	*or above for developing the integrated design as their Assignment 3.*
7. Guide learners to use their own digital devices, services and apps in support of learning, in class and independently.	Participants include appropriate guidance when digital devices and apps are used to facilitate learning (Assessment 3 Part C) *Findings: 65% gained a 'credit' or above for this activity.*
10. Source appropriate digital learning resources, assessing for eg accuracy, relevance, accessibility, diversity, effectiveness.	Participants implement accessibility and copyright protocols of sourced digital learning resources (Assessment 3 Part C). *Findings: 81% gained a 'credit' or above for this activity.*
11. Develop and adapt digital learning resources according to learners' needs, with an awareness of licensing issues.	As per 10 above.
12. Work with other professionals eg library/learning resources, e-learning, learning support, to support learners' digital capabilities.	Participants identify relevant professionals across the University and draw upon their expertise to enhance their own digital capabilities (Assessment 2 Part B). *Findings: All participants identified relevant professionals from across the university to progress their work.*
13. Use digital tools in support of assessment (eg quizzes, polls, self-assessment, peer assessment, e-portfolio, peer review), & to give feedback (eg via. annotations, audio tracks).	Participants create formative assessment with embedded feedback and feedforward advice using appropriate tools. (Assessment 3 Part C) and peer reviewed colleagues' assessments prior to submission (Assessment 3 Part B). *Findings: 69% gained a 'credit' or above for designing such formative assessment tasks, with 82% gaining a 'credit' or above for peer reviews.*
14. Design assessment activities to progress and demonstrate learners' digital capabilities.	Participants design assessment activities incorporating purposeful, differentiated scaffolded activities to support assessment. (Assessment 3 Part C). *Findings: 69% gained a 'credit' or above for this activity.*

Discussion and future implications

Rubrics for all three assessments were analysed. Assessment 1 introduced students to a range of evidence-based blended learning theoretical frameworks. Assessment 2 required constructively aligned pedagogical design for active learning based on these frameworks. Assignment 3 implemented that design embedding peer review of the draft development. Overall participants scoped learning for pre-class, in-class and online settings demonstrating some thoughtfully constructed pedagogically sound, blended learning designs.

As per Table 2, participant familiarity with the tools indicated good up-take of the university tool-based workshops offered over the past two years, and confidence in selecting appropriate tools (83% received a 'credit' or above in this area). However, an unexpectedly low 65% included instructions for tool-use in their assignment which was contradictory to their own requirement for instructions at the beginning of the course. As greater familiarity with the LMS was developed, the need for instructions waned. Seventy-five percent of participants also demonstrated a high level of conceptual engagement with relevant theoretical frameworks (receiving a 'credit' or above). However, participants' understanding of how to design constructively aligned learning activities and assessment tasks for blended learning environments were lower (62% receiving a 'credit' or above). In contrast, 82% of participants provided improvement-orientated peer feedback, while a smaller proportion (74%) implemented that advice. Overall, participants found extending their knowledge of 'teaching as design' was more challenging than learning to use the technology, or revising their work based on peer feedback.

At the time of writing this paper, participants were yet to implement and evaluate their newly created blended learning modules. Data from the phase 2 interviews will throw further light on these issues.

Conclusion

Our study suggests a need to extend institutional investment in developing pedagogical capabilities in relation to technology use. A common challenge in university-wide blended learning initiatives is supporting staff to implement sustainable blended learning strategies. At VU, AET4010 is one effort to support a resilient, knowledgeable workforce capable of rising to the opportunities afforded by technology-enhanced learning. Institutions have a responsibility to develop pedagogical capabilities, technological skills and 'teaching design' of early career academics' to support the learning needs of increasingly diverse student cohorts. Academics with such capabilities can engage learners when equipped with a solid foundation of pedagogical strategies – strategies that can continue to be realised in this fluid technological environment.

References

Ayiro, L.P. (2012). *Functional Approach to Educational Research Methods and Statistics: Qualitative, Quantitative, and Mixed Methods Approaches*. Lewiston, N.Y.: Edwin Mellen Press.

Bexley, E., Janes, R., & Arkoudis, S. (2011) *The Australian academic profession in transition: Addressing the challenge of reconceptualising academic work and* *regenerating the academic workforce.* Melbourne: University of Melbourne, CSHE. Available at http://melbourne-cshe.unimelb.edu.au/__data/assets/pdf_file/0010/1490923/The_Academic_Profession_in_Transition_Sept2011.pdf

Bourdieu P. (1997). The forms of capital. In: Halsey A.H., Lauder H., Brown P., Wells A.M., editors. *Education, Culture, and Society*. Oxford, UK: Oxford University Press. pp. 46–58.

Englund, C., Olofsson, A.D., & Price, L. (2017). Teaching with technology in higher education: understanding conceptual change and development in practice. *Higher Education Research and Development*, 18. 73-87.

Garrison, D. R. & Vaughan N.D. (2008). *Blended learning in higher education.* San Francisco: Jossey-Bass.

Garrison, D. R. & Vaughan N.D. (2013). Institutional change and leadership associated with blended learning innovation: Two case studies. *The Internet and Higher Education* 18. 24-28.

Graham, C. R., Woodfield, W. & Harrison, J.B. (2013). A framework for institutional adoption and implementation of blended learning in higher education. *The Internet and Higher Education*. 18. 4-14.

Hall, G.E. & Hord, S.M. (2001) *Implementing change: Patterns, principles and potholes*. Boston: Allyn and Bacon.

JISC (ca. 2015). Building digital capability: Building capability for new digital leadership, pedagogy and efficiency. Viewed 03 May 2017. https://www.jisc.ac.uk/rd/projects/building-digital-capability.

Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology.* London: Routledge.

Victoria University (2014). *Blended Learning Strategy and Operational Plan.* Viewed 28 April 2017. https://www.vu.edu.au/learning-teaching/blended-learning-strategy

Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wiggins, G.P. & McTighe, J. (2005). *Understanding by design*. (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

Wilson, G. & Stacey, E. (2004). Online interaction impacts on learning: Teaching the teachers to teach online. *Australasian Journal of Educational Technology*, 20(1), 33-48. Viewed 28 April 2017. http://www.ascilite.org.au/ajet/ajet20/wilson.html

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Developing virtual collaborative health team educational environments

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In this short paper we introduce a conceptual framework that is under development to create virtual educational environments to simulate collaborative health team experiences. Building on our work of developing virtual environments for authentic Paramedicine education scenarios, we are extending the concept across the seven health disciplines at the university, beginning initially with a prototype involving three health discipline teams: Paramedicine, Nursing, and Physiotherapy. Using a design based research methodology we are developing prototypes of immersive simulated environments to simulate the real - world interaction between these three health teams for our students. We leverage a low cost mobile BYOD approach enabling rapid prototyping and development of these scenarios.

Introduction

A key determinant in successful patient clinical treatment and outcome is efficient and reliable transfer of patient care between the various health professionals involved in their care (Fletcher, Bedwell, Rosen, Catchople, & Lazzara, 2014; Shah, Alinier, & Pillay, 2016). Emergency care patients' journey to recovery begins with emergency services such as Paramedics, followed by handover to hospital services (including nursing), and finally through rehabilitation services such as Physiotherapy. Various approaches to improving the handover of patients between these health teams have been explored, including a recent popular communication model - Situation, Background, Assessment, Recommendation (SBAR) (Eberhardt, 2014). Simulating these health team handovers in health education ideally leads to improved interprofessional collaboration, and ultimately improved patient prognostic outcomes. However, authentic interprofessional collaboration and handover experiences are limited as a result of: physical dispersion of health disciplines across university campuses; silo allocation of resources; difficulties teaching across disciplines (e.g. nursing teaching interprofessional concepts to physiotherapy); and size and mix of health student cohorts (Year 1 nursing 117; physiotherapy 139; paramedicine 84; occupational therapy 92; midwifery 75; oral health 39; podiatry 32) total 578 year one students within the seven departments of one University's School of Clinical Sciences. Through the development of virtual reality (VR) simulations we are exploring authentic interprofessional handover experiences for our students in the disciplines of Paramedicine, Nursing, and Physiotherapy. Students from each health team will be able to authentically explore and critique the critical elements of the experience of a patient through the virtual handover of the same case scenario between these three teams.

Prototype scenarios of each of the three clinical steps in patient care have been developed using Seekbeak to create mobile BYOD immersive virtual environments for the three student discipline groups to explore and experience the health teams with whom they will collaborate in real world situations, for example:

- Paramedicine: https://seekbeak.com/v/2lVjKrZzBby
- Nursing/ICU: https://seekbeak.com/v/NYojXG69z8e

- Physiotherapy:https://seekbeak.com/v/GYbjNxLE1A7

Literature review

Interprofessional education (IPE) is critical in the preparation of healthcare students who can communicate clinically relevant information and work collaboratively for safe patient care (Cumin, Skilton & Weller, 2017; Stow, Morphet, Griffiths, Huggins & Morgan, 2017). One example of interaction between health disciplines is the handover of a patient, whereby clinical information is exchanged and responsibility and accountability for some, or all aspects of care for a patient is transferred to another interprofessional (Stow, et al., 2017). Ineffective communication, including the use of different professional “language” during clinical handover, impacts the continuity of patient care and contributes to adverse effects and potentially legal claims of malpractice (Thomas, Schultz, Hannaford & Runciman, 2013; Wong, Yee & Turner, 2008). Recent reviews of undergraduate interprofessional education found that there were few opportunities, other than clinical training on the wards, for handover practice between nursing, physiotherapy and paramedicine students (Gough, Hellaby, Jones, & MacKinnon, 2012; Reeves et al., 2013). This, along with the fast pace and high complexity of managing intensive and acute care patients, has led to healthcare students often feeling challenged and unprepared to practice in this environment (Thomas, Rybski, Apke, Kegelmeyer & Kloos, 2017; Reed, Hermelin, Kennedy & Sharma, 2017). With limited literature describing simulation between paramedicine, nurses and physiotherapy, the handover of a patient is viewed as a point of overlapping practice between these disciplines to develop interprofessional education (Stow, et al., 2017).

Interprofessional simulation can be delivered in many forms - from panels of discipline experts co-contributing to a case scenario, to clinical scenarios simulated in a simulation room with a manikin. Interprofessional simulation has demonstrated value in enhancing respect, collaboration, communication and understanding of roles between care disciplines (Bursiek, Hopkins, Breitkopf, Grubbs, Joswiak, Klipfel & Johnson, 2017; Jacobs, Beyer & Carter, 2017). Simulation can provide “hands-on” learning experiences that are realistic and help students to gain competence and confidence (Thomas, et al., 2017). As the virtual interprofessional environment can be interacted with individually, it can also provide flexible access to educational experiences, thereby improving the learning value from a more active involvement of non-technical skills (Reime, Johnsgaard, Kvam, Aarflot, Engeberg, Breivik & Brattebø, 2017). When developing simulation, the importance of piloting scenarios before use in larger scale has been emphasised in previous studies (Stow, et al., 2017).

Methodology

Informed by our literature review, our initial research question is: What are the key principles for creating an authentic virtual experience for health care students that simulates real world health-team patient handover using mobile VR?

The research project involves collaboration of clinical lecturers from three health disciplines at the university who will partner with the university’s central teaching and learning research and support unit. Participants are drawn from students enrolled in the university’s three and four-year degree programmes in Paramedicine, Nursing, and Physiotherapy. We utilise a design based research (DBR) methodology to guide the project development, that is informed by a framework for designing mobile VR environments for higher education (Cochrane et al., 2017). The design framework (Cochrane, 2016) employs a simple ecology of resources to capture and share user-generated VR environments. Health care environments are captured by a smartphone controlled 360-degree camera (e.g. LG360 cam-www.lg.com/us/mobile-accessories/lg-LGR105.AVRZTS-360-cam), then content is added through editing platforms (e.g. SeekBeak- www.seekbeak.com) to enable interaction in the clinical virtual environment. Authentically designed contexts can be viewed on the participant’s smartphones using a Google Cardboard compatible Head Mounted Display (HMD). While DBR (used synonymously with Educational Design Research) involves three iterative stages (McKenney & Reeves, 2012), this paper focuses upon the design and prototyping stage, representing a design and construction study (Kopcha, Schmidt and McKenney, 2015) that presents the design frameworks along with theoretical and empirical grounding that gives it shape. Through several initial exploratory projects we have identified five design principles (DP1-DP5) that will be refined through the DBR research.

- DP1: Basing the project within a design-based research methodology (Bannan, Cook, & Pachler, 2015; Cook & Santos, 2016)
- DP2: Supporting the project through the establishment of a community of practice (Cochrane, 2014; Cochrane & Narayan, 2016)
- DP3: Using heutagogy (student-determined learning) as a guiding pedagogical framework (Blaschke & Hase, 2015; Hase, 2014)
- DP4: Designing around the authentic use of mobile devices and VR (Burden & Kearney, 2016; Cochrane & Narayan, 2017; Kearney, Schuck, Burden, & Aubusson, 2012)
- DP5: Integrate collaboration and team-work into the project activities (Kearney et al., 2012; OECD, 2015)

In addition to McKenney and Reeves (2012) three DBR stages, we add a fourth stage that emphasises the dissemination of the research through peer reviewed publications or the scholarship of technology enhanced learning (SOTEL), illustrated in Figure 1.

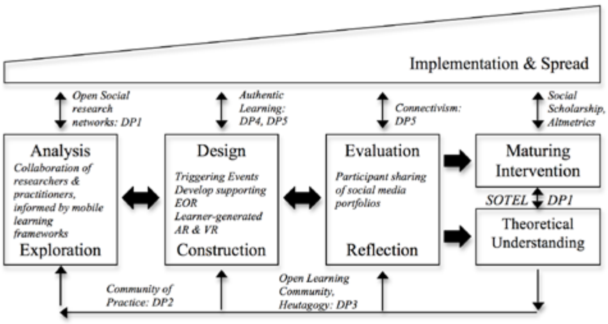

Figure 1: The four stages of DBR – modified from McKenney and Reeves, 2012; p159

Design and construction iteration 1

This paper outlines the first two DBR phases of each research project where we co-define the project problem and requirements, and develop prototype solutions based on existing design principles and technological innovation. Cormier (2008) refers to the design of a collection of tools to support learning as an ecology of resources (EOR). A generic mobile VR ecology of resources is designed to support each project consisting of a bricolage of mobile social media tools that facilitate five key elements associated with our identified design principles: (1) a participant team hub, (2) a mobile VR content creation platform, (3) a cloud-based VR content host, (4) VR content publication and sharing via social networks (SNS), and (5) a smartphone-driven head mounted display. In our case the ecology of resources utilised to support the projects include:

- Individual Wordpress blogs as project journals.
- A team Wordpress blog for publicising project outputs (for example: http://meshVR.wordpress.com).
- A shared Google Drive folder for project documentation, collaborative research writing, and collaborative curriculum brainstorming and redesign.
- A Google Plus Community.
- A project YouTube Channel.
- SeekBeak – VR creation and publication platform.
- A social media hashtag (for example: #mesh360).

The mobile VR ecology of resources provides both a bricolage of community building and nurturing tools for the projects, and provides a rich source of participant-generated artefacts and reflections from both lecturers and students. The mobile EOR supports the design of triggering events for stimulating student discussion and collaboration. In choosing platforms for each element of the framework we have focused upon selecting cross-platform tools that enable a rapid prototyping and development strategy enabling lecturers and students to create and share authentic scenarios quickly and easily. A simple and flexible delivery platform is key to making the project sustainable and affordable, and therefore we have chosen social media platforms such as YouTube and Seekbeak as suitable mobile VR content hosts that do not require any specialised institutional web server, minimises the project IT infrastructure, and provides the opportunity for either private or shared collaboration.

Conclusion

This paper highlights the initial development of virtual reality (VR) simulation of healthcare team handover and details the prototype design stage exploring whether the creation of an authentic virtual experience using mobile VR enhances interprofessional education. We have utilised five design principles to guide the implementation of a design-based research framework. Initial feedback from lecturers in the three discipline contexts of Paramedicine, Nursing, and Physiotherapy has been very positive, and the lecturers have been empowered to create and share their own custom designed mobile VR scenarios using Seekbeak as a rapid prototyping tool. The project has facilitated increased interprofessional collaboration, modelling real world health team interaction. Collaboration with educational researchers has provided a theoretically informed framework to guide the development of these scenarios. The next stages of the project will involve student participation, feedback, and evaluation.

References

Bannan, B., Cook, J., & Pachler, N. (2015). Reconceptualizing design research in the age of mobile learning. *Interactive Learning Environments*, 1-16. doi:10.1080/10494820.2015.1018911

Blaschke, L., & Hase, S. (2015). Heutagogy, Technology, and Lifelong Learning for Professional and Part-Time Learners. In A. Dailey-Hebert & K. S. Dennis (Eds.), *Transformative Perspectives and Processes in Higher Education* (Vol. 6, pp. 75-94): Springer International Publishing.

Burden, K., & Kearney, M. (2016). Conceptualising Authentic Mobile Learning. In D. Churchill, J. Lu, K. F. T. Chiu, & B. Fox (Eds.), *Mobile Learning Design: Theories and Application* (pp. 27-42). Singapore: Springer Singapore.

Bursiek, A.A., Hopkins, M.R., Breitkopf, D.M., Grubbs, P.L., Joswiak, M.E., Klipfel, J.M., Johnson, K.M. (2017). Use of High-Fidelity Simulation to Enhance Interdisciplinary Collaboration and Reduce Patient

Falls. *Journal of Patient Safety, Article in Press.* DOI: 10.1097/PTS.0000000000000277.

Cochrane, T. (2014). Critical success factors for transforming pedagogy with mobile Web 2.0. *British Journal of Educational Technology, 45*(1), 65-82. doi:10.1111/j.1467-8535.2012.01384.x

Cochrane, T. (2016). Mobile VR in Education: From the Fringe to the Mainstream. *International Journal of Mobile and Blended Learning (IJMBL), 8*(4), 45-61. doi:10.4018/IJMBL.2016100104

Cochrane, T., Cook, S., Aiello, S., Christie, D., Sinfield, D., Steagall, M., & Aguayo, C. (2017). A DBR Framework for Designing Mobile Virtual Reality Learning Environments. *Australasian Journal of Educational Technology (AJET), 33*(In Review for Special Issue on Mobile Augmented and Virtual Reality).

Cochrane, T., & Narayan, V. (2016). Principles of modeling COPs for pedagogical change: Lessons learnt from practice 2006 to 2014. In J. McDonald & A. Cater-Steel (Eds.), *Implementing Communities of Practice in Higher Education: Dreamers and Schemers* (Vol. Part IV, pp. 619-643). Singapore: Springer.

Cochrane, T., & Narayan, V. (2017). Design Considerations for Mobile Learning. In C. Reigeluth, B. J. Beatty, & R. Myers (Eds.), *Instructional-Design Theories and Models* (Vol. 4, pp. 385-414). New York: Routledge.

Cook, J., & Santos, P. (2016). Three Phases of Mobile Learning State of the Art and Case of Mobile Help Seeking Tool for the Health Care Sector. In D. Churchill, J. Lu, T. K. F. Chiu, & B. Fox (Eds.), *Mobile Learning Design* (pp. 315-333): Springer Singapore.

Cumin, D., Skilton, C., Weller, J. (2017). Information transfer in multidisciplinary operating room teams: A simulation-based observational study. *BMJ Quality and Safety, 26*(3), 209-216.DOI: 10.1136/bmjqs-2015-005130.

Eberhardt, S. (2014). Improve handoff communication with SBAR. *Nursing2017, 44*(11), 17-20. doi:10.1097/01.nurse.0000454965.49138.79

Fletcher, K. A., Bedwell, W. L., Rosen, M., Catchople, K., & Lazzara, E. (2014). Medical Team Handoffs. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 58*(1), 654-658. doi:doi:10.1177/1541931214581154

Gough, S., Hellaby, M., Jones, N., & MacKinnon, R. (2012). A review of undergraduate interprofessional simulation-based education (IPSE). *Collegian, 19,* 153–170. doi:10.1016/j.colegn.2012.04.004

Hase, S. (2014). An introduction to self-determined learning (Heutagogy). In L. M. Blaschke, C. Kenyon, & S. Hase (Eds.), *Experiences in Self-Determined Learning* (Vol. Paperback and Kindle editions, pp. 1-9): CreateSpace Independent Publishing Platform.

Jacobs, R., Beyer, E., Carter, K. (2017). Interprofessional simulation education designed to teach occupational therapy and nursing students complex patient transfers. *Journal of Interprofessional Education and Practice, 6*,67-70. DOI: 10.1016/j.xjep.2016.12.002.

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology, 20*(14406), 1-17. doi:10.3402/rlt.v20i0.14406

Kopcha, T. J., Schmidt, M. M., & McKenney, S. (2015). Editorial 31(5): Special issue on educational design research (EDR) in post-secondary learning environments. *Australasian Journal of Educational Technology, 31*(5), i-ix. doi:http://dx.doi.org/10.14742/ajet.2903

McKencney, S., & Reeves, T. (2012). *Conducting educational design research*. London: Routledge.

OECD. (2015). *Students, Computers and Learning*. rue André-Pascal, 75775 PARIS: PISA, OECD Publishing.

Reed, D.J.W., Hermelin, R.L., Kennedy, C.S., Sharma, J. (2017).

Interdisciplinary onsite team-based simulation training in the neonatal intensive care unit: A pilot report. Journal of Perinatology, 37(4),461-464. DOI: 10.1038/jp.2016.238.

Reeves, S., Perrier, L., Goldman, J., Freeth, D., & Zwarenstein, M. (2013). Interprofessional education: Effects on practice and healthcare outcomes (update). *Cochrane Database of Systematic Reviews, 13*. Art. No.: CD002213. doi:10.1002/14651854.CD002213.pub3.

Reime, M.H., Johnsgaard, T., Kvam, F.I., Aarflot, M., Engeberg, J.M., Breivik, M., Brattebø, G. (2017). Learning by viewing versus learning by doing: A comparative study of observer and participant experiences during an interprofessional simulation training. *Journal of Interprofessional Care, 31*(1), 51-58. DOI: 10.1080/13561820.2016.1233390.

Shah, D. Y., Alinier, P. G., & Pillay, Y. (2016). Clinical handover between paramedics and emergency department staff: SBAR and IMIST-AMBO acronyms. *International Paramedic Practice, 6*(2), 37-44. doi:10.12968/ippr.2016.6.2.37.

Stow, J., Morphet, J., Griffiths, D., Huggins, C., Morgan, P. (2017). Lessons learned developing and piloting interprofessional handover simulation for paramedic, nursing, and physiotherapy students. *Journal of Interprofessional Care. 31*(1), 132-134, DOI: 10.1080/13561820.2016.1251404.

Thomas, E.M., Rybski, M.F., Apke, T.L., Kegelmeyer, D.A., Kloos, A.D. (2017). An acute interprofessional simulation experience for occupational and physical therapy students: Key findings from a survey study. Journal of Interprofessional Care, 31(3), 317-324. DOI: 10.1080/13561820.2017.1280006.

Thomas, M., Schultz, T., Hannaford, N., & Runciman, W. (2013). Failures in transition: Learning from incidents relating to clinical handover in acute care. *Journal for Healthcare Quality, 35*(3), 49–56. doi:10.1111/j.1945-1474.2011.00189.x.

Wong MC, Yee KC, Turner P. (2008) Clinical Handover Literature Review. eHealth Services Research Group, University of Tasmania, Australia. https://www.safetyandquality.gov.au/wp-content/uploads/2008/01/Clinical-Handover-Literature-Review-for-release.pdf.

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Enhancing the role of pedagogical beliefs in TPACK-based professional development

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Professional development programs that aim to enhance the use of educational technology in higher education have become a priority in many countries. However, educators' pedagogical beliefs may present a barrier to the successful outcomes of these programs and are often overlooked. This paper presents a professional development approach designed to make explicit educators' pedagogical beliefs in regards to educational technology. The outcomes of the study will provide insights into strategies to address educators' beliefs about teaching, learning and students in general, as a launching pad for improvements in practice to occur.

Introduction

Technological advances have greatly influenced the higher education context. Digital systems and tools afford more flexible learning, and offer the potential to actively engage students in the construction of their own knowledge in ways that were previously difficult. But for educational technology to effectively impact the quality of education, it should be used along with "coherent instruction and assessment that supports high quality learning" (Kimberly & Pellegrino, 2007, p. 581). As a result, professional development (PD) programs focused on supporting effective technology integration into teaching practices have received much attention from the research community (Kimberly & Pellegrino, 2007; Parr & Timperley, 2010). In part, this is due to the fact that in higher education, educators have traditionally been employed based on their qualifications as subject matter experts, rather than on sound pedagogical training and experience (Ferman, 2002). Moreover, in Australia, over 50% of university teaching is done by sessional staff (Hamilton, Fox, & McEwan, 2013; May, Strachan, & Peetz, 2013). This highlights the need for comprehensive PD opportunities based on a sound pedagogical basis. There is evidence of a rich diversity of PD approaches and models; yet, the outcomes of such efforts have not always been reported as being effective in changing actual teaching practice (Kandlbinder & Peseta, 2009; Kimberly & Pellegrino, 2007). Some researchers have provided evidence of three main barriers affecting the impact of PD outcomes for technology integration: access to resources, educators' knowledge and skills, as well as their pedagogical attitudes and beliefs (Ertmer et al., 2012). A key question therefore, is how should PD be approached to respond to these barriers? This paper presents a PD approach for technology integration in higher education that focuses particularly on educators' pedagogical attitudes and beliefs. As the implementation of the PD approach is a work in progress, the focus on the paper will be on how previous research studies have informed the design features of the PD approach.

Background and context

The concern with pedagogical beliefs is that if the strategies suggested in a PD activity are inconsistent with educators' preconceptions about teaching, learning, and students in general, they are unlikely to adopt the proposed strategies in their delivery methods (Ertmer, 2005). It is also important to recognize that most of the time, existing pedagogical beliefs are tacit and idiosyncratic (Ertmer, 2005), meaning that educators themselves may not be aware of how their beliefs impact their teaching practice. For this reason, in higher education, it is not uncommon to find that teaching practices often reflect how lecturers were taught themselves. Moreover, when educators use, adapt, or redesign instructional materials, they make decisions based on their practical knowledge and on their beliefs about how a curriculum should be taught and learned (Boschman, McKenney, & Voogt, 2014). Another interesting finding is that educators' enacted beliefs do not always reflect their intentions (Norton et al., 2005). For instance, an educator may believe in the benefits of a student centred approach but in practice may employ a rote learning strategy. These inconsistencies may be due to institutional constraints, attitudinal shortcomings or a lack of appropriate training. Thus, to increase the likelihood of a PD approach being effective, these beliefs should to be made explicit. Ertmer (2005) suggests that a change in beliefs is likely to follow a successful experience, which could be triggered by observing exemplary peers. She also suggests challenging beliefs through extended conversations, participation in communities of practice, access to expert performances, or through ongoing technical and pedagogical support.

In Australia, most universities are appropriately equipped, and educators have a high degree of control over the curriculum of their subjects (Bennett et al., 2011). Moreover, recent theoretical developments have informed approaches to improving educators' knowledge and skills. For instance, Mishra and Koehler (2006) established the Technological Pedagogical Content Knowledge (TPACK) framework, which promotes a holistic approach to technology integration. Due to its comprehensiveness and parsimony, the TPACK framework has been extensively researched and used as a lens to design, implement and evaluate PD programs for educators around the world (Graham, 2011). The authors based their work on Shulman's Pedagogical Content Knowledge framework, and stress that effective integration of educational technology requires a dynamic interrelation of content, pedagogy and technology. In their view, Technological Pedagogical Content Knowledge is represented in exemplary educators that use educational technology as an intrinsic part of their teaching practice.

Initially, Mishra and Koehler (2006) recommended a Learning Technology by Design approach to PD in which lesson planning and subject designs are a collaborative effort between educators and educational designers. The approach blends theory and practice, and takes into consideration the constraints and trade-offs between educators, resources, supports and audience. Since then, the TPACK framework has been utilized in a wide variety of contexts, resulting in a series of suggested approaches for implementation. Harris (2016) conducted a systematic review of the literature, which culminated in a comprehensive overview of eight models and twelve strategies for TPACK based PD for educators. Herring, Meacham, and Mourlam (2016) furthered this work by proposing a model specifically prescribed for higher education. However, what is evident from this research is that even though pedagogical beliefs are recognised as a potential barrier to successful PD outcomes, most of the studies emanating from the TPACK framework do not provide suggestions to directly address educators' pedagogical attitudes and beliefs. One study that addressed this issue was conducted by Rienties, Brouwer and Lygo-Baker (2013), who implemented an approach and reported a positive increase in participants' TPACK competences, but were unsuccessful in influencing the implementation of more student centred approaches, even after participants' pedagogical beliefs were challenged during training. The authors suggested that a limitation of their study was their over reliance on self reported results, and their oversight in measuring the impact on daily teaching practice.

This paper describes the main characteristics of a PD approach that builds on the aforementioned efforts by enhancing the role of pedagogical beliefs in TPACK based PD. The impact of the approach will be assessed using a longitudinal research design, in which a variety of data collection methods are employed. The approach also takes into consideration the link between learning design, evaluation and actual teaching practice.

Method

The main objective of this program of doctoral research is to investigate the impact of the PD approach on educators' pedagogical beliefs in relation to educational technology. In this paper, the discussion is centred on the following research question: what are the salient features that characterise an effective PD approach for technology integration that addresses educators' pedagogical attitudes and beliefs?

The research adopts an iterative design based approach. The current implementation of the approach involves a multi phased mixed methods design. Data collection methods to measure the impact of the PD approach on educators include a pre and post intervention diagnostic survey and document analysis, interviews and confidence logs. Data collection methods to measure student engagement and learning with the subject include a focus group, student satisfaction surveys and statistical data from the learning management system.

The study began with a review of the literature, focused on PD in higher education for in-service, pre-service and sessional staff. To further refine the focus, the analysis centred on studies describing PD programs that support the use of educational technology in teaching practice, with special attention to the ones that addressed pedagogical beliefs and TPACK. A total of 52 studies were identified, resulting in the identification of six broad elements outlining key design features that characterise effective PD programs for educational technology. These six elements are summarized below.

PD elements from the literature

The first element to emerge from the literature is the suggestion to focus on teaching practice. This includes the modelling of effective instructional methods and reducing the gap between theory, research and practice. This element is critical as research shows that a clear emphasis on pedagogical transformation, rather than on technology training, is more likely to have an impact on teacher knowledge and behaviour, and potentially on student learning (Kimberly & Pellegrino, 2007). In the second element, it is recommended that in order to achieve pedagogical transformation, participants should be immersed in a reflection process, supported by continuous feedback. This element includes promoting reflective practice, making explicit pedagogical beliefs, considering participants' needs, providing continuous feedback, and undertaking formative evaluation throughout the intervention.

The third element involves a careful consideration of delivery methods. There is evidence to suggest that PD approaches for educators are most effective when active, reflective, job-embedded, coherent, in depth, longer in length, and link curriculum content to pedagogy (Ferman, 2002; Harris, 2016; Wilson, 2012). The suggestion is to design PD activities with the objective to deliver a combination of know-how and know-why that directly respond to participants' curricular needs. To compliment this, the fourth element regards a careful selection of the technical infrastructure. This includes, for example, using a website to disseminate training materials, modelling the use of social networking to create virtual learning communities, and making sure the selection of digital tools are reliable and easy to access.

Taking into consideration organizational culture is another relevant element to consider. This includes ensuring the PD effort is perceived as quality enhancement rather than quality management, aligning activities to national and institutional standards, engaging stakeholders in developing a shared vision, and creating a safe space to discuss practice. This also involves taking into consideration the constraints of accountability, the incentives for participation, and providing ongoing support.

The last element identified is collaboration. This can occur between educators and educational designers, amongst educators in the form of peer review of teaching, mentoring or coaching, or in the form of participation in communities of practice. This element is relevant for evidence points to collaboration between educators and an educational designer or a mentor as most impactful on teaching practice, and to participation in communities of practice as conducive to sustaining outcomes in the long term (Wilson, 2012).

Implementation of the elements in the PD approach

To address the element of organizational culture, participation in this PD approach is voluntary, confidential and flexibly scheduled around participants' time availability. The head of teaching and learning of each faculty at the university is notified of the initiative and an advertisement is posted on staff newsletters inviting educators to participate. In total, participation in this PD amounts to a minimum of five and a half hours over the course of a semester to provide ongoing support.

To ensure a focus on teaching practice, it is necessary to first become familiar with the teaching approach of each participant. An initial welcome email is sent out requesting participants to fill out a diagnostic of competences survey, which is based on Schmidt et al.'s (2009) *TPACK Assessment Instrument for Pre-service Teachers* and Norton et al.'s (2005) *Beliefs and Intentions Questionnaire*. The results of this diagnostic are useful means to challenge participants' pedagogical beliefs, and enable the PD activities to be aligned to participants' competence and prior knowledge. These results also serve as a starting point to evaluate the impact of the intervention on participants' teaching practice. Furthermore, participants are requested to send their instructional materials for an initial document analysis. This enables a further understanding of participants' subject matter and curriculum. The analysis also allows the researcher to come up with strategic improvements to the instructional materials and to structure delivery methods around the modelling of specific instructional strategies linked directly to each participant's curricular needs.

The first encounter with participants is based on a semi-structured interview designed to trigger a reflection process. The results of the diagnostic are discussed, and participants are challenged to explore how their own student experiences impact their instructional decisions and teaching practice. This is also an opportunity to guide participants to identify their own needs. The initial, mid-program and final interviews in this approach are implementation instruments focused on exposing participants' pedagogical beliefs.

To address the elements of collaboration and delivery methods, this approach is based on a maximum of 12 design consultations. These are one hour-long meetings scheduled throughout the semester with the objective of redesigning instructional materials in collaboration. Mishra and Koehler's (2006) TPACK framework and the Learning Technology by Design Approach are used as guiding principles. Design consultations allow for extended discussions on how pedagogical strategies can increase student learning, and on how educational technology can facilitate engagement with the curriculum. These discussions also serve to further challenge pedagogical beliefs, to evaluate instructional methods throughout the implementation of the subject and to provide continuous feedback on learning designs. Each design consultation is structured to culminate in the creation of a product (i.e. activities, assessments, supports or resources). Moreover, as part of the technical infrastructure, a website was created to support the delivery methods. This website contains information on learning theory, links to resources and videos of expert performances. It also includes design blueprints and activities created to scaffold participants' design thinking and process.

At the end of the semester, a focus group with students is held to gather their perceptions of the quality of teaching and the impact of instructional strategies on their learning. Results from the focus groups are discussed during the final design consultation, which involves a summative evaluation of the subject. To finalise the implementation, participants are requested to fill out the diagnostic survey once again, and send their instructional materials for a pre and post document analysis. The last encounter with participants involves a final interview aimed to gather self-reported improvements in competence and pedagogical beliefs, as well as final comments on participant's satisfaction with the PD approach.

Discussion and future directions

This paper presents the main characteristics of a PD approach designed to address educators' pedagogical beliefs in TPACK based PD. In recognising that educators' beliefs need to be made explicit to ensure successful outcomes, the design of this approach attempts to integrate a reflection process for participants to better understand their teaching practice. In the first iteration there were two case studies, but preliminary findings from the first case provide evidence of an improvement in TPACK competences and confidence, an increase in student centred beliefs, which are reflected in the learning designs. However, there is also an increase in teacher centred perspectives, given that educators are more aware of how their instructional decisions, actions and learning designs impact their students learning.

References

Bennett, S., Thomas, L., Agostinho, S., Lockyer, L., Jones, J., & Harper, B. (2011). Understanding the design context for Australian university teachers: implications for the future of learning design. *Learning, Media and Technology, 36*(2), 151-167.

Boschman, F., McKenney, S., & Voogt, J. (2014). Understanding decision making in teachers' curriculum design approaches. *Educational Technology Research and Development, 62*(4), 393-416.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for Technology Integration?. *Educational Technology Research and Development, 53*(4), 25-40.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: a critical relationship. *Computers & Education, 59*(2), 423-435.

Ferman, T. (2002). Academic professional development practice: What lecturers find valuable. *International Journal for Academic Development, 7*(2), 146.

Graham, C. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education, 57*(3), 1953-1960.

Hamilton, J., Fox, M., & McEwan, M. (2013). Sessional academic success: a distributed framework for academic support and development. *Journal of University Teaching & Learning Practice, 10*(3), 1-16.

Harris, J. (2016). In-service teacher's TPACK development: trends, models and trajectories. In P. Mishra, M. J. Koehler, & M. C. Herring (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators* (Second edition, pp. 191-205). New York: Routledge.

Herring, M. C., Meacham, S., & Mourlam, D. (2016). TPACK development in higher education. In P. Mishra, M. J. Koehler, & M. C. Herring (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators* (Second edition, pp. 207-223). New York: Routledge.

Kandlbinder, P., & Peseta, T. (2009). Key concepts in postgraduate certificates in higher education teaching and learning in Australasia and the United Kingdom. *International Journal for Academic Development, 14*(1), 19-31.

Kimberly, A. L., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research, 77(4)* 575.

May, R., Strachan, G., & Peetz, D. (2013). Workforce development and renewal in Australian universities and the management of casual academic staff. *Journal of University Teaching and Learning Practice, 10*(3).

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017.

Norton, L., Richardson, J. T. E., Hartley, J., Newstead, S., & Mayes, J. (2005). Teachers' beliefs and intentions concerning teaching. *Higher Education,* 50(4) 537.

Parr, J. M., & Timperley, H. S. (2010). Multiple "black boxes": Inquiry into learning within a professional development project. *Improving Schools, 13*(2), 158-171.

Rienties, B., Brouwer, N., & Lygo-Baker, S. (2013). The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology. *Teaching and Teacher Education: An International Journal of Research and Studies, 29*, 122-131.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*(2), 123.

Wilson, A. (2012). Effective professional development for e-Learning: What do the managers think?. *British Journal of Educational Technology, 43*(6), 892-900.

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Understanding students' views on feedback to inform the development of technology-supported feedback systems

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In an increasingly expanding higher education system, students have routinely said that they don't get enough access to feedback to support their learning. While this feedback loop is recognised as a critical issue, the growing use of technology as part of teaching and learning could provide some solutions to this problem. The emergence of the field of learning analytics has the potential to provide mechanisms for reducing some of the concerns students have about receiving feedback. However, a greater understanding of how learning analytics can be used to provide meaningful assessment feedback to students is needed. This paper presents the initial findings from a study that investigated students' preferences for the delivery of assessment feedback to improve their learning. The findings show that there is a diversity of student perspectives on what feedback is most useful for their learning which is influenced by the type of assessment, the discipline in which the assessment takes place, the year level of the student and the ability to compare performance to others. The outcomes of this study provide evidence of what students want when it comes to analytics-based feedback which can be used to inform the development of guidelines for how such feedback can be designed and delivered in higher education.

Introduction

There are many ways that technology can be used when providing feedback to students. Recently new developments, often based on learning analytics, are being developed in order to be able to provide better and more personalised feedback to students in higher education. These technology-supported feedback systems may focus on a single assessment/task, or may offer a high-level view of engagement and/or performance across several assessments/tasks. The use of dashboards is becoming increasing popular to deliver this form of feedback, especially as part of learning management systems. The emergence of such tools for feedback delivery provide new opportunities to represent feedback in meaningful ways for students, but in order for this to occur the design needs to be based on established understandings of the principles of effective feedback.

While there is an existing, extensive array of literature exploring what constitutes effective feedback for student learning, there has been less consideration of how this feedback could be delivered through technology-based tools such as dashboards. Instead questions have been raised about the design and impact of these forms of feedback representation can have on students' motivation and approaches to study (Corrin & de Barba, 2014; Teasley, 2017). Additionally, most studies of students' perceptions of feedback are often conducted at a single point in time, requiring students to reflect on a single, specific assessment type or on feedback in a fairly general sense. There are very few studies that adopt a sustained approach to understand students' feedback preferences over time. In order to be able to develop effective technology-supported feedback systems we need to understand not only what students want and value - but how this changes and evolves over time. This paper reports on a study that seeks to explore students' perspectives on feedback across assessment types and time to inform how technology can be used to support the provision of feedback most effectively.

Background

Feedback is defined as "information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding" (Hattie & Timperley, 2007, p.81). The importance of feedback for student learning has long been recognised (Black & Wiliam, 1998). One critical aspect of the link between feedback and improved learning outcomes is students' ability to self-regulate their learning. High-achieving students use feedback as a catalyst for their self-regulatory processes (Butler & Winne, 1995). That is, these students are able to use feedback to assist them in setting goals, selecting the most appropriate learning strategies to use, monitoring their own learning progress, and adapting to the learning tasks and activities they face (Pintrich, 2000).

However, while feedback is viewed as a valuable element of student learning, there have long been concerns over how useful students perceive the feedback they receive to be on their learning (Price, Handley, Miller & O'Donovan, 2010; Rowe & Wood, 2008). Recently, a large, cross-institutional study conducted in Australia (Baik, Naylor & Arkoudis, 2015) found that only 56% of surveyed students (n = 1,739) were satisfied with the usefulness of feedback given by their teachers. These findings clearly indicate there is room for improvement in relation to feedback practices in higher education so that students feel they are receiving adequate feedback on their learning.

Researchers suggest that it is not simply a matter of providing more feedback to students. Hattie and Timperley (2007) indicate "it is necessary to consider the nature of the feedback, the timing, and how a student 'receives' this feedback" (p. 101). Boud and colleagues (2010) suggest specific information that can help students to improve the quality of their work needs to be provided, not just a mark or grade. Moreover, students often regard the *personal* nature of feedback from lecturers and tutors as particularly valuable (Pokorny & Pickford, 2010).

The study reported in this paper was designed to build on the findings of previous feedback research by investigating a greater level of detail about the types, format and timing of assessment feedback as it relates to personal analytics. By personal analytics we refer to information that is customised and delivered to students about their own performance and activity through technology. The study was undertaken across a whole semester to gauge what assessment feedback would be useful at particular points in time. It focused on the meaningful ways assessment data can be presented to students so that they can modify their study approaches to enhance learning outcomes.

Method

The study was guided by the following questions: (1) What type of feedback do students want to receive? (2) At what level of granularity do they want this feedback? (3) What form do they want this feedback to take? (4) When would they like to receive the feedback? and (5) How often would they like to receive feedback? The findings presented in this paper relate primarily to the first two of these questions. A multiple case study approach was adopted including a sample of 30 students recruited from across different disciplines and undergraduate year levels at the University of Melbourne. This diverse sample enabled the examination of any differences in students' perspectives of the type and usefulness of feedback across the different stages of study. The participants were asked to participate in four interviews at different points throughout the semester. The first interview investigated students' initial definitions and expectations regarding the provision of feedback on their learning. In subsequent interviews, we explored how these perceptions and expectations changed over the course of the semester within the context of the types of assessments participants were undertaking and feedback they had received. Case summaries were prepared for each participant bringing together the main themes and elements of each individual case. A cross-case analysis was then conducted to identify the emerging themes that are presented in this paper.

Findings and discussion

In this work-in-progress paper, we present the emerging findings from the study which focus on four main themes: (1) the inconsistent understanding of what feedback is; (2) the differences in perspectives on feedback across different year levels; (3) the feedback for different types of assessment designs across different disciplines; and (4) the ability of students to compare their assessment performance with others or to a particular standard. Each of these themes will be considered in more detail below.

Students' understanding of feedback

There was diversity across the understandings about what constituted feedback among the student participants. While many focused on the output of a mark or grade, others highlighted the comments provided on written work or the provision of the correct answers and related justification to multiple choice tests. When talking to students at the beginning of semester to find out what they would like to receive in the future, many students expressed a preference for face-to-face discussions with teachers to go through the exact issues with their individual work (e.g. one student requested: "I wish that there is a period both before and after the essay that the tutors or lecturers will be open to students so that the student ... could discuss the problem with [their] essay" (S02)). Alternatively, students tended to request feedback of the kind they had received and liked most recently in previous educational settings/semesters. Interestingly, a large proportion of students requested feedback on their progress through assessment tasks in the semester - a way to track what they had completed so far and what was still to come.

Early in semester students commonly wanted clarification related to the assessment design and expectations, prior to submission, rather than just results at the end. In the context of self-regulated learning this relates to the concept of task interpretation (Butler & Winne, 1995). Students wanted pre-task feedback to understand the expectations of the task. For example, one student suggested "if they could do practice questions [that] would allow us to observe how they want us to write and how they want us to structure the answer, so that we can write an answer they want to see" (S03). A few students also requested past exam papers or exemplars of student work so that they could understand the way a particular teacher wanted the assessment to be completed.

Over the period of the semester requests for assistance with task interpretation often expanded into requests for changes to assessment design to allow for more frequent feedback opportunities. For example, a larger task being split into smaller ones on which the students would receive feedback to feed into the next part. This was common among those students who had a large number of assessment tasks that had submission dates towards the end of the semester. These students were concerned about submitting such a substantial assessment piece without a clear sense of whether they had fully understood the task requirements. The issue of providing feedback on task preparation is an interesting one for designers of assessment feedback systems. It is common for tools such as dashboards to focus on the outcomes of completed assessments, but less emphasis has been placed on ways to build in support for task interpretation and progress. It is possible that learning analytics could be used to provide pre-assessment feedback by presenting summaries of previous cohorts' feedback. The provision of pre-assessment support can also be built into the learning design of assessment activities and factored into how these activities are represented in the LMS.

Feedback perspectives across year levels

Students from different year levels reported various needs and strategies to get feedback during the semester. First-year students mentioned their previous experience in high-school as their benchmark on what to expect to how they would receive feedback in university. For example, one first year student mentioned "Maybe we could have smaller tests or I don't know because I'm used to high-school topic tests" (S06). By the end of the semester, first year students mentioned they were satisfied with some of the feedback received, although it did not often include face-to-face time with teaching staff. They also noticed the need to be more proactive in order to get feedback in subjects with large cohorts. This involved interacting with peers and looking up for extra resources to receive feedback rather than solely relying on teaching staff. On the other hand, the majority of third year students reported from the outset that their strategies to get feedback during the semester revolved around their peers and the curriculum, rather than only on teaching staff. This included strategies such as participating in study groups, peer review processes, and accessing past exams. For example, one student stated about participating in a peer review process: "I was able to see a student who was above me and what they had done and what they had included and I was able to look at mine and think oh ok, so if I had done that, I could've made this much better" (S10). Face-to-face time with teaching staff was mainly perceived as a last resource for feedback provision.

Overall, these preliminary findings suggest that across their undergraduate years students move from a position where they expect to receive one-on-one feedback mainly from teachers (and initiated by teachers themselves), to a position where they create their own opportunities for feedback, relying mainly on their peers and resources rather than on the teaching staff. From a self-regulated learning perspective, this means students are being required to adjust their strategies to seek help and learn from their peers to fit into a new learning context (Pintrich, 2000). Consideration for how assessment and feedback can been designed to better support this transition is important, especially in relation to how technology may play a role in supporting large classes in earlier years at university. For example, personalised tips could be built into feedback representations (e.g. dashboards) to suggest additional or alternative ways that feedback can be sought if students feel that what they have been provided with is insufficient.

Different types of assessment across disciplines

Not surprisingly, it was quite common that different assessment types were favoured in different disciplines. Some disciplines had very similar patterns of mid-semester and final exams (science/business) or mid-semester and final essays (Arts). Of course, there were exceptions to these patterns within these faculties, where different assessments were incorporated to match the content of particular subjects or as an initiative of an innovative teacher. Overall the variety of assessment designs was quite extensive across all 30 student participants. A theme that emerged across a large number of student cases was that there was sometimes a lack of alignment between the assessment tasks throughout the semester and the final assessment. Students comments on this in relation to their response to feedback as they were less likely to engage with feedback given if it had little impact on the final assessment.

A feature of the University in which this study took place is the requirement that students undertake a subject each semester from a discipline outside their major discipline. While this exposes students to a broader range of content, it also exposes them to a broader range of assessment types. When talking about the assessments they were required to do in their non-core subjects, students tended to ask for more guidance on the requirements and expectations for the task prior to submission. They were also faster to justify lower results in these subjects as an outcome of their lack of familiarity with the assessment design. The ability of students to move between disciplines, and sometimes even between institutions, is increasing in the higher education environment and this too must be taken into consideration when developing feedback systems that can cater for a vast array of assessment designs. Potentially this may require the design of different methods of support for students who have different levels of familiarity with assessment types common to core vs. elective subjects.

Comparison of assessment feedback with peers and/or a standard

A common theme across most cases was students' request for feedback that would allow them to compare their performance with their peers. However, students were somewhat ambivalent about how effective that comparison would be to help improve their learning. Some students perceived comparison with peers a way to feel better about their own performance. For example, one student said "some assessments may be harder than others. And if you, say, had a very difficult lab as your first lab, and you have multiple labs, then you might bring your confidence down, unless you knew that other people also had trouble, so at least I'm on their level" (S03). Others mentioned the negative impact this would have in their motivation if their grade was much lower than the class average. Another student raised concerns about the potential promotion of competition amongst peers, which could be detrimental to students' collaborative relationships. An alternative a few students raised to deal with the disadvantages of comparing students with their peers was for group level feedback to be delivered to the whole class. According to one student, a presentation at the beginning of a lecture or tutorial highlighting points of the assignment that most of the class went well or that needs improvement should be enough to allow him/her to identify where he/she sits in comparison to peers and what he/she needed to do to keep up with the class.

A few students mentioned that rather than comparing their results with their peers, they wanted to receive feedback that provided them comparison with predetermined standards. This includes, for example, providing exemplar answers to open-ended questions. As one student said, "that way I can pinpoint what I can focus on because looking at the questions and answers back I can see what I would be thinking at the time that I was going through the steps and if I agree or disagree or find some sort of mistake in my thinking" (S03). In this way, students would be able to use these materials as a source of formative feedback when preparing for their assignments. The literature, to date, has not provided any definitive answers about the best method for offering comparisons as an element of feedback. How this could be incorporated in technology-support feedback systems and the extent that students could potentially choose their preferred standard are challenges still to be addressed. Although the benefit of providing a standard to assist students in monitoring their learning has been identified as an important element in support students' self-regulation of learning (Butler & Winne, 1995; Pintrich, 2000).

Conclusion

From the outcomes of this study so far, the wide variety of perspectives on feedback and preferences for how and when it is delivered confirms the difficulty of being able to develop a "one-size-fits-all" feedback system (Teasley, 2017). Not only do preferences vary across assessment types, but the expectations of feedback evolve over time as students progress through their studies. While this doesn't mean that systems such as dashboards can't be used for feedback delivery, it does mean that important design decisions need to be made in order for such tools to provide flexibility and benefits to students learning. The impact of assessment design on representations of feedback needs to be reflected in the design of any technology-support feedback tools. While there has been recognition of the role of learning design in teachers' interpretation of learning analytics data (Bakharia et al., 2016), more needs to be understood about how students can be supported to match the designs of their assessments with the feedback provided. It was clear from this study that while some students were able to use their understanding of the assessment design and purpose to interpret feedback and transform this into future actions, others struggled to make this connection. A better understanding of this relationship could inform alternatives to improve assessment feedback delivery to students.

The emerging themes presented in this paper demonstrate the complexity of designing and delivering effective feedback to support student learning. It is important to note that decisions around feedback provision shouldn't be based only on what students want. Teachers have a responsibility to determine when feedback is necessary to support learning and how this can be delivered in a way that it is received by students (Hattie & Timperley, 2007). Consideration of the tensions between assessment design and learning practices is also necessary to ensure that what is assessed and how it is assessed aligns with the learning outcomes. While this research was undertaken at a single institution, the data gathered on students' perceptions of feedback can be transferable across the higher education context. It is hoped that the outcomes of the broader study can be used by universities to inform institutional learning analytics initiatives around student feedback and/or tool development. The diverse findings highlight that there are many factors that require further consideration in order to design effective personal analytics solutions for students.

References

Baik, C., Naylor, R., & Arkoudis, S. (2015). *The First Year Experience in Australian Universities: Findings from Two Decades, 1994-2014*. Melbourne, Australia: Melbourne Centre for the Study of Higher Education, University of Melbourne.

Black, P. & Wiliam, D. (1998). Assessment and Classroom Learning. *Assessment in Education, 5*(1), 7-74.

Boud, D. and Associates (2010). *Assessment 2020: Seven propositions for assessment reform in higher education*. Sydney: Australian Learning and Teaching Council.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65*(3), 245-281.

Corrin, L., & de Barba, P. (2014). Exploring students' interpretation of feedback delivered through learning analytics dashboards. In B. Hegarty, J. McDonald, & S.-K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology. Proceedings Ascilite Dunedin 2014* (pp. 629-633).

Hattie, J. & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research, 77*(1), 81-112.

Pintrich, P. R. (2000). The Role of Goal Orientation in Self-Regulated Learning. In M. Boekaerts, M. Zeidner & P. R. Pintrich (Eds.), *Handbook of self-regulation* (pp. 451-501): San Diego, CA: Academic Press.

Pokorny, H., & Pickford, P. (2010). Complexity, cues and relationships: Student perceptions of feedback. *Active Learning in Higher Education, 11*(1), 21-30.

Price, M., Handley, K., Millar, J., & O'Donovan, B. (2010). Feedback: all that effort, but what's the effect? *Assessment & Evaluation in Higher Education, 35*(3), 277-289.

Rowe, A. D., & Wood, L.N. (2008). Student Perceptions and Preferences for Feedback. *Asian Social Science, 4*(3), 78-88.

Teasley, S. D. (2017). Student Facing Dashboards: One Size Fits All?. *Technology, Knowledge and Learning*, doi: 10.1007/s10758-017-9314-3.

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Visualising mixed reality simulation for multiple users

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Blended reality seeks to encourage co-presence in the classroom, blending student experience across virtual and physical worlds. In a similar way, Mixed Reality, a continuum between virtual and real environments, is now allowing learners to work in both the physical and the digital world simultaneously, especially when combined with an immersive headset experience. This experience provides innovative new experiences for learning, but faces the challenge that most of these experiences are single user, leaving others outside the new environment. The question therefore becomes, how can a mixed reality simulation be experienced by multiple users, and how can we present that simulation effectively to users to create a true blended reality environment? This paper proposes a study that uses existing screen production research into the user and spectator to produce a mixed reality simulation suitable for multiple users. A research method using Design Based Research is also presented to assess the usability of the approach.

Introduction

Blended reality collaborative learning environments strive to enhance learning through embodied co-presence in the classroom, allowing multiple learners to interact within one blended (physical and virtual) space (Bower, Cram, & Groom, 2010). Work to date in this area has looked in detail at how participants have collaborated across physical and virtual worlds, with promising results looking at the best practice to achieve this synchronicity, despite difficulties occurring in areas such as facilitating effective communication, enabling productive co-creation and establishing a sense of co-presence between virtual and physical participants (Bower, Lee & Dalgarno, 2016).

However, to date there has been limited research into how this concept of blended reality would fit into a situation involving multiple participants using mixed reality (MR) devices to experience the same digital reality simultaneously. This is important, because whilst mixed reality is having a resurgence in the literature, these experiences are often physically located within a space, complex to setup and individually focussed. Because of this, a single user at a time experiences the simulation, while other users are *stuck on the outside*, watching, unable to embody what the main user is fully experiencing (Loomis, 2016). Hence, a challenge presents itself, how can a method be developed that allows multiple users (located in a single space both physically and virtually) to experience this learning method simultaneously using currently available commercial technology, creating a true blended reality that uses mixed reality in the same physical space?

This paper will explore the use of new techniques in producing effective mobile mixed reality simulations that work to provide users with a true simultaneous mixed reality experience. Specifically, it will look at how the use of an in-headset view can be combined effectively amongst multiple users to produce a clearer idea of how the mixed reality intervention operates, proposing an experimental and research design to test various views of this concept and looking to answer the research question "How can a mixed reality simulation be experienced effectively by multiple users simultaneously?"

Background literature

Technologies such as 3D printing (3DP), augmented reality (AR), virtual reality (VR) and mobile bring your own devices (BYOD) have emerged as innovative technologies to assist learners (Adams et al., 2017). Similarly, the term mixed reality (MR) has become more popular as a mechanism to provide a framework to position these new technologies across real and virtual worlds (Milgram and Kishino 1994). This has resulted in the development of new paradigms, tools, techniques, and instrumentation that allow for immersive visualisations at different and multiple scales, and the design and implementation of comparative mixed reality pedagogy across multiple disciplines (Magana, 2014). More recently, researchers have started to explore the connections between these technologies to greater enhance learning through the affordances of each of these technologies in combination (Cowling, Tanenbaum, Birt & Tanenbaum, 2017). At the same time, researchers have continued to look at how the digital and physical worlds can be combined, and how students can work effectively in these worlds simultaneously in the form of blended reality (Bernard, 2014). This work builds on the work of Moreno & Mayer (2007) and Mayer (2014) that looked at how multiple forms of modality (in this case pictures and text) could be combined to provide a more cohesive environment. It also builds on work by Ainsworth (2014) that looked at ways to use multimedia environments for discovery learning.

Specifically, work by Bower, Lee & Dalgarno (2016) looked at how these new digital and physical environments could become true blended reality collaborative environments, bringing together participants in augmented reality spaces and allowing them to interact. This work found that whilst there were technological and logistical challenges, the technology did work towards communication, collaboration, and co-presence. However, it did acknowledge that the technology as implemented in the pilot study did maintain a hard distinction between the physical and the virtual environment, and required users to switch between communicating across and within spaces.

This hard distinction makes it difficult for current blended reality work to be applied to immersive mixed reality systems. Specifically, as noted previously, once a user puts on a headset, they are immersed in an individual world, and spectators are left on the outside (Loomis, 2016). Work has been done in this area in other disciplines, with Lukosch, Billinghurst, Alem, & Kiyokawa (2015) reporting on successful studies in product design, maintenance and factory planning. Billinghurst, Clark & Lee (2014) also note the use of collaboration systems in research contexts in mixed reality. However, little work appears to have been done on the use of co-presence mixed reality simulations in an educational environment for collaborative problem solving, skills development and training.

This raises the question, as education moves towards a multimodal pedagogy of online and face to face learning, and given the individual nature of mixed reality technology, how do we effectively produce a mixed reality experience for multiple users that blends the physical and virtual classroom? In this space, the field of screen production, and particularly research into new modes of screen production has the potential to help provide some answers to this problem. Berry (2016) uses the theory of Ingold's (2008) zones of entanglement to explain that mobile devices provide us with an environment which surrounds the organism. She argues that these notions provide alternative and useful ways to explore and reflect upon how this new participatory culture and creative vernaculars penetrate our everyday lives, as well as dynamic adjustment to our social and routine practices. Drawing on the work of Creswell (2011), Berry (2016) argues that this change is part of a larger push towards mobility and movement and will only increase in the future.

Looking at MR and the growth of mobile MR, it's clear that these concepts apply even more strongly to the immersive world created in a MR context. And yet, as noted, it is difficult for mixed reality to present any more than a single user experience. Drawing on the view of Kerrigan (2016), it's clear that the role of spectator in the mixed reality space is yet to be well defined, and that they are not a part of the filmic reality when developing mixed reality simulations. A possible solution to this problem is presented by Kerrigan (2016), through the *Systems View of Creative Practices*. Using this framework, the role of the agent that participates in the simulation can be reframed to include somebody who poses simultaneously as both a user and a spectator. In this way, the roles become deeply interconnected, and the developer can work with this new type of agent in mind.

In practice, for mixed reality, this therefore gives us a way forward to develop mixed reality screen production that considers both the active user and the spectator. By embodying the new agent as described by Kerrigan (2016), and incorporating the work of Berry (2016) as well as the overarching theory of zone of entanglement as outlined by Ingold (2008), the developer can create a simulation that provides insight for both participant and spectator. The next section will explain how an intervention could be designed with these principles in mind.

Experimental design

Previous work by the authors piloted an approach to asynchronous multi-user mixed reality that can be used to ground this experiment. As detailed in (Birt, Moore & Cowling, 2017), a mixed reality implementation was conducted in paramedic science involving 3d printed tools and an augmented reality app. In addition to being provided with these components, students were also provided with a video explaining how to conduct the simulation. Following the theory laid out by Kerrigan (2016), this video was constructed for students using integrated knowledge of both the spectator and the user view. In practice, this meant showing students both views simultaneously using a picture-in-picture style screen production method.

Imagery from this video tutorial is shown in Figure 1. Sample videos can also be found on youtube at the following link (http://youtu.be/wIfwZFKlSQU). Students were shown how the whole procedure could be conducted from both the spectator view and the user view, and were then asked in surveys after the intervention how this helped with their learning. Response from students was that they felt the video was useful (with 95% of students that used the simulation indicating that the video was helpful), but data was not collected on their specific perception of the mixed reality tutorial video.

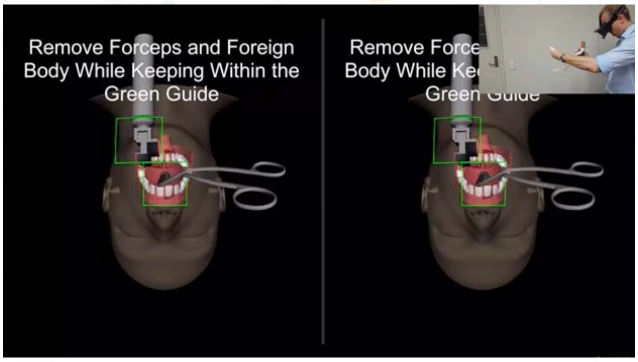

Figure 1: Screen Production of Student Tutorial Showing Combined Spectator and User Views

However, this view, whilst useful for confirming the spectator-user combination, does not allow for a true collaborative mixed reality experience, where agents can transition seamlessly from a user context to a spectator context as required to work with the simulation. Further, it does not show whether there is value in this type of true collaborative simulation in the classroom, as opposed to a view similar to that presented above.

For this reason, a further experiment in multi-user mixed reality is being proposed. Using existing mobile mixed reality hardware similar to that presented in the previous trial, five views will be constructed and presented to participants. Based on the previous screen production research identified, these views will all involve a single user and multiple spectators, and will comprise:

1. Multiple Spectators via non-immersive POV: In this view, a single user will wear the headset to complete a simple task, with other users viewing what they see (their Point-of-View or POV) on a standard screen. This represents the baseline usual representation of how multiple users experience a mixed reality simulation – via an external 2D view from the user's perspective.
2. Multiple Spectators via immersive POV: In this view, the single user view will be replicated into other immersive stereoscopic headsets worn by the other participants. Spectators will not be able to manipulate the simulation, but will be able to see it from a first person POV but with depth. Previous work has indicated that this view might cause motion sickness and disorientation for spectators as they have no control over their view or actions (Suma, 2010).
3. Multiple Spectators with POV and PiP: Replicating the previous study, this view will show spectators both a POV for the mixed reality user, as well as an in-set non-enhanced picture-in-picture (PiP) view of the user from a second spectator-style angle.
4. Multiple Spectators with non-immersive third-person view: Working to enhance the PiP approach, this view will incorporate a third-person view of the mixed reality user enhanced with digital objects from the mixed reality simulation. Rather than showing POV for this user, spectators will be able to view the conducted simulation in third-person view through a screen.
5. Multiple Spectators with immersive third-person view: As per option 4 above, this view will give the spectator a third-person viewpoint. However, rather than a screen, it will use existing stereoscopic immersive mobile mixed reality hardware. This is expected to be the most immersive experience for the participants of the options given.

For each of these described views, a user will be asked to perform a simple mixed reality task, with participants viewing under each of these conditions. Details of the research method used during this experiment and data collected is provided in the next section.

Research method

The theoretical framework underpinning this work is design-based research (DBR) methodology (Anderson & Shattuck, 2012), with an underlying action research mentality (Kemmis, McTaggart, & Nixon, 2014) implemented in the conduct of the research in the classroom. Specifically, the four steps of the DBR methodology will be followed through the first loop analysis of the problem and design of the current simulation solution (as detailed in the section above), and then an evaluation will be conducted by several industry experts. This first loop will be followed by the proposed second loop pilot study that will involve an iterative implementation of the new solution using the feedback from the first loop experts and delivered into the classroom by a discipline expert practitioner positioned to evaluate the effectiveness of the solution who will provide detailed feedback on the re-design from the student stakeholder perspective. This will then result in a loop back for design refinement and further iterative testing and evaluation.

Participants will be shown a demonstration as both users and spectators in each of these views, and for each view will be asked to complete a survey to assess the effectiveness of the tool. Categories were developed for both the observation as well as the data collection for surveys. These are based on previous work conducted by one of the authors (Birt & Horvoka, 2014). For the second loop, an undergraduate class at the lead authors institution will be recruited as per the studies ethics to perform the testing. Specifically, a small sample of students (*n <= 30*) will be selected for this initial student usability test in line with common first phase software usability testing practice (Nielsen, 2012), so that it would be possible for a single research assistant to interact with these students in depth and collect rich feedback on their use of the tool. Data from these loops will then be analysed and used in a DBR process to assess and refine the prototype. Future testing of the system in the classroom will then be conducted to determine which multi-user mixed reality can most effectively be used for learning.

Conclusion

Mixed reality is a new and growing area. In addition to challenges related to how mixed reality can be used to improve pedagogy and skills development, screen production challenges also exist on how this experience can be made accessible to multiple users, both synchronously and asynchronously. This paper has provided some insight into how these challenges might be addressed, proposing a research and experimental design seeking to answer the research question “How can a mixed reality simulation be experienced effectively by multiple users simultaneously?”. Specifically, a methodology involving simultaneous viewing of the mixed reality experience from both the spectator and user view is proposed, and a research design based on Design Based Research has been proposed to test this approach.

Future work will look at how this approach can be extended to more complex synchronous mixed reality experiences. In particular, thought will be given to how multiple users within mixed reality can be given a seamless mixed reality experience, and how their perception of their role as spectator or user effects their ability to interact in this context. This will require connection between mixed reality devices as well as a clear understanding of the zone of entanglement, or environment which surrounds the organism, as outlined by Ingold (2008).

References

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher, 41*(1), 16-25. doi:10.3102/0013189X11428813

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., and Ananthanarayanan, V. (2017). *NMC Horizon Report: 2017 Higher Education Edition*. Austin, Texas: The New Media Consortium. Retrieved from: http://cdn.nmc.org/media/2017-nmc-horizon-report-he-EN.pdf.

Ainsworth, S. (2014). The Guided Discovery Learning Principle in Multimedia Learning. Chapter. In *The Cambridge Handbook of Multimedia Learning*, edited by Richard E. Mayer, 2nd ed., 464–86. Cambridge Handbooks in Psychology. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139547369.024.

Bernard, R. M., Borokhovski, E., Schmid, R. F., Tamim, R. M., & Abrami, P. C. (2014). A meta-analysis of blended learning and technology use in higher education: from the general to the applied. *Journal of Computing in Higher Education*, *26*(1),87-122. doi:10.1007/s12528-013-9077-3.

Berry, M. (2016). Out in the open: locating new vernacular practices with smartphone cameras, *Studies in Australasian Cinema*, 10 (1): 53-64. doi: 10.1080/17503175.2015.1084173.

Billinghurst, M., Clark, A. & Lee, G. (2014) *A Survey of Augmented Reality*. Foundations and Trends in Human-Computer Interaction, 8(2-3): 73–272.

Birt, J. & Horvoka, D. (2014). Effect of mixed media visualization on learner perceptions and outcomes. *Proceedings of the 25th Australasian Conference on Information Systems, Auckland, New Zealand.* doi:10292/8097

Birt, J., Moore, E., & Cowling, M. (2017, April). Piloting mobile mixed reality simulation in paramedic distance education. *Paper presented at 5th IEEE Conference on Serious Games and Applications for Health. Perth, Western Australia*. Retrieved from http://epublications.bond.edu.au/fsd_papers/491/

Bower, M., Lee, M. J., & Dalgarno, B. (2016). Collaborative learning across physical and virtual worlds: Factors supporting and constraining learners in a blended reality environment. *British Journal of Educational Technology*. 48: 407–430. doi:10.1111/bjet.12435

Bower, M., Cram, A., & Groom, D. (2010). Blended reality: Issues and potentials in combining virtual worlds and face-to-face classes. *Curriculum, technology & transformation for an unknown future. Proceedings of ASCILITE 2010, Sydney*, Australia. 129-140.

Cresswell, T. (2011). Mobilities I: catching up. *Progress in Human Geography* 35 (4): 550-558. http://journals.sagepub.com/doi/abs/10.1177/0309132510383348.

Cowling, M., Tanenbaum, J., Birt, J., & Tanenbaum, K. (2016). Augmenting reality for augmented reality. *Interactions, 24*(1), 42-45. doi:10.1145/3019008

Ingold, T. (2008). Bindings Against Boundaries: Entanglements of Life in an Open World. *Environment and Planning A* 40 (8):1796–1810. http://journals.sagepub.com/doi/abs/10.1068/a40156.

Kemmis, S, McTaggart, R & Nixon, R. (2013). The action research planner: Doing critical participatory action research. Springer Science & Business Media. https://dx.doi.org/10.1007/978-981-4560-67-2.

Kerrigan, S. (2016). The spectator in the film-maker: re-framing filmology through creative film-making practices. *Journal of Media Practice* 17(2-3):1-13. http://dx.doi.org/10.1080/14682753.2016.1248172.

Lukosch, S., Billinghurst, M., Alem, L., Kiyokawa, K. (2015), Collaboration in Augmented Reality, Computer Supported Cooperative Work (CSCW), 24: 515. doi:10.1007/s10606-015-9239-0

Loomis, JM. (2016). Presence in virtual reality and everyday life: Immersion within a world of representation. *PRESENCE: Teleoperators and Virtual Environments* 25 (2): 169-174. https://doi.org/10.1162/PRES_a_00255.

Magana, AJ. (2014). Learning strategies and multimedia techniques for scaffolding size and scale cognition. *Computers & Education* 72: 367-377. http://doi.org/10.1016/j.compedu.2013.11.012.

Mayer, RE. (2014). Multimedia instruction." In *Handbook of research on educational communications and technology*, Springer New York. 385-399.

Moreno, R, & Mayer, R. (2007). Interactive multimodal learning environments. *Educational Psychology Review* 19 (3): 309-326. doi:10.1007/s10648-007-9047-2.

Milgram, P, and Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE TRANSACTIONS on Information and Systems.* 77 (12): 1321-1329. https://cs.gmu.edu/~zduric/cs499/Readings/r76JBo-Milgram_IEICE_1994.pdf.

Nielsen, J. (2012). How many test users in a usability study? *Nielsen Norman Group, 4* Retrieved from https://www.nngroup.com/articles/how-many-test-users/

Suma, E., Finkelstein, S., Reid, M., Babu, S., Ulinski, A., & Hodges, L. F. (2010). Evaluation of the cognitive effects of travel technique in complex real and virtual environments. *IEEE Transactions on Visualization and Computer Graphics*, *16*(4), 690-702.

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Improving the undergraduate Science experience through an evidence-based framework for design, implementation and evaluation of flipped learning

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Flipped Learning (FL) is a student-centred pedagogical approach where new content is introduced prior to class which permits more time during class for active learning. Despite the growing body of evidence of the effectiveness of FL, many educators are reluctant to adopt this approach to teaching or are unsure of how to implement FL in their classes. Many students are uncertain of how to adapt their approaches to learning to a FL curriculum. In response to these challenges and calls for a robust framework to guide the design and implementation of FL, we developed the Flipped Teacher and Flipped Learner (FTFL) Framework based on the pedagogical literature. This paper reports on the use of our FTFL framework in the redesign of a large first year science subject from a traditional delivery to a FL delivery. We evaluated the efficacy of the redesign using a mixed methods approach with data on students' interactions with FL activities, and student and educator experiences. Findings from two iterations of the redesign indicate successful implementation of FL through high student engagement with online and class materials, and positive feedback from students and academics. Using the FTFL framework to guide the design and integration of FL, with an emphasis on clear communication, is key to our successful FL intervention and support of student learning.

Introduction

Flipped Learning (FL) is a pedagogical approach in which new instructional content is delivered before class, freeing up time for student-centred active learning during the class. This approach has gained traction in Science disciplines and lends itself to enquiry-based learning through active and collaborative tasks (Huber & Werner, 2016). Evidence of the effectiveness of FL is growing; however despite the evidence of the benefits of this 'new' approach (Weaver & Sturtevant, 2015; Rotellar & Cain, 2016) many educators are hesitant to adopt this change.

One of the reasons for this reluctance is the lack of a robust theoretical framework to guide the design, implementation and evaluation of the FL experience (Rotellar & Cain, 2016). A recent occasional paper written for the Australian Council of Deans of Science highly recommends that academics should 'embrace flipping' but there is no detail on *how* to implement this approach (Overton & Johnson, 2016). There are educators who are willing to try FL but they may be unsure how to implement this approach in their own classes, particularly in large enrolment classes. Furthermore, students may have difficulty adopting this approach to learning because their expectations of how they learn are based on transmissive approaches (Chen, Wang, Kinshuk & Chen, 2014).

To address these challenges we developed the Flipped Teacher and Flipped Learner (FTFL) Framework (Fig. 1; Reyna, Huber & Davila, 2015) based on the literature of well known pedagogical approaches such as blended and student-centred learning, organisational appearance, universal design and evaluation. Our innovative FTFL framework includes seven elements: planning and pedagogy; storyboard and lesson plan; activity design (before, during, after class); organisation and presentation; building, testing, deploying; communication; and evaluation. The aim of this study was to investigate the effectiveness of this FTFL framework for implementing FL and to measure the perceived learning gains of FL in a large science subject.

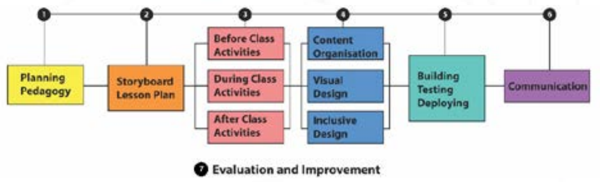


Figure 1: The Flipped Teacher and Flipped Learner Framework (Reyna et al., 2015)

Background

An institution-wide approach to blended learning has recently been rolled out across the University of Technology Sydney, which is the setting for the current study. Active and collaborative learning along with FL are key features of this initiative. 'Principles of Scientific Practice' (PSP) is a core first year subject for students enrolled in science degrees in the Faculty of Science (~850 students over two semesters). This subject introduces the major themes in science and inquiry-oriented experimentation, and focuses on developing scientific professional and communication skills. In 2016, PSP was redesigned to align with the university's blended learning strategy, with an emphasis on FL.

Learning design

Before the redesign, PSP was delivered with a traditional weekly lecture, one-hour weekly workshop and five laboratory sessions across the semester. The rationale for change to FL came through low student attendance at lectures and not enough time to apply newly learnt concepts in the workshops. A design-based research approach was used, following the FTFL framework and First Year Transition Pedagogy (Kift, 2009) to redesign the PSP curriculum and students' learning experience.

In contrast to other FL interventions we did not produce recorded lectures. Instead we purpose built interactive online modules to replace the lectures, with embedded short videos, written explanations of concepts, built-in questions and feedback (also see Davila & Griffiths, 2016). The modules were created with a content authoring tool (Adobe Captivate) and delivered every 1-2 weeks via the learning management system (LMS, Blackboard). Students could access the content at their own pace, and at a time and location that suited them. The face-to-face class time was conserved in new 2-hour workshops, designed using constructive alignment principles (Biggs & Tang, 2011) to ensure collaborative learning activities drew on the online content and built in feedback opportunities from peers and tutors. Students also completed short post workshop activities designed to consolidate their learning that week. The practical classes remained the same. After evaluating our first FL intervention and in response to student feedback in 2016, we developed more questions for the existing modules to test students' understanding and created new modules and workshops targeting the assignment.

Research design

We evaluated the efficacy of implementing FL in PSP using a mixed methods approach, collecting data on students' interactions with FL activities, alongside student and educator experiences. Quantitative and qualitative data obtained from a student survey instrument were summarised and analysed using thematic analysis, respectively. The open-ended responses were coded (Saldana, 2013), and compared against the literature and the quantitative results. The student data were triangulated with the qualitative semi-structured interview data from the subject coordinator. The results and comments presented are from the surveys conducted after the first iteration of FL in 2016 and are a subset of a larger dataset from across different science subjects using the FTFL framework.

Preliminary findings & discussion

Engagement with content in the flipped classroom

Low attendance at lectures is a growing trend at universities and one influenced by a range of factors including assessment pressures, quality of teaching, timetabling clashes and work commitments (Dickson & Stephens, 2016). Average lecture attendance of around 60% has been reported for large subjects (see Yeung, Raju, & Sharma, 2016 and references within). Anecdotal evidence from our University suggests that lecture attendance tends to drop off towards the middle of the semester, sometimes below 50%, and increases again just before a revision lecture or pre-exams. In this study, completion of the online pre-workshop modules, which introduce the main concepts and replaced the lectures, remained high throughout the semester (Fig. 2). In semester 2 2016, three new online modules were introduced in weeks 9 and 11 that provide scaffolded instruction for writing the major assignment. Over 80% of students completed the first module in each series, but fewer completed the second and third module, resulting in the lower overall average completion for those weeks compared to earlier weeks. The decrease in module completions observed in week 9 also corresponded to a busy time in the semester when many assessment tasks are due. Overall, the average percentage of students completing weekly modules was between 76% and 87% for the first three semesters after the redesign indicating that a large majority of students engage with the online content and the FL model.

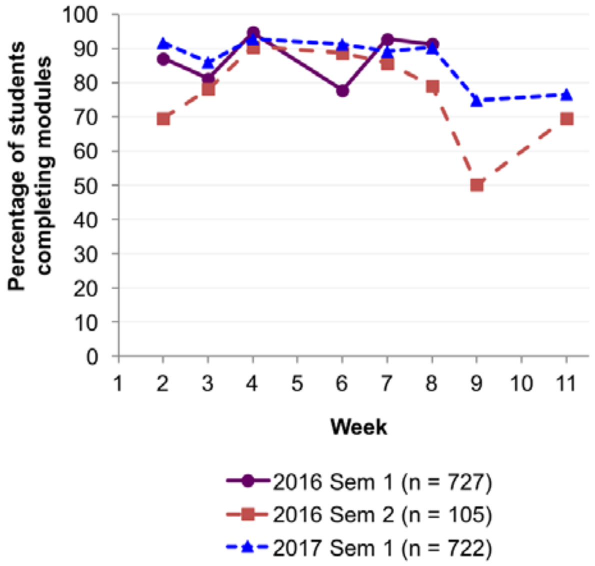


Figure 2: Percentage of students completing online pre-workshop modules over three semesters of FL delivery

The high percentage of online module completion throughout the semester also contrasts the common view that students will not complete pre-class activities or prepare for class (Kim, Kim, Khera & Getman, 2014; Rotellar & Cain, 2016). This is corroborated by positive student comments on their preparation and preferences for FL (Table 1). Most students reported that the online modules prepared them for learning in the workshops and this combination enhanced their learning (Table 2).

Table 1: Summary of students' comments from 2016 about PSP after the implementation of FL

Theme	Student comment
Flexibility and preparation for workshops	Being able to complete [the online modules] in my own time before the next workshop helped to create a less stressful learning approach … helped me to have the information for that said workshop, fresh in my mind.
Active learning in class	I wish more subjects were run like this. It is so much better. The workshops are really good for discussing ideas and clearing up confusion as you are able to discuss problems with a range of people.
FL compared to lectures	… it was great to do this [online modules] instead of sitting in a lecture as it allowed me more time to focus on other things and still learn.

Table 2: Student evaluation survey results after the first semester of flipped learning implementation in a large first year science subject (n = 567 respondents)

Survey item and % of respondents that agree and strongly agree	
There was a clear link between the online modules and the workshop activities	86.4
The online pre-workshop modules prepared me to learn in the face-to-face workshop	74.4
The combination of online modules and workshops enhanced my learning	69.5

However, we need to be wary of equating engagement with achievement as one does not necessarily lead to the other (Lucke, Dunn & Christie, 2016). As the subject coordinator reflected, some students "are so focused on getting results and marks that they don't really care about how they learn it so long as [the result] says 6/6 or it was completed, that's it for them, a ticked box".

Student satisfaction

Institutional feedback surveys conducted independently of our study indicate an improvement in student satisfaction with the subject after the redesign to FL, with survey scores increasing from 3.7 out of 5 in the traditional mode (2015) to 4.3 in the most recent semester using FL (2017). The high satisfaction scores validate the FL approach, particularly because PSP stands out as the only completely flipped subject in the first year science curriculum.

Despite these positive scores, a small proportion of students have criticised the subject content and FL approach: "I think all the info covered in the [online modules] could have been done in class." This criticism appears to stem from the perception that the material was too easy, had already been covered in high school, or was repeated in the workshops. This last point may suggest that some of the workshop activities were not challenging enough for some students. The introductory nature of the subject was intentionally designed to meet the learning needs of a diverse first year cohort: "I liked how the subject prepared first year students with no background knowledge in science with the tools they needed for their following years in science." The subject content, therefore, comprises concepts that may be familiar to students with some science background. This is a challenge when designing first year subjects. However, the overall survey results and comments indicates that the content is appropriately pitched and scaffolded for most students, including those new or returning to science at university: "Having not studied science for over 9 years it was a great introduction and refresher to help me get back into science and show me what is expected in university science related courses."

The subject coordinator reflected that some students' attitudes towards this subject were different and not in a positive way; some students "didn't treat PSP like a real subject because it didn't have lectures". He felt that this was perhaps due to their lack of maturity and knowledge of the different styles of delivery for learning. Activities used in FL do require students to be more accountable for their learning through class preparation (Rotellar & Cain, 2016). Better communication early on of how FL is used can mitigate this mismatch in student expectations and support student transition.

The subject coordinator pinpointed that a possible factor that may have led to some students' low satisfaction was the variety of active learning strategies used each week: "every week was different in terms of what the students did in the workshops and how they did it, and that may have been difficult for the students." The learning design team addressed this concern in the second and third iterations of the subject by reducing the number of online tools used, reordering the topics into a logical progression of skills development that align with the assignments, and streamlining the format of workshop activities. This may have contributed to the increase in student satisfaction scores observed.

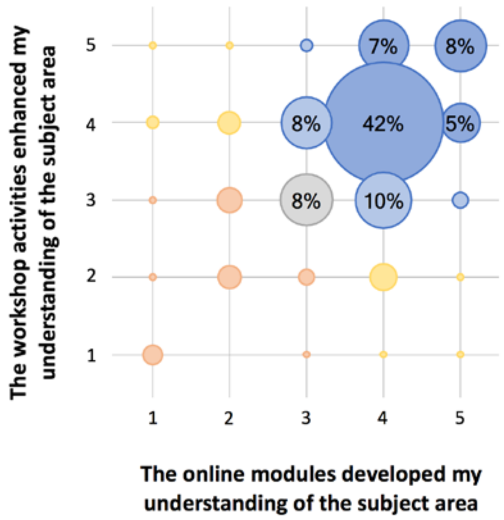
Student perception of learning

Over 69% of respondents (n = 567) agreed or strongly agreed that the combination of online modules and face-to-face workshops enhanced their learning in PSP, i.e. the FL approach enhanced their learning in this subject. This positive result aligns with the findings of several studies in Science disciplines (Huber & Werner, 2016). Unpacking this further, over 62% of students agreed or strongly agreed that both the online modules and collaborative workshops enhance their understanding (Fig. 3 top right hand corner). Only 3% of students reported that both online modules and workshops did not enhance their understanding in this subject (Fig 3. bottom left corner).

Communication and flipped learning

The importance of clear and regular communication was highlighted in this study in a number of ways. In the traditional mode of delivery, the subject coordinator stated that it was beneficial "having that open communication with [students] week to week and being able to diagnose any problems or issues as they happen". But in the FL mode the coordinator did not have any face-to-face classes with students and "If there was an issue in the workshops, I would only know about it if the [tutors] told me." This highlights the need for timely communication among all teaching staff in large FL subjects.

Initial feedback from the first student cohort of PSP in FL mode indicated that students needed reminding to complete the pre and post workshop tasks, despite the weekly tasks being documented in the subject outline and LMS. Students who are unaccustomed to FL, especially in their first year of university studies, may require explicit guidance on how they should organise their out of class time to adapt to the FL delivery (Weaver & Sturtevant 2015). The subsequent redesign included a clear communications schedule for the subject coordinator and workshop tutors including 'just-in-time' weekly announcements. Training was provided to the tutors to ensure they understood the goal of the learning activities for each week. Tutors were also provided with PDF versions of the online modules to ensure they were familiar with the content and could confidently facilitate the workshop activities.



Axes are on a Likert scale, from 1 = strongly disagree to 5 = strongly agree.

The size of circles represents the number of respondents (total n = 567), with the percentage labelled. Circles without labels represent <2%.

Figure 3: Students' perceptions of how the components of flipped learning (online modules and face-to-face collaborative workshops) enhanced their understanding in the subject

Conclusion

Preliminary findings after the second iteration of a large first year curriculum redesign using our FTFL framework indicate successful implementation of FL through high student engagement with online and class materials, and positive feedback from students and the subject coordinator. Planning using the FTFL framework with clear communication of learning outcomes was key to our FL intervention and support of student learning. Other studies have proposed design principles for effective FL (Kim et al., 2014; Rotellar & Cain, 2016). Our framework builds on those principles and we propose the integration of an effective communication strategy to ensure students are aware of the *need* and the *how* of FL.

Previous studies have indicated a paucity of evidence on the effectiveness of FL in large cohorts (Khanova, Roth, Rodgers & McLaughlin, 2015) or that it is not a good fit for first year cohorts (Persky & Dupuis, 2014). However, we concur with studies (Yelmarthi & Drake, 2015; Davila & Griffiths, 2016) who found that when support is offered through concept reinforcement during hands-on activities and timely feedback from the instructor, students can succeed in a FL environment. When planned well, FL brings a healthy variety for teachers, as noted by the subject coordinator: "it is a positive learning approach in that you can choose how the information is displayed and it doesn't just have to be [the lecturer] telling them one or two things … we introduced videos, quizzes, interactive elements."

We have shown that FL can be successfully implemented in a large first year science subject when the concepts are scaffolded in a way to meet the learning needs of a diverse cohort and class time is used effectively for active and collaborative learning. We have demonstrated that our FTFL framework (Reyna et al., 2015) is a comprehensive guide to the design, implementation and effective communication of FL for science disciplines, large enrolment classes and diverse first year cohorts.

Acknowledgements

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References

Biggs, J., & Tang, C. (2011). *Teaching for Quality Learning at University: What the Student Does* (4th ed.). Berkshire, England: McGraw-Hill Education (UK).

Chen, Y., Wang, Y., Kinshuk, & Chen, N. S. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Computers & Education, 79*(1), 16-27.

Davila, Y.C., & Griffiths, N. (2016). Supporting student transition: embedding reading practices into the first year Science curriculum. *Proceedings of STARS Students Transitions Achievements Retention & Success conference 2016* (paper 12C). Perth, Australia. Retrieved from: http://unistars.org/papers/STARS2016/12C.pdf

Dickson, K. A., & Stephens, B. W. (2016). Standing room only: faculty intervention increases voluntary lecture attendance and performance for disadvantaged year 1 Bioscience students. *Higher Education Pedagogies*, *1*(1), 1–15.

Huber, E., & Werner, A. (2016). A review of the literature on flipping the STEM classroom: Preliminary findings. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), *Show Me The Learning. Proceedings ASCILITE 2016* (pp. 267–274). Adelaide, Australia: Australasian Society for Computers in Learning in Tertiary Education.

Khanova, J., Roth, M. T., Rodgers, J. E., & McLaughlin, J. E. (2015). Student experiences across multiple flipped courses in a single curriculum. *Medical Education*, *49*(10), 1038–1048.

Kift, S. (2009). *Articulating a transition pedagogy to scaffold and to enhance the first year student learning experience in Australian Higher Education*: Final report for ALTC Senior Fellowship Program. Retrieved from FYHE Centre: http://fyhe.com.au/wp-content/uploads/2012/10/Kift-Sally-ALTC-Senior-Fellowship-Report-Sep-092.pdf

Kim, M. K., Kim, S. M., Khera, O., & Getman, J. (2014). The experience of three flipped classrooms in an urban university: an exploration of design principles. *The Internet and Higher Education*, *22*, 37-50.

Lucke, T., Dunn, P. K., & Christie, M. (2016). Activating learning in engineering education using ICT and the concept of "Flipping the classroom." *European Journal of Engineering Education*, *42*(1), 45-57.

Overton, T., & Johnson, L. (2016, July). *Evidence-based practices in learning and teaching for STEM disciplines*. Occasional paper, Deakin University. Retrieved from ACDS: http://www.acds-tlcc.edu.au/wp-content/uploads/sites/14/2016/07/ACDS-stem-principles-WEB.pdf

Persky, A., & Dupuis, R. (2014). An Eight-year Retrospective Study in "Flipped" Pharmacokinetics Courses. *American Journal of Pharmaceutical Education, 78*(10), 1–7.

Reyna, J., Huber, E., & Davila, Y. (2015). Designing your Flipped Classroom: an evidence based framework to guide the Flipped Teacher and the Flipped Learner. *The 12th Annual Conference of the International Society for the Scholarship of Teaching and Learning* (pp. 91-92). RMIT Melbourne, Australia.

Rotellar, C., & Cain, J. (2016). Research, Perspectives, and Recommendations on Implementing the Flipped Classroom. *American Journal of Pharmaceutical Education*, *80*(2), 1–9.

Saldana, J. (2013). *The Coding Manual for Qualitative Researchers* (2nd ed.). London, England: SAGE.

Weaver, G. C., & Sturtevant, H. G. (2015). Design, implementation, and evaluation of a flipped format general chemistry course. *Journal of Chemical Education*, *92*(9), 1437-1448.

Yelmarthi, K., & Drake, E. (2015). Flipped First-Year Digital Circuits Course for Engineering and Technology Students. *IEEE Transactions on Education*, *58*(3), 179–186.

Yeung, A., Raju, S., & Sharma, M. D. (2016). Online lecture recordings and lecture attendance: Investigating student preferences in a large first year psychology course. *Journal of Learning Design*, *9*(1), 55-71.

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Key success factors to implementing an active learning platform

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This study reports on the key success factors when introducing a new lecture capture platform, Echo360 Active Learning Platform (ALP), at an Australian University. This is an interactive platform, designed to actively engage students in their courses including in lectures (online and/or face to face) through a range of interactive tools. A trial of ALP, which is known within the University as the *Echo360 ALP Early Adopter Program*, was conducted in Semester 2, 2016. The purpose of the Echo360 ALP Early Adopter Program was to identify the key success factors required for implementation of Echo360 ALP at the enterprise level. The study reports data on students' experience of the interactive tools in Echo360 ALP. In total, over 1250 students, seven academics from across seven courses, Blended Learning Advisors from within each of the University's four academic groups, and support staff participated in the Echo360 ALP Early Adopter Program. The results of the study show that students were engaged when using Echo360 ALP and with support from professional staff this program can be successfully implemented by academics. Thus, the key success factors to this implementation include the academics themselves and the support staff involved in the implementation. A further success factor was the vendor themselves.

Introduction

Griffith University, like many universities in Australia, has used Echo360 lecture capture in face-to-face teaching for some time. Lecture capture enables students who are unable or unwilling to physically attend the lecture, to engage with the course lectures after the physical lecture has taken place. In 2016, when Echo360 was coming to end-of-life, the University considered an updated version, called Echo360 Active Learning Platform (ALP). This newer version, includes more interactive tools than its predecessor. It allows students to engage in questions and polls, participate in Q&A discussions, flag course materials that need clarification, and take notes corresponding to presentation slides or videos. It also provides academic staff with the opportunity to review analytics data informing them of the level of student engagement. In Semester 2, 2016, the University undertook a trial of Echo360 ALP which was called the Echo360 ALP Early Adopter Program. The purpose of this program was to examine the key success factors required to implement Echo360 ALP at an enterprise level.

Literature review

The use of digital technologies is ubiquitous in learning and teaching in higher education. From enterprise level learning management systems to social media tools incorporated into individual lectures, students and staff are encouraged to interact with technologies fully and regularly (Henderson, Selwyn, Finger, and Aston, 2015). In terms of pedagogical value, studies show that, when used judiciously, digital technologies can be an important component of creating an engaging learning environment (Adams Becker, Cummins, Davis, Freeman, Hall Giesinger, & Ananthanarayanan, 2017; Junco, R., Heiberger, G. & Loken, E., 2011). Student engagement is increasingly important as there are many reasons for students not attending lectures. These are complex and varied as one study by Massingham and Herrington (2006) demonstrated. Reasons included being busy, working, sick, or bored. Thus, it is important to ensure that students take a deep approach to learning (Biggs & Tang, 2012) as this will allow students to gain the most from their studies. By engaging students through the use of

Echo360 ALP it is hoped that students will engage in as many lectures as possible throughout the semester.

Lecture capture is a commonly used digital technology in university teaching in Australia. Its purpose is to increase flexibility for students in terms of when and where they study. Initially some academics were concerned that its introduction would have a negative effect on lecture attendance (Young, 2008) and hence student learning. However, this seems not to be the case. A study by Toppin (2011) found that attendance at lectures was not negatively affected by the use of lecture capture, and in fact many students' perceived it to be a useful tool in helping them understand concepts taught in the course. This finding is consistent with that of Chandra (2007), who concluded that reviewing videos of class lectures can have a positive impact on student learning. A study into the use of Echo360 as a lecture capture platform (Mark, Vogel & Wong, 2010), concluded that students "instead of developing an intention to skip classes … believe that Echo360 plays greater value in helping students to revise" (p.1732). Research on the newer version of Echo360 lecture capture, Echo360 ALP is limited. However there is early evidence that Echo360 ALP engages students who use it (Campbell & Centre for Learning Futures, 2017).

This study reports on the findings of the trial of Echo360 ALP and identifies the key success factors required for its implementation at an enterprise level.

Methodology

The Echo360 ALP Early Adopter Program was conducted from January 2016 until November 2016. It took approximately four months to define the project; find participants (through collaboration with the University's Deans Learning and Teaching, and the submission of expressions of interest); and allocate teams and schedules. The project was then implemented in Semester 2, 2016.

Participants

Seven academics participated in the program, from four academic groups and a variety of schools. The courses that the participating academics taught were delivered across a range of different modes, including face-to-face teaching across two campuses (and in one instance fully online). The courses included small and large class sizes. Figure 1 shows a breakdown of the mode of delivery, year level of the students and number of students in the course.

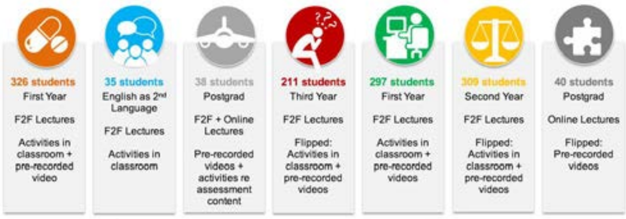

Figure 1: The range of courses and mode of delivery and numbers of students in each course

An initial meeting was held in May, 2016, and a site visit was organised to The University of Queensland to see the Echo360 ALP program being used in a face-to-face lecture. The Echo360 ALP devices (specific hardware to assist with the software) were then installed in specifically identified rooms at Griffith and planning then occurred to capture the recordings of lectures that occurred in rooms without the devices installed. Orientation sessions were offered across two campuses prior to the start of semester and online support materials for students were developed. Handouts were also provided informing students and support staff of how to access the Echo360 ALP, access the Griffith wifi, allow popups, and enable cookies in their web browsers ready for the first weeks of lectures.

Informal feedback was gained from the technical and support staff on the project. This was in the form of team meetings that contained minutes and email correspondence. These results have been included below as they inform the complete picture.

Data collection

To determine the key success factors for implementation of Echo360 ALP at an enterprise level, data were collected from several sources. Data were gathered through anonymous student surveys in weeks 1, 7 and 13, in both paper and online formats. A total of 200 students completed the survey in week 1, 160 in week 7 and with only 26 student's completing the survey in week 13, showing a significant drop in survey data across the weeks the Early Adopter Program was conducted. This may have been because the students were not given the opportunity to complete the survey in class, or due to decreasing lecture attendance. In addition to the formal survey, informal feedback was also collected from students in their lectures.

Data were also collected each week from the students in each class using the using the ALP system analytics. Statistics were collected that related to the number of engaged students; overall usage; and tool usage from each course were also gained from the ALP reporting system. Data is only presented here for the first five weeks due to the short length of the paper.

Staff data were collected through reflections and they were given the opportunity to provide feedback from each week they used the ALP. Additional data were collected from staff, both academics and support staff, in training sessions, through consultations and also through emails.

Results

An analysis of data showed that students were generally engaged with ALP and saw value in its use. A closer examination of the data identified three key factors for this result. The results are presented below and are structured around the four sources of data gathered during the Early Adopter Program. These include the data analytics from the Echo360 system, the students' perceptions of ALP's value, academics' perceptions of ALP's potential to enhance learning and teaching; and, results from technical staff and professional staff.

Table 1: The number of students engaged with Echo360 ALP throughout the Early Adopter Program by course

	NURSING	PSYCHOLOGY	ICT	LAW
Total ALP Students (n)	326	211	297	309
Total students who engaged* (n)	182	201	245	287
Total % students engaged	56%	95%	82%	93%

The number of students who engaged with Echo360 ALP varied between the courses. Table 1 shows the largest four courses and students who had the opportunity to engage with ALP, with the total number of students who engaged. Nursing was the lowest at 56% while Psychology was the highest at 95%. This may have been due to a number of reasons, for example, the lecturer suggesting to students to use ALP, or perhaps due to the support staff offering various types of support to the lecturer, including assistance in class time, or perhaps less assistance when teaching was occurring.

Students engaged in the system in various ways throughout weeks 1-5 of the semester. These included 61% of Law students using ALP via presentation views, with 42% of ICT students engaging in presentation views, down to Psychology (36%) and Nursing (37%) students engaging with the presentation views in class. A smaller number of students viewed the videos with 6% of students in each course accessing the videos in this manner. Students accessed the notes tool quite readily and some students accessed the quiz tools successfully. Access depended on the course and if students were asked to complete quizzes in class, with over 50% from Nursing, Psychology and ICT accessing the quizzes this way.

Students' perceptions of ALP's value

As indicated in the responses from the student voice surveys, students generally found Echo360 ALP easy to use, and found it useful for their learning. Their favourite features were viewing the presentations, participating in activities, viewing video recordings, and taking notes. They also suggested enhancements that could be made to improve the ALP. Positive student survey comments suggest that the features of Echo 360 are what makes it very positive to use and include:

> *The Echo360 ALP was easy to use (Weeks 1 and 7)*
>
> *I liked the ability to answer anonymously, it allowed me to participate without the fear of voicing my opinion to a large group (Week 1)*
>
> *I could view it at a time that was suitable to me (Week 1)*
>
> *I like the ability to take notes and interact during the lecture (Week 1)*
>
> *Make it available in all my courses (Week 7)*

Negative student comments were generally around the quality of the features of the program rather than the features themselves. Comments include:

> *Provide better explanations as to how to use the additional features (Week 13)*
>
> *Improve the notes so that it includes the relevant slide (Week 7)*
>
> *Improve the quality of the videos (Week 7)*
>
> *Make classroom selection screen easier to read (Week 7)*
>
> *Mobile screen is too small to properly view the content or to take notes (Week 1)*

There was some initial concern that students would have problems with accessing the ALP platform. This was not to be the case although there were a few negative comments about access in general. Students who completed the survey report using ALP in lectures, reported that they found it useful for their learning (74% in week 1). Data from the other weeks are not presented as less students completed the survey. This is a positive outcome for the Early Adopter program as it suggests it is worthwhile continuing with an enterprise wide implementation.

Academics' perceptions of ALP's potential to enhance learning and teaching

The academics commented on their lectures after using Echo360 ALP in their courses. Most saw the potential of the platform, were interested in exploring it and that the effort was worth the "ah ha" moments. Comments were generally positive:

> *I see the potential and have interest in exploring it (Week 1)*
>
> *All the effort and hard work was worth it for those in class "ah ha" moments (Via email)*
>
> *I find the interactivity is better with this than just asking the questions in class (Week 5)*
>
> *Investment was at the beginning of the semester. Time spent now is moderating. This provides useful information (Week 5)*

There were some negative aspects to the academic results, such as, when analysing the course data, it was evident that the implementation of activities in small classes was not successful, and students rarely used the Questions and Answer feature. First year courses had a high number of presentation views, but not many students watched the video recordings. In the second and third year courses, the presentation views, video views, and number of notes taken was considerably higher. For the successful use of its implementation, particularly for first year courses, monitoring students' engagement with ALP appears to be particularly important.

Technical and support staff feedback to enhance the ALP implementation

Feedback from technical and support staff indicate that there was a consensus that the amount of work required by all involved was much higher than anticipated. Choosing the right participants in the trial and having support staff to assist throughout the pilot was key to its success. Ongoing support for students including that from academics, support staff in lectures, and the availability of just-in-time online resources (which are regularly updated with ALP enhancements) is also key.

> *Many students had problems accessing the wi-fi and enabling cookies in their browsers*
>
> *Many students with English as a second language had language packs installed on their devices*
>
> *Drop in sessions that were offered for students who were unsuccessful in the lecture theatres also had low attendance*
>
> *Support materials had to be regularly updated during semester as enhancements were made to the Echo360 ALP*

The IT helpdesk did not have any student enquiries during the Early Adopter Program, suggesting that the students and academic staff were able to use the platform with only the technical assistance provided. It was reported that support from staff (volunteers, wifi, and support teams) at the first lecture were the reason why the number of students who successfully logged on was so high. Academics commented on the support that was provided by the educational designers and blended learning advisors from each school and they were reported to be key resources for the pilot.

Discussion on the key success factors

There are two main key success factors that have become evident with the results of this study and another third key success factor that staff feel contributed to the success of the program. These factors are the academics themselves, and the technical and support staff along with the vendor support in the implementation. These success factors include the academics trialling the program due to their keenness and their ability to be able to trial something new. This ensured the academics attended the training and reflected on the implementation throughout, so that they were able to ensure their students' learning was enhanced throughout.

The blended learning advisors and the educational designers assisted with technical support and were also key success factors. They were consulted early on and were key partners in the pilot. Their training consisted of the same training as the academics, in how to use the tool and also embed it in teaching sessions. This meant they were able to assist the academics to update their course materials, course site, and lesson plans, as well as provide general support to the academics in the implementation. This allowed the academics to feel more comfortable with the implementation and to feel supported when using it.

Although not featured in this paper another key success factor is the platform vendor who was very supportive throughout the trial, and appreciated the feedback provided by university staff including academics, students and support staff. This allowed enhancement requests to be implemented in a timely manner for all to benefit from. One limitation of this study is that there is no direct data around the vendor changes and how the academics and technical and support staff benefited from these changes. This is an area of for future research.

Conclusion and future directions

The results of this paper demonstrate the key success factors to implementing an active learning platform such as Echo360 ALP. The key success factors of the academics themselves, the ongoing support of technical and support staff, and the vendor acknowledging feedback from staff and students in terms of enhancement requests, goes a long way to assisting with implementation. Based on this analysis and exploration, it would seem that when implementing an enterprise role out of the Echo360 ALP, these key success factors should be considered.

It is planned that in 2017, the Early Adopter Program will continue with a second cohort, this time across three of the four academic groups. In 2018, it is planned that Echo360 ALP will be rolled out at an enterprise level across the university. During the rollout some features may be turned off at a system level to allow for an easy rollout for across the university, although individual academics can choose to turn them back on. At some point in the future it is expected these features will be turned on as part of the continuing use of the program by the university. This study supports previous results from a study at another Australian university (Campbell & Centre for Learning Futures, 2017) which shows students engaged in the various features of Echo360 ALP and that it is a novel product to assist academics with their teaching. This paper adds to the body of knowledge in this area and allows others to benefit from this pilot study.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., & Ananthanarayanan, V. (2017). *NMC horizon report: 2017 higher education edition*. Austin, Texas: The New Media Consortium.

Biggs, J. & Tang, C. (2012). *Teaching for quality learning at university*. (4th Ed.), Berkshire: Open University Press.

Campbell, C., & Centre for Learning Futures. (2017). Using Echo360 Active Learning Platform to promote engagement in lectures. Retrieved from https://app.secure.griffith.edu.au/explore/entry/4369/view

Chandra, S. (2007). *Lecture video capture for the masses.* ITiCSE '07, June 23–27.

Henderson, M., Selwyn, N., Finger, G. & Aston, R. (2015) Students' everyday engagement with digital technology in university: exploring patterns of use and 'usefulness'. *Journal of Higher Education Policy and Management*, *37*(3), pp. 308–319. doi.org/10.1080/1360080X.2015.1034424

Junco, R., Heiberger, G. & Loken, E. (2011). The effect of Twitter on college student engagement and grades. *Journal of Computer Assisted Learning*, 27, pp. 119-132. doi:10.1111/j.1365-2729.2010.00387.x

Mark, K. P., Vogel, D. R., & Wong, E. Y. W. (2010). *Developing learning system continuance with teachers and students: Case study of the Echo360 lecture capturing system*. Pacific Asia Conference on Information Systems, 2010 Proceedings.

Massingham, P. & Herrington, T. (2006). Does attendance matter? An examination of student attitudes, participation, performance and attendance. *Journal of University Teaching and Learning Practice, 3*(2), 82-103.

Toppin, I. N. (2011). Video lecture capture (VLC) system: A comparison of student versus faculty perceptions. *Education and Information Technologies*, *16*(4) 383-393. doi:10.1007/s10639-010-9140-x

Young, J. R. (2008). The lectures are recorded, so why go to class? *Chronicle of Higher Education*, *54*(36), p.A1.

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Digital equity: Diversity, inclusion and access for incarcerated students in a digital age

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ELearning has been touted as the way in which universities can enable participation by large numbers of students from non-traditional cohorts. There is no doubt that the flexibility of access that eLearning allows makes study accessible for a number of cohorts, including those engaged in full-time work or caring duties. However, cohorts such as incarcerated students and other students without Internet access, are sitting on the wrong side of the digital divide and are increasingly marginalised by the very technology anticipated to overcome their exclusion from study. This paper examines the fundamental issues of equity involved with eLearning, and particularly for incarcerated students. The very issue of access to the Internet is fraught with rates of access varying widely between different sectors of society. This discussion prompts higher education providers to think beyond business-as-usual when speaking of increasing participation in higher education.

Introduction

The notion of equity is challenging to define in any context especially when we use the term ‘equity’ in regards to teaching and learning in higher education. Unlike the foundational centuries of privileged male access to higher education, with the rise of the Internet and digital technology, the opportunities for access and participation in higher education have broadened; yet some barriers remain (Anderson, 2015). Digital equity – and inversely, the perpetuation of the digital divide – are significant human rights issues (La Rue, 2011). There are many aspects of the issue to be discussed in this space. Equity relates to access. It also relates to inclusion.

This paper aims to open a dialogue about teaching and learning for digital equity, to identify issues that are still present despite technological advances, and to identify what the implications are for teaching and learning in a digital age. This paper will focus on one particular cohort that is becoming increasingly marginalised as universities move their course offerings online: incarcerated students. In every state and territory of Australia, prisoners are prohibited from directly accessing the internet and as universities move away from delivering printed materials, this sector of the population are even further disadvantaged (Farley, 2016).

Progress towards achieving digital equity

Participation in higher education cannot be taken for granted. With increasing access by women to higher education from the 1800s (Eschbach, 2017), the rise in distance professional education opportunities late in the 19th century (Matthews, 1999), and Australian Indigenous peoples from the mid-1900s (Andersen, Bunda & Wallter, 2008), progress is being made. Australian government acknowledgement of the existence of equity groups in higher education from the 1960s, through policy documents, also helped to raise the profile of the issue. In more recent times, the publication of the Bradley Report in 2008 firmly moved equity onto the agendas of most Australian universities.

The increased prevalence and sophistication of digital technologies and the internet from the 1980s, opened the doors for potentially greater opportunity for participation in higher education (Selwyn, 2010). Electronic access to course materials and course activities enables many students, otherwise unable to participate in face-to-face activities on campus, to participate in higher education. This digital access is often heralded as the way in which higher education institutions can enable participation by large numbers of students from non-traditional cohorts (Selwyn & Gorard, 2003; Sims, Vidgen, & Powell, 2008). Students are able to study in a range of modes (full-time or part-time; on-campus or at a distance), have variable enrolment patterns to accommodate their particular

circumstances, and are able to enter higher education through a variety of bridging programs.[1]
Though programs have become ever more flexible since the 1980s, the necessity of accessing programs via a learning management system (LMS) remains a constant, irrespective of the mode of study, be it in a blended or distance mode (Farley, 2013). In this way, higher education institutions can claim that they are increasing participation of previously under-served and marginalised groups of students in higher education. These cohorts include mature-aged students who have employment and have carer responsibilities (Selwyn, 2007).

However, this increasing reliance on digital technology for teaching and learning in higher education presupposes ubiquitous connectivity, that is, a reliance on the internet. For many cohorts, including those in regional and remote Australia, ubiquitous connectivity is no more than an aspiration (Freeman & Park, 2015; Willems, 2010). However, the reality remains that 53 percent of the world's population does not have access to the internet (ICT Data and Statistics Division, 2016). With the increasing internationalisation of education, this is likely to remain a problem for universities into the foreseeable future. Further, it cannot be assumed that internet access is assured in first-world countries like Australia (Farley & Hopkins, 2016). In fact, there are vast tracts of Australia that are neither served by the internet either to the home or through mobile reception (3G, 4G) (Park, 2016). And even of those who can theoretically access the Internet, a certain proportion cannot afford to use it (Wilson, 2013). The internet access plans offered by service providers can be prohibitively expensive for those families with one or no income, high costs of healthcare or childcare, or high housing costs. Overlay this with issues of power connectivity or stability, and/or the ability to access computer hardware and software (Willems, 2010), the reality of the barriers start to become apparent.

As such, issues remain (Willems, 2013) and can easily pale into the background with the hype of new digital horizons. On May 16 2011, the United Nations declared that access to the internet was a human right. That statement has implications for governments in terms of the provision of infrastructure, hardware, social access and so on (La Rue, 2011). Even given this acknowledged right, the harsh reality is that minorities all over the world are accessing the Internet at lower rates than those mainstream users. This is not just a factor on distant shores. In Australia, Aboriginal and Torres Strait Islander people are 69 percent less likely than the mainstream population to have an Internet connection and 52 percent less likely to have a broadband connection (Australian Bureau of Statistics, 2008). Though these figures are a little dated and are no doubt changing, this discrepancy will still exist (Rennie, Hogan, Gregory, Crouch, Wright & Thomas, 2016).

The incarcerated population – a case in point

One cohort traditionally marginalised from participation in higher education are incarcerated students (Farley, 2016). To highlight some of the barriers that exist, prisoners in most Australian jurisdictions are prohibited from accessing the internet. Universities are beginning to desert this cohort due to the difficulties and high costs associated with provisioning them with access to higher education. Given that a post-secondary qualification potentially reduces rates of recidivism by some 40 per cent, it seems this is the cohort most in need of such an education (Davis, Bozick et al., 2013).

Indeed, the most disenfranchised group of young people are those that have made an early entry into the criminal justice system and have found themselves in correctional centres serving custodial sentences (Gardner, 2009). This is especially true for Aboriginal and Torres Strait Islander people, who are almost 15 times more likely to be incarcerated than other Australians (House of Representatives Standing Committee on Aboriginal and Torres Strait Islander Affairs, 2010). In Australia, 35 percent of all prisoners are aged less than 30 years of age, with about half of these aged less than 25 years (Australian Bureau of Statistics, 2013). These young people face an uncertain post-release future due to limited education opportunities and employment discrimination (Visher, Debus-Sherrill, & Yahner, 2011).

The situation is even worse for Aboriginal and Torres Strait Islander people that comprise just 2% of the general population (Australian Bureau of Statistics, 2011), yet 27 percent of the total prisoner population (Australian Bureau of Statistics, 2013). In many cases, a lack of education may have contributed to their incarceration; Aboriginal and Torres Strait Islander students are half as likely as other Australian students to complete Year 12 (Wong, 2008). Low levels of education remain a key driver of the ongoing cycle that leads to the over-representation of Indigenous Australians in the criminal justice system. And a lack of education will make it even harder for them to secure employment upon release from incarceration in an increasingly tight job market. Even if they do find employment, they are likely to receive lower wages than others of a similar age and background who have not been incarcerated (Visher et al., 2011). This prohibition from prisoners using the internet, coupled with limited access to computer hardware and software, ensures that

[1] These bridging programs generally allow students who have not finished year 12 or who have completed with an insufficient score to enter into a range of undergraduate programs.

this cohort rarely break the endless cycle of offending and incarceration. Access to higher education is one way in which prisoners could interrupt this cycle (Farley, 2017).

How incarcerated students currently access higher education

In Australia, around 1.5 per cent of eligible prisoners access higher education. This varies significantly across various states and territories with around 6.2 per cent of eligible Queensland prisoners accessing higher education (ROGS, 2017). Until very recently, correctional centres in some states were unable to facilitate prisoner enrolment in tertiary programs. For example, prisoners in the Northern Territory had access neither to the technology or to the support that would enable them to participate in higher education.

In some jurisdictions, prisoners have access to computer labs where eight or ten computers are networked to an isolated server. Hardware and software are typically out of date and poorly maintained. In the Australian Capital Territory, prisoners have access to in-cell computers running on a Linux platform. Certain websites are whitelisted, i.e. can be accessed by prisoners but the degree of access is not sufficient for prisoners to undertake university study. This same system does allow limited emails to five email addresses. This enables parents or partners to access materials on behalf of the incarcerated student.

In other jurisdictions, education officers would work with prisoners to download course materials and to load them onto correctional centre computers (without access to the internet). Alternative arrangements are made to accommodate assessments with education officers very often searching for and downloading journal articles and other resources that enable prisoners to complete assignments. Correctional centres are very often registered as exam centres so that prisoners can complete exams. All of these measures place a considerable burden on both education and custodial staff.

The only large-scale project that is enabling prisoners to access higher education with technology is the University of Southern Queensland-led Making the Connection project. To date, this project has enrolled over 1000 prisoners into five programs in Queensland, Tasmania, Western Australia and the Northern Territory. The project uses two technologies: 1) a server-based solution, and 2) notebook computers that are not able to be connected to the internet. A version of their Learning Management System which doesn't rely on internet access is installed onto these technologies to enable access to courses and programs.

Discussion: What can universities do to overcome these barriers?

There are a number of strategies that universities can adopt in order to overcome these inadvertent barriers to digital equity. With equity centres established in several Australian universities and some federal funding tied to equity targets, there are good social and economic reasons for universities to better serve equity cohorts.

First, provision must be made so that these excluded students are able to access the technologies that they need to participate. This would include hardware, software and access to the Internet (Sims et al., 2008; Farley, 2016). Though this sounds relatively uncomplicated, there are certain instances where the provision of Internet access will just not be possible. For example, it is difficult to imagine a time when incarcerated students in Australian jurisdictions will ever have access to the Internet.

Second, it is not enough to supply access to the technology to enable participation in eLearning. Those potential students must be shown how to use the technology that they have never had access to (Sims et al., 2008). For example, in the case of incarcerated students, they may have been incarcerated since before a particular technology became available on a mainstream basis. In a University of Southern Queensland pilot project with incarcerated students, some students reported that they had never seen or handled a smart phone (Farley, Murphy & Bedford, 2014). It is also conceivable that a prisoner will have been in custody since before tablets such as iPads became available. Before educators can expect a student to deal with this kind of technology, the student must be taught how to use it.

Third, and overlaying the above points, those who have not previously participated in higher education will not have any cultural capital and will most likely have low educational attainment to this point. The same is likely to be true of their families and close circle of friends. Pedagogies that are used must take this into account and be appropriate for the cohorts that are to be included (Sims et al., 2008). Being first in the family, especially for distance learners in remote communities, can raise issue of its own (Willems, 2014; Willems, 2010). This can be very difficult to influence and change within universities due to the high level of autonomy of many teaching academics (Sims et al., 2008).

These potential solutions pre-suppose that access to technologies and the chance to engage with higher education is the main reason why preventing these groups from participating (Selwyn & Gorard, 2003). It is most likely that the situation is far more complex. There are likely to be other issues at play such as a lack of appropriate role models, the necessity to work or engage in other activities that compete for the potential student's time, and a whole raft of cultural, social, health and economic issues. Any potential solution will have to involve an active engagement with all stakeholders and a holistic approach to not only dealing with the lack of access to Internet and other technologies, but also tackle those social, cultural and other issues which may be at play. There is also likely to be heightened needs in terms of support both from a technical point of view and from a personal and educational point of view. Generic skills such as time management, prioritising competing demands and generic writing skills will also need to be part of the solution.

Conclusion

Highlighting the continuing digital divide is not a popular or 'edgy' topic of scholarly output, yet it is crucial to the continuing development of our sector, and for the scholarship of teaching and learning. It is also an issue of humanity. From the discussion of the layers of considerations in and around equity, and specifically educationally equity and with the notion of launching the ASCILITE Digital Equity Special Interest Group (SIG).

Though the rhetoric is that eLearning is able to increase participation in higher education by non-traditional cohorts, the reality is that it is also preventing many of those people from participating. Delivery of course materials and activities through the learning management system and through the Internet is problematic, when the distribution of that access is not democratic in itself. Many minority groups are able to access the Internet and all that it holds at a significantly lower rate as compared to mainstream users. This can be both because of the lack of access to the appropriate technologies (including the Internet) or because of the costs associated with that access. Even given this lack of access, there may be a large number of other factors at play which combine to decrease participation of marginalised cohorts in higher education. Any serious attempt to encourage these cohorts to participate in higher education via eLearning must include strategies to deal with other sources of disenfranchisement which may be due to cultural, social, economic or health issues. Only in this way will the rhetoric match the reality.

References

Andersen, C., Bunda, T., & Wallter, M. (2008). Indigenous Higher Education: The Role of Universities in Releasing the Potential. *The Australian Journal of Indigenous Education, 37*(1), 1-8. doi: 10.1017/S1326011100016033

Anderson, N. (2015). Digital technologies and equity: gender, digital divide and rurality. In M. Henderson & Romeo (Eds.), *Teaching and Digital Technologies: Big Issues and Critical Questions* (pp. 46-56). Port Melbourne, Australia: Cambridge University Press.

Australian Bureau of Statistics (2008). 8146.0.55.001 - Patterns of Internet Access in Australia, 2006 Canberra.

Bradley, D., Noonan, P., Nugent, H., & Scales, B. (2008). *Review of Australian Higher Education, Final Report*. Retrieved from Canberra, Australia: www.deewr.gov.au/he_review_finalreport

Davis, L. M., Bozick, R., Steele, J. L., Saunders, J., & Miles, J. N. V. (2013). Evaluating the Effectiveness of Correctional Education: A Meta-Analysis of Programs That Provide Education to Incarcerated Adults (pp. 113). Santa Monica, CA: RAND Corporation.

Eschbach, E. S. (2017). *The Higher Education of Women in England and America, 1865-1920*. New York: Routledge.

Farley, H. (2017). *Introducing digital technologies into prisons: Issues and challenges*. Paper presented at the Prisons2017 Conference, Sydney, Australia.

Farley, H. (2016). *Engaging Correctional Leaders and Students in Higher Education: The Making the Connection Project*. Paper presented at the International Corrections and Prisons Association Conference, Bucharest, Romania.

Farley, H. (2013). *Making the connection: creating a pathway for indigenous incarcerated students into higher education*. Paper presented at the 11th Biennial Australasian Corrections Education Association (ACEA) Conference, Sydney.

Farley, H. & Hopkins, S. (2016). The prison is another country: incarcerated students and (im)mobility in Australian prisons. *Critical Studies in Education*, 1-18. doi:10.1080/17508487.2016.1255240

Farley, H., Murphy, A., & Bedford, T. (2014). Providing simulated online and mobile learning experiences in a prison education setting: Lessons learned from the PLEIADES pilot project. *International Journal of Mobile and Blended Learning, 6*(1), 17-32.

Freeman, J., & Park, S. (2015). Rural realities: Digital communication challenges for rural Australian local governments. *Transforming Government: People, Process and Policy, 9*(4), 465-479. doi:10.1108/TG-03-2015-0012.

Gardner, J. (2009). Democracy's Orphans: Rights, Responsibility, and the Role of the State in the Lives of Incarcerated Youth. *Youth & Society, 42*(1), 81-103. doi: 10.1177/0044118X09336268

House of Representatives Standing Committee on Aboriginal and Torres Strait Islander Affairs. (2010). Inquiry into High Levels of Involvement of Indigenous Juveniles and Young Adults in the Criminal Justice System. 13. Canberra: Law Council of Australia.

ICT Data and Statistics Division (2016). *ICT Facts and Figures 2016*. Retrieved from Geneva, Switzerland: http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2016.pdf

La Rue, F. (2011). Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression, Frank La Rue (pp. 22). Geneva: United Nations General Assembly.

Matthews, D. (1999). The Origins of Distance Education and Its Use in the United States. *T H E Journal (Technological Horizons In Education), 27*(2), 54-66.

Park, S. (2016). Digital inequalities in rural Australia: A double jeopardy of remoteness and social exclusion, Journal of Rural Studies, Available online 13 January 2016, ISSN 0743-0167, http://dx.doi.org/10.1016/j.jrurstud.2015.12.018.

Rennie, E., Hogan, E., Gregory, R., Crouch, A., Wright, A., & Thomas, J. (2016). *Internet on the outstation: The digital divide and remote Aboriginal communities*: Institute for Network Cultures.

Selwyn, N. (2010). Degrees of digital division: reconsidering digital inequalities and contemporary higher education. *RUSC, Universities and Knowledge Society Journal*, 33-42.

Selwyn, N. (2007). The use of computer technology in university teaching and learning: a critical perspective. *Journal of Computer Assisted Learning, 23*(2), 83-94. doi:10.1111/j.1365-2729.2006.00204.x

Selwyn, N., & Gorard, S. (2003). Reality bytes: examining the rhetoric of widening educational participation via ICT. *British Journal of Educational Technology, 34*(2), 169-181.

Sims, J., Vidgen, R., & Powell, P. (2008). E-learning and the digital divide: perpetuating cultural and socio-economic elitism in higher education. *Communications of the Association for Information Systems, 22*(1), 429-442.

Visher, C. A., Debus-Sherrill, S. A., & Yahner, J. (2011). Employment After Prison: A Longitudinal Study of Former Prisoners. *Justice Quarterly, 28*(5), 698-718. doi:10.1080/07418825.2010.535553

Willems, J. (2013). Equity in distance education. In J. Willems, B. Tynan, & R. James (Eds.), *Global Challenges and Perspectives in Blended and Distance Learning* (pp. 17-35). Hershey, PA: IGI Global. DOI: 10.4018/978-1-4666-3978-2.ch002

Willems, J. (2010). The Equity Raw-Score Matrix–a multi-dimensional indicator of potential disadvantage in higher education. *Higher Education Research & Development, 29*(6), 603-621.

Wilson, S. (2013). Internet access is a human right in Guatemala, why not in Australia? web log Retrieved from http://www.probonoaustralia.com.au/news/2013/10/Internet-access-human-right-guatemala-why-not-australia#

Wong, A. (2008). Build Communities, Not Prisons: The effects of the over-representation of Indigenous people in the criminal justice system. Hobart: University of Tasmania.

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A learning analytics pilot in Moodle and its impact on developing organisational capacity in a university

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Moodle is used as a learning management system around the world. However, integrated learning analytics solutions for Moodle that provide actionable information and allow teachers to efficiently use it to connect with their students are lacking. The enhanced Moodle Engagement Analytics Plugin (MEAP), presented at ASCILITE2015, enabled teachers to identify and contact students at-risk of not completing their units. Here, we discuss a pilot using MEAP in 36 units at Macquarie University, a metropolitan Australian university. We use existing models for developing organisational capacity in learning analytics and to embed learning analytics into the practice of teaching and learning to discuss a range of issues arising from the pilot. We outline the interaction and interdependency of five stages during the pilot: technology infrastructure, analytics tools and applications; policies, processes, practices and workflows; values and skills; culture and behaviour; and leadership. We conclude that one of the most significant stages is to develop a culture and behaviour around learning analytics.

Introduction

The Moodle Engagement Analytics Plugin (MEAP) is a redesigned Moodle plugin (Liu, Froissard Richards & Atif, 2015a) based on the original plugin developed by a team led by Philip Dawson (Dawson & Apperley, 2012). MEAP has four ‘indicators’ that can be used to create an at-risk profile for students. The indicators were: (i) assessment activity that measures assessment submissions, (ii) forum activity that measures participation in forums, (iii) gradebook that interrogates students’ records in the gradebook, and (iv) login activity that measures students’ access to the LMS (Liu et al., 2015a). MEAP identifies the degree to which students meet the at-risk profile by calculating a total risk percentage based on weighted thresholds set by teachers. MEAP then allows teachers to email groups of students with a personalised message from Moodle. From August 2015 to November 2016, we conducted a pilot with MEAP at Macquarie University, involving 36 units with enrolments from 79 to 1,599 students for a total of 13,824 students. These were first- and second-year units across a range of disciplines, as diverse as Ancient History, Accounting and Engineering. Throughout the pilot, 2,263 personalised emails were sent to students. Before the MEAP pilot, there was little organisation capacity in learning analytics (LA). After the pilot we developed organisational capacity in LA which allowed us to improve teaching and learning. Here we use the organisational capacity framework for LA by Arnold et al. (2014) and pathways to the integration of LA by Beer, Tickner and Jones (2014) to discuss and explore the pilot.

Arnold et al. (2014) presented a framework to develop organisational capacity in LA which is based on five stages. These were: (1) technology infrastructure, analytics tools and applications; (2) policies, processes, practices and workflows; (3) values and skills; (4) culture and behaviour; and (5) leadership. They argue that ideally they should all be addressed if organisational capacity in LA is to be achieved (Arnold et al., 2014). We consider each of these stages in the context of the pilot.

The development of a LA tool (stage 1) is only the first stage in the implementation of LA in an institution. Next is the “integration of this tool into the practice of teaching and learning” (Elias, 2011, p.5). Teachers are crucial to this process (Radloff, 2008). Beer et al. (2014) outline three pathways to consider when embedding LA into teaching practice at a university. These include the ‘do it to’ teachers pathway whereby LA solutions are imposed from the top down, starting from an identified institutional strategic goal. The ‘do it for’ pathway results from a ‘technologist’ alliance (Geoghehan, 1994) between teaching, professional and information technology staff. The ‘do it with’ teachers pathway is a result of learning and teaching staff working closely with teachers in a unit to develop an understanding of their needs which then informs the process. Ultimately these three pathways are not mutually exclusive and elements from all three may be required in the implementation of LA in an institution (Beer et al., 2014). These pathways provide a useful lens through which to explore the implementation of LA during the pilot through the stages (Arnold et al., 2014) comprising of policies, processes, practices and workflows; values and skills; and culture and behaviour.

Technology infrastructure, analytics tools and applications

An LA system that is appropriate to the needs of an institution is crucial, as is the technical infrastructure underpinning it (Arnold et al., 2014). In the context of our institution, these needs included a system that worked within the existing learning management system (LMS) and did not require extensive resources to operate. In addition to systems and infrastructure, analytic tools that meet the needs of stakeholders are required (Arnold et al., 2014). During the pilot we followed a design-based research methodology whereby we worked with unit convenors (academics responsible for a unit of study) and student support staff to understand their needs around measuring student performance and how they would determine if students were engaged (Liu et al., 2015a). This process resulted in iterative and incremental development of MEAP so that it was able to display more meaningful information about student engagement with the LMS, and provide for efficient and personalised communication with select students.

Due to the exploratory nature of a pilot, it was necessary to set up test servers with clones of the organisational LMS. This resulted in unavoidable infrastructure issues that could have potentially undermined acceptance of MEAP. Buchanan, Sainter & Saunders (2013) discussed factors associated with lower technology use which included institutional/infrastructure issues. A number of these incidents during the pilot revealed issues around data currency and accuracy caused by the underlying infrastructure. In one incident a unit convenor sent emails to students incorrectly stating that they had not completed specific tasks. This was caused by a lag in the update of a database resulting in out-of-date activity logs for students in the LMS. In another instance the student information system did not regularly update the enrolment status of students in the LMS. As a result of these incidents, students contacted unit convenors, tutors and student support staff expressing confusion, frustration and anger about having received these emails. Staff expressed concern about their future use of this tool if the technical infrastructure was not improved.

Policies, processes, practices and workflows

Since the pilot was the first practical implementation of actionable LA at our university, it raised a number of issues around governance, procedures and structures that are necessary for a sustainable and systemic LA culture (Arnold et al., 2014). The pilot raised issues around data stewardship and usage, triggering the development of an university-wide code of practice for LA, based on Jisc's work in this area (e.g. Sclater & Bailey, 2015) to inform future funding, implementation, and governance decisions. The pilot also uncovered a wide range of conflicting approaches and expectations of student support across the university, which provided an opportunity to start standardising practices. There were two models of student support identified during the pilot. The first involved unit convenors being wholly responsible for student support, where they used MEAP to identify and contact students and follow up with support. This included composing and sending personalised messages to students with specific instructions and references to support materials. The second model was where the unit convenor worked with student support staff to identify students and compose messages. Students were also referred to additional support programs run by the faculty, and support staff followed up with them. In some units, support staff would send the messages on behalf of the unit convenor. The second model was typically adopted where there were large student enrolments (> 450 students) in the larger faculties that had financial capacity to employ support staff.

To provide further consistency for student support, practices and workflows around the use of MEAP were developed during the pilot by leveraging the experience of unit convenors and student support staff. These included what type of unit MEAP was most effective for, strategic times during the semester to contact students, how to compose the most effective messages for students, aligning the use of at-risk indicators in MEAP with the instructional design of the unit, sharing information about at-risk students with support staff, and using MEAP as an evaluation tool to make unit improvements at the end of semester. In addition, a workflow was developed that addressed challenges that unit convenors experienced when using MEAP during the pilot. Consequently, unit convenors who want to use MEAP must now complete a training session and are supported by learning and teaching staff. They are provided with regular communications during the semester about approaches to using MEAP that include typical questions and issues. Unit convenors are also automatically enrolled in an online community of practice on LA within the university.

The approach taken in the pilot around the development of processes, practices and workflows was to 'do it for' teachers (Beer et al., 2014). Unit convenors did not have the time or capacity to contribute to these. Instead, the project team developed these based on observations and feedback provided by staff. A limitation of this approach is that there may be significant differences between the perspectives and needs of the larger academic population and members of the 'technologists' alliance (Geoghagen, 1994), which can lead to the benefits of LA not being effectively communicated and hence implemented in the institution (Beer et al., 2014). This was addressed through a flexible and iterative approach where practices and workflows were adapted and amended following lessons learnt and feedback from staff.

Values and skills

When using MEAP, staff needed to understand how the limited indicators available in the tool could reflect student engagement. This required a level of data expertise (Arnold et al. 2014) which was developed through relationships between the project team and staff. Through a process of questioning and discussion, we worked with staff to determine what metrics they thought were important and to help them select appropriate settings and interpret results. In particular, MEAP has four indicators that can be used to create an at-risk profile for students (assessment activity, forum activity, gradebook and login) and each indicator has a number of parameters. The project team would work with the unit convenors to choose the relevant indicators and their parameters. The team would ask unit convenors what students needed to do online to successfully complete the unit. If students needed to engage with content online to access videos, readings and discussions, then login activity would be more heavily weighted. In this example, unit convenors would then consider the time students would need to spend online to complete all the tasks required. These parameters would then be input into the login activity indicator. If there were regular online tasks that contributed towards students' final grades, such as weekly quizzes, then gradebook could be used to identify students who, for example, scored below 50%. A weighted combination of indicators could then be used to develop a nuanced profile of an engaged or disengaged student that reflected the intended learning design of the unit.

Evaluation and research competencies are another key component of driving LA acceptance (Arnold et al., 2014). An integral part of the pilot was evaluation of the impact of MEAP on student learning and unit convenor teaching experience. Students' expectations of early alert systems and their experience of personalised messages from MEAP were surveyed. The results on expectations of early alert systems aligned with those from a previous survey (Atif, Bilgin & Richards, 2015); an overwhelming majority of students wanted to be contacted by their unit convenor if their performance was not satisfactory (90%) by university email (77%) and as soon as the behaviour occurred (60%). The results on their experience of MEAP found that of the students that had received an email, 76% reported that they took follow-up action when contacted, 62% started to engage more with the readings and/or forums, 40% completed a missing assignment and 25% realised that they needed help. Students' attitude towards being contacted were strongly favourable where they reported they were glad to speak to teaching staff about their situation, appreciated that someone was looking out for them, and were grateful that they were contacted. We also interviewed unit convenors on their views and challenges on using early alert systems in general and MEAP in particular. In addition, we performed analyses to validate the effectiveness of the indicators in MEAP to predict student performance (Liu et al., 2015b).

Our approach around the development of values and skills could be characterised as a combination of 'do it for' and 'do it with' teachers. 'Do it for' because the MEAP expertise and knowledge of the project team was used to develop the skills of unit convenors. 'Do it with' because, during the pilot in our evaluations we attempted to develop an understanding of the lived experience (Beer et al., 2014) of the unit convenor and students so as to establish how LA could best support teaching and learning.

Culture and behaviour

When staff gain practical experience with LA, conditions are created for conversations about its advantages and disadvantages. As staff started to use MEAP, we observed that they began to think more deeply about how student engagement might be measured. Some unit convenors experimented, to understand what was happening in their unit, and how they might change the learning design to capitalise on these insights (Lockyer, Heathcote & Dawson, 2013). For example, a unit convenor noted, "In tracking students' progress in the various different assessment tasks, I have gained an insight into how the cohort approaches the completion of the unit's requirements. In redesigning the learning tasks over summer (in a renovation of the unit) I have been able to take this into account."

The rapid pace of change in higher education can result in 'change fatigue'. Whilst unit convenors were receptive to supporting students, they were disinclined to use a tool such as MEAP since there were already too many tools to use and understand. A successful strategy to address this challenge was to highlight the time-saving benefits of MEAP. As one unit convenor noted, "Before MEAP came along, I would use the time consuming method of going through individual [LMS] logs to identify at-risk students … and then send them individual messages. MEAP provides a far more efficient way to identify students by level of engagement and achievement, especially in large units."

When an institution implements LA it needs to be aware of risk aversion that some staff have in relation to negative student responses. The institution must be prepared to help staff place their concerns within a wider context of the benefits that a majority of students gain from the continuing use of LA. It is also important to deliver a message of persistence and dedication to allow sufficient time for LA to yield meaningful results (Arnold et al., 2014). The pilot attempted to convey this message through workshops and conversations between staff and the project team. Specifically, research (Liu et al., 2015a; Pistilli, Arnold & Bethune, 2012; Harrison, Villano, Lynch & Chen, 2016) was presented on the impact of LA on retention and students' behaviours, together with information from students and unit convenors that had already used MEAP and had gained benefits from its use.

The pilot was run over several semesters, allowing the university to develop a growing body of practice and understanding of the advantages and challenges of using LA. As unit convenors have become more aware of, and familiar with, the impact of MEAP on supporting their teaching and learning, they have started to support its use within their departments and with their colleagues. This resulted in more unit convenors using MEAP which in turn created a growing body of staff who relied on the tool to support students. This increase in usage was crucial in convincing senior management to support the development of MEAP into an enterprise tool in early 2017. It went from a tool only available to a small group of unit convenors in a pilot on a test server, to becoming available to all unit convenors on the institutional LMS.

The 'do it with' teachers approach was used when developing culture and behaviour for LA. It was important to understand, from the perspective of the unit convenor, the advantages of, and challenges faced using MEAP. We sought to understand the barriers that they faced when using new technology and worked with them to develop compelling reasons to adopt the new practice (Beer et al., 2014). This, in turn, resulted in new experiences for unit convenors and students that led to reflection and change and ultimately a development of culture and behaviour around LA at our university.

Leadership

Leadership is crucial to successfully launch LA in an institution, but also to ensure coordination, problem-solving and strategic planning (Arnold et al., 2014). However, the university was undergoing major change, and key policies in relation to LA had yet to be developed. LA had been an area of interest and focus of multiple projects for a number of years, but no single view or direction prevailed. As a consequence, the university was not at a point where it could undertake strategic thinking or planning about LA. Despite this, the MEAP pilot was successful in driving a bottom-up adoption of a particular LA tool and development of practices, values, and culture around LA.

Conclusion

Leadership of a unified approach to LA was lacking in the university. This caused a drag on the development of organisational capacity. Fortunately, all the other stages (technology infrastructure, analytics tools and applications; policies processes, practices and workflows; values and skills; and culture and behaviour; Arnold et al., 2014) contributed to developing organisational capacity. In addition, the culture and behaviour that had been developed during the pilot acted as an impetus to drive senior management to make decisions that ultimately supported organisational capacity development in LA.

During the pilot, the project team used a combination of 'do it for' and 'do it with' teachers pathways (Beer et al., 2014) to support the integration of MEAP into teaching and learning at the university. The 'do it for' pathway provided for the expertise and knowledge of the 'technologists alliance' to develop policies, processes, practices and workflows that unit convenors did not have the time, inclination, interest or knowledge to develop. The 'do it with' pathway was followed when developing culture and behaviour, whereby the project team worked with teachers to understand from their viewpoint, the advantages and challenges of using MEAP. A combination of these two pathways was followed during the development of values and skills, allowing the growth of unit convenors' data literacies based on knowledge of the technology inherent in MEAP and their insight into learning design.

References

Arnold, K. E., Lynch, G., Huston, D., Wong, L., Jorn, L., & Olsen, C. W. (2014). Building institutional capacities and competencies for systemic learning analytics initiatives. In *Proceedings of the Fourth International Conference on Learning Analytics And Knowledge* (pp. 257-260). ACM.

Atif, A., Bilgin, A., & Richards, D. (2015). Student Preferences and Attitudes to the use of Early Alerts. Paper presented at the *21st Americas Conference on Information Systems (AMCIS*): Blue Ocean Research, Puerto Rico.

Beer, C., Tickner, R., & Jones, D. (2014). Three paths for learning analytics and beyond: moving from rhetoric to reality. In *31st Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (ASCILITE 2014), Dunedin.

Buchanan, T., Sainter, P., & Saunders, G. (2013). Factors affecting faculty use of learning technologies:

Implications for models of technology adoption. *Journal of Computing in Higher Education*, 25(1), 1-11.

Dawson, P., & Apperley, T. (2012). Workshop 1: Open-Source Learning Analytics and “what the student does”. Paper presented at the *SoLAR Southern Flare Conference*.

Elias, T. (2011). Learning analytics: Definitions, processes and potential. *Learning*, 23, 134-148.

Geoghegan, W. (1994). Whatever happened to instructional technology? Paper presented at the *22nd Annual Conference of the International Business Schools Computing Association*.

Harrison, S., Villano, R., Lynch, G., & Chen, G. (2016). Measuring financial implications of an early alert system. In Proceedings of the *Sixth International Conference on Learning Analytics & Knowledge* (pp. 241-248). ACM.

Liu, D. Y. T., Froissard, J.-C., Richards, D., & Atif, A. (2015a). An enhanced learning analytics plugin for Moodle - student engagement and personalised intervention. In Proceedings of the *2015 ASCILITE Conference*, 29 November - 2 December, Perth, Australia.

Liu, D. Y. T., Froissard, J.-C., Richards, D., & Atif, A. (2015b). Validating the Effectiveness of the Moodle Engagement Analytics Plugin to Predict Student Academic Performance. In Proceedings of the *2015 Americas Conference on Information Systems*, August 13-15. Puerto Rico.

Lockyer, L., Heathcote, E., & Dawson, S. (2013). Informing pedagogical action: Aligning learning analytics with learning design. *American Behavioral Scientist*, 57(10), 1439-1459.

Pistilli, M. D., Arnold, K., & Bethune, M. (2012). Signals: Using academic analytics to promote student success. *EDUCAUSE Review Online*.

Radloff, A. (2008). Engaging staff in quality learning and teaching: what's a Pro Vice Chancellor to do? Sydney: *HERDSA*.

Sclater, N. & Bailey, P. (2015) Code of practice for learning analytics. *JISC*, London. Retrieved from https://www.jisc.ac.uk/guides/code-of-practice-for-learning-analytics

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‘One size does not fit all’: Towards cultural adaptivity in learning management systems

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Online learning is immensely popular and attracts learners from diverse cultural backgrounds. Given learning is situated in culture, the diversity of online students presents a great challenge to course designers, but remains largely unaddressed. To complicate matters, Learning Management Systems (LMS), though efficient and easy to use for course design, promote a *one-size-fits-all’* approach. The PhD study referred to in this paper seeks to make inroads to cultural sensitivity in LMS. A beginning point for the project is to explore Instructional designers’ perspectives on culturally sensitive online learning design features. We report on the early findings from this first step and aim to incite rich discussion around culture, instructional design and online learning.

Introduction

Online learning is perceived to be cost effective and time efficient method of delivering to large student populations and has thus gained great popularity over recent years. Despite the hype, major challenges facing online educators are the high dropout rates and low completion rates (Lee & Choi, 2011; Levy, 2007; Kolowich, 2013). The poor student success rates in online courses are of concern given the sheer numbers of students involved in addition to the significant investments made by higher education institutions in designing and delivering online education. A commonly cited issue leading to high dropout rates is the “*one size fits all*” approach to course design (Sammour, Gladun, Khala, Al-Zoubi, Schreur, 2015; Williams et al., 2014; Lee & Choi, 2011; Levy, 2007) and Learning Management Systems (LMSs)(e.g. Moodle, Blackboard, WebCT) promote a one size fits all approach (Oskouei & Kor, 2016) and thus the same content and instruction are delivered to learners in the same format irrespective of their differences. Increasingly evident in online learning environments is the diversity of students’ cultural backgrounds (Jayatilleke & Gunawardena, 2016). However, issues of online cultural diversity are largely ignored in online learning, to the detriment of learning quality. Neglecting culture in course design is one of the reasons for low student success but we do acknowledge that reasons for low success are complex, varied, and some are due to social, cultural, or personal circumstances beyond control of instructors and institutions. Perhaps the most easily controlled aspect of online learning, is the instructional or course design. The question is how to design online courses that are contextualized to the diverse students’ cultural backgrounds (importantly this also raises the question of what is culture – a complex issue discussed shortly).

Teaching philosophy differ among societies and this leads to different expectations in the teaching and learning process (Hofstede, 1986) thus different cultures handle the teaching and learning process differently. When students and course designers come from different cultural backgrounds come together, conflicts may arise due the differences in role expectations, usefulness of learning objects, and instructional approaches which results into several pedagogical challenges that lead to poor learning experiences, engagement, and learning outcomes (Mei & Boyle, 2010; Hannon & D'Netto, 2007).

Culture impacts *cognitive processe*s, *perceptions* and *interactions* within educational settings (Hofstede, 1986) and also impacts learner satisfaction, participation, engagement, and usability in e-learning systems (Hannon & D'Netto, 2007). Online learning system components such as interface layout, icons, language, menus, procedures, and interaction schemes present different challenges to learners from different cultural backgrounds (Hannon & D'Netto, 2007). Similarly, how students interact with instructional sequence, assessment style etc. is influenced in part by culture. The multicultural nature of online learning environments calls for cultural adaptation in online course design and delivery. McLoughlin & Oliver (2000), addressing cultural diversity in online learning design improves student motivation, satisfaction, and results into positive learning experiences. Despite the undeniable impact of culture on online learning, and the need for culture sensitivity, there is a dearth of research on how cultural aspects should be addressed during online course design (Jayatilleke & Gunawardena, 2016; Ogan & Johnson, 2015; Al-Harthi, 2014; Parrish & Linder-VanBerschot, 2010). This dearth is attributed to many reason such as complexity of culture, lack of frameworks and models for addressing cultural issues during course design and culture is hard to represent in computational models thus can't be processed by machines (Ogan & Johnson, 2015; Parrish & Linder-VanBerschot, 2010; Savard, I., Bourdeau & Paquette, 2008).

In the present concise paper we present some insights gained from early data relating to exploring the culturally sensitive learning/course design features from the instructional/ course designers perspectives. As earlier noted, lack of tools to support instructional designers in addressing cultural variables during course design was cited a major factor (Savard et al., 2008) in low success/retention in online courses. In the same way, we acknowledge this fact and agree that we cannot provide a complete solution, however, we join others in taking up the challenge by first, seeking to establish the most important culturally sensitive features as a step to developing an approach to support online course designers in designing and delivering courses that fit the sociocultural context of learners using LMSs. One possible solution would be to develop a course for every culture (localization), however, this can be cumbersome and time consuming thus not feasible. Therefore, building adaptivity into LMS course design and delivery to enable cultural adaptation, at least in terms of some of the more significant factors, is desirable.

Conceptual framework

The Socio-cultural theory of learning is informed by the work of Vygotsky (1978) posits that learning is a social, collective and active process that takes place within a social context thus pointing to the fact that social-cultural aspects play a critical role in the learning process and human development. According to Vygotsky (1978), learners create meaning through the social-cultural interactions with the surrounding environment and without which learning becomes difficult. Culture is complex and remains an ill-defined domain because of its multidisciplinary nature ranging from anthropology, psychology, philosophy, sociology, education, and cognitive science among others and this makes it hard to tell what constitutes culture and what is not (Ogan & Johnson, 2015; Mohammed & Mohan, 2013) But, it is important to understand what constitutes culture as relating to learning environments. Collis (1999*)defined culture "as the beliefs, philosophies, traditions, values, perceptions, norms, customs, arts, history, experiences, and patterns by individuals and groups* (p. 204) Savard *et al.,* (2008) mentioned two major component of a person's culture including individual and collective cultures of which individual culture refers to a "*set of general knowledge acquired by an individual*" whereas collective culture is a "*set of usages, customs, artistic, religious, and intellectual expressions that define and differentiate a group, a society*". In the present study, we're concerned about collective culture referring to the enduring patterns of behaviors, beliefs, and values exhibited by an individual as a result of identifying with a particular group in society.

Throughout literature, various authors have sought to expand understanding of the complex concept of culture by considering similarities and differences among cultures and by identifying various cultural constructs which are thought to constitute the idea of culture. There are various cultural frameworks that explain the similarities and difference of two or more cultures based on a given set of cultural constructs. However, every model has its own set of constructs and scope upon which cultural variations are measured. Historically, anthropologists took a leading role and endeavored to simplify and categorize culture, however, the work of Hofstede (1980), Trompenaars &Hampden-Turner, C. (1998), and Hall (1976) among others have been recognized in many disciplines. In addition, we have cultural based models specific to educational setting such as the Multiple Cultural Model (Henderson, 1996), Cultural Dimensions Learning Framework (Parrish & Linder-VanBerschot, 2010). For purposes of this study, we conceptualize culture from the instructional design point of view using Hendersons' (1996) multiple cultural model. Henderson (1996) developed the "Multiple Cultural model" for understanding cross-cultural dimensions in interactive multi-media learning environments. Henderson(1996) argues that "*minority ethnic groups or developing nations looking for technological solutions to their educational and training needs will not be well served by packages designed for a majority Western culture*" (p. 93). Henderson's model is comprised of 14 dimensions that can be applied in understanding learning preferences of learners from different cultures and these include: *epistemology, underlying psychology, pedagogical philosophy, instructional sequence, goal orientation, experiential value, teacher role, programs flexibility, value of errors, accommodation of differences, learner control, user activity, collaborative learning, and origin of motivation.* Henderson's Multiple Cultural Model is based on the "*eclectic paradigm"* which posits that learning materials should support flexibility and variability by reflecting multiple cultural values and perspectives so as to promote equity and enhance learning outcomes (Henderson 1996). Collis (1999) states that the *eclectic* means providing a variety of learning experiences to cater for the diverse cultural learning needs. Embracing the eclectic paradigm in designing and delivering courses to culturally diverse student cohorts is our major concern. Online learning environments are cultural artefact that reflects the cultural values, expectations and beliefs of the designers (Parrish & Linder-VanBerschot, 2010; Swierczek & Bechter, 2010; Henderson, 1996) thus learning design features such as communication tools, assessment, and feedback techniques, learning support mechanisms and instructional approach always reflect the preferences of the designers. McLoughlin (1999) observed that culture and the learning context "*are interwoven and inseparable*" (p.232) and the process of instructional or course design in online learning is a cultural activity (Parrish & Linder-VanBerschot, 2010).

A survey of empirical studies on cultural influences in online learning environments utilizing Henderson's Multiple Cultural Model (Henrson,1996) as a conceptual framework revealed some of the culturally sensitive learning design features presented into three dimensions including roles and responsibilities, course design elements, and presentation dimension. Roles and responsibilities refer to the role pairs as regards to how power and authority are shared and elements include: teacher and learner roles. Course design elements refer to the key course design features within online learning environments and these include: Course structure (Mercado, Parboteeah, & Zhao, 2004); Course content (Mercado et al., 2004); Assessments and assignment (Mercado,et al., 2004); Feedback (Savard, 2014; Stewart, 2012); Collaboration (Liu, Liu, Lee, & Magjuka, 2010).); Communication (Savard et al, 2008; , Swierczek & Bechter, 2010); Rewards mechanism/Motivation (Savard et al, 2008); Learner support (Swierczek & Bechter, 2010; Collis, 1999). Presentation dimension addresses learning design features from the Computer Human Interaction perspective and these include: Navigation & hierarchy (Mercado *et al.,* 2004); Layout (Reinecker & Bernstein, 2010; Mercado *et al.,* 2004); Language (Swierczek & Bechter, 2010; Mei & Boyle, 2010).

Methodology

The study adopts a design based research as we intend to design an approach for cultural adaption.

In the initial phase of the project the emphasis is on identifying the course/learning design features while confirming the need for an approach. This is being achieved through the use of survey collected data. We wish to capture both the perspective of course designers (instructional designers and academics), and later students perspectives. The initial survey was designed based on a list of course/learning design features generated from literature review on culture influences in online learning. One section elicited demographic data and the other section was for identifying the most culturally sensitive course design features. Other questions related to participant perceptions of the importance of culture in online learning design. The respondents were asked questions such as "How important do you believe it is to consider culture making decisions related to each of the following learning design features?" A 7-point Likert scale was used from 1=not at all important to 7= extremely important. Data was collected via an email survey to Griffith Business School and the School of Information and Communication Technology, 19 surveys are received to date. Respondents included faculty academics, instructional designers, curriculum advisors all of which had been involved in designing and/or delivering online courses.

Preliminary insights

Our early data points to a general agreement among participants that culture is an important consideration in the design of online learning environments. 60% of respondents agreed mostly or entirely that culture is an important course design factor influencing student learning outcomes (mean = 5.65), and 52% agreed that culture is an important course design factor influencing student engagement and participation (mean=5.58). All participants agree (50% strongly agree, 25% mostly agree and 25% somewhat agree) that is necessary to consider cultural values in the design of online courses but they made it quite clear that cultural values are complex and difficult to understand, 50% of respondents felt there were some good theories about the role of culture in learning but the remaining half felt that there were not. Interestingly, less than 40% felt they had the necessary knowledge and skills to integrate cultural considerations in their course design. Furthermore, insufficient time to give consideration to culture in online design was identified as an issue (with only 10% agreeing or mostly agreeing they had enough time). A key issue identified in the survey from the preliminary data is that all participants agreed to some extent that "there is a need for better models and frameworks to guide culturally sensitive instructional design of online learning environments". Participants were also asked the open ended question of what is needed to better address culture in their course design. Of the 12 comments received, all but 2 related to the need for training and the need to understand better the influence of culturally diverse students. The need for more funding for time and tools to design to these needs was also raised.

To identify which course elements designers give consideration to in terms of culture, participants were asked "How important do you believe it is to consider culture making decisions related to each of the following learning design features?" .The roles and responsibilities (teacher role, student role) dimension gained the highest agreement with mean score of 6.89. This was followed by collaborative course elements with a mean of 6.37. Agreement on the importance of culture in how the content is presented had a mean value of 5.86. Agreements about importance of culture in relation to course structure and instructional flow was lower. It is interesting that although there is much evidence from the Human-Computer-Interaction perspective on how culture impacts interface design, participants tended to consider these features less important. It appears that most of the course designers were concerned with aspects of the learning environment which involved communication. Other features of the course design were comparatively less important. Potentially this is more evidence for better models and understanding of the impact of culture along with greater knowledge of interface design.

Conclusion and future work

Although, the project is in early stages and data obtained to date is meager, the results align with what was gleaned from the survey of literature in the area. It is agreed generally that culture is important in online learning design, but to attend to culture is not simple and straightforward, but rather difficult and time consuming. This is attributed to the fact that culture is complex and its influence on student learning and experience are still not well understood. There is thus a need for further research to unravel the dimensions of culture and to cast some light on which of the dimensions are most important in terms of impacting on learner outcomes and engagement. The project proposed seeks to contribute in this way by establishing the most important culturally sensitive learning design features in online course design and delivery as a step to developing an approach for addressing cultural diversity in LMS. Course designers feel relatively poorly equipped with the skills and tools needed to effectively integrate culture into course design, designing for cultural adaptivity is time intensive. Thus, there is a need to develop more effective, efficient and easy to use methods of incorporating culture.

Our preliminary data is helping to identify the most culturally sensitive learning design features in online learning design and delivery from the instructional/course designers' perspectives. Additionally, the finding that cultural considerations are predominantly being implemented in online interaction tools but not in educational tools raises the issue of possible lack of knowledge and aligns with the participants views of the need for more training and better tools and frameworks.

One limitation about this undertaking is the view that there is a potential of undermining the ability of learners to develop intercultural competence. It is true that learners need intercultural skills to survive in the changing the world, however, our concern is embracing the *eclectic* paradigm which is about providing a variety of learning experiences to cater for the diverse cultural learning needs. Nonetheless, we bring the culturally sensitive learning design features to the attention of online instructional/course designers while at the same time provoking discussion on the nature of culture itself.

References

Al-Harthi, A.S. (2014). An analysis of culture-focused articles in open, distance, and online education journals. In Jung, I. and Gunawardena, C.N. (Eds.), *Culture and Online Learning* (pp. 161-173). Stylus Publishing LLC, Sterling, VA.

Collis, B., (1999). Designing for differences: Cultural issues in the design of WWW-based course support sites. *British Journal of Educational Technology*, *30*(3), 201-215. DOI: https://doi.org/10.1111/14678535.00110

Dunn, P., & Marinetti, A.(2007). Beyond Localization: Effective Learning Strategies for Cross-Cultural Elearning. In A. Edmundson, Globalized E-Learning Cultural Challenges (pp.255-265), Hershey.PA: Idea Group Inc.

Hall, E.T. (1976), Beyond Culture, Doubleday, New York, NY.

Hannon, J., & D'Netto, B. (2007). Cultural diversity online: student engagement with learning technologies. *International journal of educational management*, *21*(5), 418-432. Retrieved https://doi.org/10.1108/09513540710760192

Henderson, L. (1996). Instructional design of interactive multimedia. *Educational Technology Research and Development*, 44(4), 85-104. DOI: 10.1007/BF02299823

Hofstede, G. (1980). *Culture's consequences: International differences in work-related values*. Beverly Hills, CA: Sage.

Jayatilleke, B. G., Jayatilleke, B. G., Gunawardena, C. (2016). Cultural perceptions of online learning: transnational faculty perspectives. *Asian Association of Open Universities Journal*, *11*(1), 50-63. https://doi.org/10.1108/AAOUJ-07-2016-0019

Kolowich, S. (2013). The professors who make the MOOCs. *The Chronicle of Higher Education, 18*. Retrieved from http://www.chronicle.com/article/The-Professors-Behind-the-MOOC/137905

Liu, X., Liu, S., Lee, S.-h., & Magjuka, R.J. (2010). Cultural Differences in Online Learning: International Student Perceptions. *Educational Technology & Society*, *13*(3), 177–188. Retrieved from http://www.jstor.org/stable/jeductechsoci.13.3.177

McLoughlin, C. & Oliver, R. (2000). Designing learning environments for cultural inclusivity: a case study of indigenous online learning at tertiary level. *Australian Journal of Educational Technology*, 16(1), 58-72. DOI: https://doi.org/10.14742/ajet.1822

McLoughlin, C. (1999). Culturally responsive technology use: developing an on-line community of learners. *British Journal of Educational Technology*, 30, 231–243. DOI:10.1111/1467-8535.00112

Mercado, S., Parboteeah, K.P., & Zhao, Y.(2004). On-line course design and delivery: Cross-national considerations. *Strategic Change,* 13(4), 183-192. doi:10.1002/jsc.677

Mei, Q., & Boyle, T. (2010). Dimensions of culturally sensitive factors in the design and development of learning objects. *Journal of Interactive Media in Education*, *2010*(1). DOI: http://doi.org/10.5334/2010-6

Mohammed, P., & Mohan, P. (2013). Breakthroughs and challenges in culturally-aware technology enhanced learning. In *Proceedings of Workshop on Culturally-aware Technology Enhanced Learning in Conjunction with EC-TEL*.

Lee, Y., & Choi, J. (2011). A review of online course dropout research: Implications for practice and future research. *Educational Technology Research and Development, 59*(5), 593-618. Retrieved from http://www.jstor.org/stable/41414962

Levy, Y. (2007). Comparing dropouts and persistence in e-learning courses. *Computers and Education*,48(2), 185–204. https://doi.org/10.1016/j.compedu.2004.12.004

Reinecke, K., & Bernstein, A. (2013). Knowing What a User Likes: A Design Science Approach to Interfaces that Automatically Adapt to Culture. *MIS Quarterly*, *37*(2). Retrieved from http://aisel.aisnet.org/misq/vol37/iss2/8/

Ogan, A., & Johnson, L.W. (2015). Preface for the special Issue on Culturally Aware Educational Technologies. *International Journal of Artificial Intelligence in Education*, *25*(2), 173-176. Doi:10.1007/s40593-015-0036-1

Oskouei, R.J & Kor, N.M.(2016). Proposing a novel adaptive learning management system: an application of behavior mining & intelligent agents. *Intelligent Automation & Soft Computing*. DOI:10.1080/10798587.2016.1186429

Parrish, P., & Linder-VanBerschot, J. (2010). Cultural dimensions of learning: Addressing the challenges of multicultural instruction. *The International Review of Research in Open and Distributed Learning, 11*(2), 1-19. doi:http://dx.doi.org/10.19173/irrodl.v11i2.809

Sammour, G., Al-Zoubi, A., Gladun, A., Khala, K., & Schreurs, J. (2015, December). Semantic web and ontologies for personalisation of learning in MOOCs. In *Intelligent Computing and Information Systems (ICICIS), 2015 IEEE Seventh International Conference on* (pp. 183-186). IEEE.

Savard, I., Bourdeau, J., & Paquette, G. (2008). Cultural variables in the building of pedagogical scenarios: The need for tools to help instructional designers. In *CATS 2008: Workshop on Culturally-Aware Tutoring Systems* (p. 83).

Swierczek, F.W., & Bechter, C. (2010). Cultural features of e-learning. In J.M. Spector, D. Ifenthaler, P. Isaias, Kinshuk and D. Sampson (eds.) *Learning and instruction in the digital age* (pp. 291-308). Boston, MA: Springer US.

Trompenaars, F. & Hampden-Turner, C. (1998). *Riding the waves of culture: Understanding diversity in global business*. New York, McGraw-Hill.

Vygotsky, L.S.(1978). *Mind in Society*. Cambridge, MA: Harvard University Press, 1978.

Williams, J. J., Li, N., Kim, J., Whitehill, J., Maldonado, S., Pechenizkiy, M., & Heffernan, N. (2014). *The MOOClet framework: Improving online education through experimentation and personalization of modules*.

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Face-to-face and virtual mathematics enrichment for rural schools: Intersection of teachers, students, technology and pedagogy

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In this paper the authors report on the University of Southern Queensland's (USQ) Mathematics Rural and Regional Communities (MRRC) project. This project is an extension to the Mathematics Enrichment Program (MEP), which has been running since 2007. Since the MEP's inception, more than 500 students, 29 schools, 15 pre-service teachers (who are involved to gain practical teaching experience) and many volunteer university lecturers and other mathematics and education professionals have been involved. The MRRC project builds on USQ's MEP to offer content in an online or virtual format. Through an interactive virtual environment, the MRRC project connects regional high schools to USQ's two campuses to build the capacity of the teachers and students involved. The authors describe the overall aim and structure of the MRRC program, preliminary evaluations of the program, analysis of the virtual space and future plans for the program.

Introduction

Research has shown that nowadays students typically hold negative attitudes towards mathematics; however research has also demonstrated that such negative perceptions can be addressed by showing students how mathematics can be relevant to their lives (Galligan & Woolcott, 2015). Indeed studies in Science, Technology, Engineering and Mathematics (STEM) education have found that students become more interested in engaging in science, technology and mathematics if the learning opportunities presented to them are more personally relevant and presented in a manner that involves active learning and a student-centred rather than teacher-centred learning focus (Christensen, Knezek, & Tyler-Wood, 2015; Maass & Artigue, 2013; McGregor, 2016). From a learning perspective, student-centred active learning has also been shown to improve long-term knowledge retention and create a deeper understanding (Bonwell & Eison, 1991; Gallagher, 1997). Thus, to engender such deep understanding and to present content that has relevance to students' lives, the program reported in this paper has been designed to incorporate an active learning approach that is presented through regionally relevant group-based learning activities.

Literature review

Despite increasing evidence that student interest in mathematics can be enhanced through the use of enrichment strategies and real-life teaching and learning examples, to date, there are limited examples of extra-curricular programs that have been specifically designed to give rural and remote students and their teachers access and opportunities to engage in targeted mathematics enrichment curricula (Marginson, Tytler, Freeman, & Roberts, 2013). What's more, for those STEM education programs that are designed for, and conducted in regional communities, evaluation of the effectiveness of the programs is often limited or not yet reported. For example, from an online learning perspective, the TSAA Virtual School in Queensland, Australia offers courses in astronomy and coding for high-school students, however the benefits students receive from participating in these online learning experience are only just beginning to be evaluated. The STEM Virtual School project has also been recently established in Australia and uses the ISee® platform to link year 6 students from a rural region (the Western Darling Downs) to a program operated out of the metropolitan areas of Brisbane and Cairns; however the relative recent development of this program means evaluations into its effectiveness are yet to be reported. Research conducted in the U.S.A. has provided some preliminary evidence that extra-curricular summer programs can have positive effects on middle school students' mathematics achievement (Somers, Welbeck, Grossman, & Gooden, 2015) and while similar programs in Australia have proved to be popular (for example see http://acems.org.au/mathscraft/), these programs are typically presented in a face-to-face format. Given access is often an issue for communities in regional and remote areas (Lyons, Cooksey, Panizzon, Parnell, & Pegg, 2006), more appropriate online and interactive-based enrichment opportunities need to be designed for use in these areas.

In addition to the need to develop programs that better address the learning needs of rural and remote communities, there is also a need to design more effective mathematics-teacher education programs that help mathematics teachers develop the skills to deliver these programs. Teaching modelling and problem solving is difficult and there is evidence that these areas of mathematics are currently not taught well in Australian schools (Office of the Chief Scientist, 2012). Recent Australian reports have highlighted the negative effects a shortage of appropriately trained mathematics teachers is having on student interest and engagement in mathematics and hence highlight the concomitant need to design more effective mathematics-teacher education programs (Australian Academy of Science, 2006; Australian Mathematical Sciences Institute, 2012; Marginson et al., 2013; Office of the Chief Scientist, 2012). What's more, as problem solving is one of the four proficiency strands of the F-10 Australian Curriculum: Mathematics, and modelling and problem solving is one of the objectives of the senior QCAA mathematics syllabi, more attention needs to be given to ensure teachers have the confidence and competency to deliver this important area of mathematics. Recent research has indeed demonstrated that participation by pre-service teachers in the modelling process can help to improve the confidence and competence of these professionals in identifying and using problems as mathematical activities for teaching (Axelsen, Galligan, & Woolcott, 2017).

Although there have been numerous education programs designed for and conducted in regional communities that focus on STEM and enrichment-type activities, the MRRC project being reported in this paper is the first to simultaneously combine mathematics education, enrichment activities, online education opportunities and a focus on teacher education. The authors report on the program structure, preliminary evaluations of the program, analysis of the virtual space and future plans for the program.

Aims

The MRRC project has multiple aims and these are to:

- develop communication channels between isolated school communities;
- give students and teachers from rural and remote areas the opportunity to access mathematics enrichment activities through either face-to-face or virtual methods;
- improve teachers' and students' problem solving abilities; and extend their understanding of mathematics through problem solving activities based on local issues;
- encourage students to use mathematics to solve 'real-life' problems and to inspire more students to study mathematics beyond their compulsory school programs;
- contribute to ongoing education of pre-service mathematics teachers by connecting these pre-service teachers with local mathematics and education experts for learning purposes;
- improve the confidence and competence of both pre-service teachers and practicing teachers in utilising modelling and mathematical problem solving as activities for teaching develop an effective online (virtual) method that can be utilised to offer schools in remote and regional areas the same opportunities as schools that participate in the traditional face-to-face method for engaging in extra-curricular mathematics enrichment programs.

The MRRC project is also innovative in three main aspects. Firstly, it connects school students with 'real life' practicing mathematicians and statisticians. By connecting with these professionals, the year 9 and 10 students are able to observe how these professionals use mathematics to solve real-world problems, as well as what it is like to think like a mathematician or statistician. Secondly, it reaches out to the community beyond the Toowoomba and Ipswich regions (e.g. Chinchilla, Kingaroy, Monto, Nanango) to offer these rural and remote communities the opportunity to access resources that may otherwise be inaccessible. Thirdly, it incorporates an educational component for pre-service teachers studying at the university involved.

With regards to this third aspect, the university educational component of the project, in 2015 and 2016, with the support of an Australian Government funded project (http://itspartofmylife.scu.edu.au), pre-service teachers were invited to participate in the project by presenting the mathematics sessions to the year 9 and 10 students with the assistance of professional mathematicians, statisticians and mathematics educators. Under the guidance of these local mathematics and education experts the pre-service teachers developed and then taught a mathematics lesson that focused on the mathematics that underpins everyday life in Australian regional communities (Axelsen et al., 2017). The aim of involving the pre-service teachers was to strengthen the competence and confidence of these teaching professionals in the teaching of mathematics. Combining the educational element for pre-service teachers not only added value to an already successful mathematics enrichment project but it also enabled the development of a series of videos and other resources that are useful for helping both school students and pre-service teachers see the usefulness of mathematics in their everyday life (Axelsen et al., 2017). The project also benefits the participant teachers from the regional and remote schools by demonstrating evidence of the Australian Professional Standards for Teachers (an increase in content knowledge {Standard 2}; and community engagement {Standard 7}) (AITSL, 2014).

Structure of the program

Each year students from the region are invited to participate in five two-hour sessions at the University of Queensland (in Toowoomba or Springfield). The sessions are led by either a mathematician, statistician or by a pre-service teacher under the guidance of a mathematician or statistician. Each session typically attracts up to 50 students from schools in the region. Table 1 provides some examples of sessions that have been run in the past. These sessions are designed to combine problems of a regional interest (e.g. detention basins) with mathematics extension of mathematical concepts that the students' may not yet have encountered or be familiar with (e.g. capture-recapture simulation) and/or with pure mathematics investigations (e.g. why does 2 + 2 = 4?).

While all of the teaching sessions are presented using the traditional classroom face-to-face format, there has been an attempt to develop an online or virtual aspect to the program and on several occasions schools in the region have been able to link in virtually to the teaching sessions. Since 2010 there have been four sessions that have presented the content in both the tradition face-to-face method as well as virtually. In 2010 and 2012, two and four schools respectively were linked virtually using the Education Queensland portal as the interface. For these sessions a mathematics teacher was employed at the participating remote schools to act as a contact point between the school and the university. The main reason for involving a liaison person was to ensure no firewalls impeded the process and to ensure a seamless link to the school was created. The participating schools were sent any relevant handouts or PowerPoint files beforehand. The tutorial room at the university gave students access to live discussion with the presenter. While active questioning was possible, the dynamic nature of the classroom meant that any communication was usually via the liaison teacher and usually using a chat facility.

Table 1 – Examples of sessions presented

Modelling question	Expert who presented the session	Mathematical skills addressed in the session
How can we cost effectively water a sports oval?	Mathematician (PST had expertise in the horticultural industry assisting customers with irrigation)	Year 9 level mathematics, including understanding variables, manipulating equations, and solving for unknowns, and understanding of pressure.
Planning the queue for a new theme park ride	Operations Research mathematician	Understand variables; average; (underlying probability)
How much sunlight am I getting? (Downs et al., 2015)	Mathematician (expert in UV radiation modelling)	Graphing, ability to understand basic trig functions and indexes; integration using areas
Detention basins: bad for school but good for flood mitigation	Engineer with expertise on flood mitigation	Volume and flow rate calculations; interpreting graphing; estimating area using the "strip method"
Why does 2 + 2 = 4?	Mathematician	Explanation of axioms; understanding of e.g. $P(0) \cap P(x) \Rightarrow P(x') \Rightarrow \forall x P(x)$
Estimating Olympic running times	Statistician	Using formula; linear regression; mean and standard deviation
Go bananas: machine vision in agriculture	Robotics engineer	Measurement (cylindrical approximation)

In 2015 and 2016, Zoom, a video conferencing program, replaced the use of the Education Queensland portal to link with the schools that were participating online. An advantage of utilising Zoom was the ability it presented for enabling students to utilise tablet screens to communicate their mathematical calculations and results. While it was possible for the presenter to manage the virtual students without help from a liaison person, the session was more successful when a dedicated liaison person was able to be the eyes and ears for the virtual classrooms. Once a presenter was familiar with the equipment, Zoom allowed for more interaction with the virtual students as the students in the face-to-face classroom could see the students who were linked virtually. The video facility in the face-to-face classroom also enabled the virtual students the see the students in the face-to-face classroom, as well as the presenter and/or the presentation. In addition, one school had a Tablet PC and were therefore able to annotate their screen to present to the whole class. Three schools were linked virtually in each of the 2015 and 2016 sessions.

While the virtual classroom was successful, there were a number of impediments to the process:

- it still needs a dedicated liaison person to ensure the virtual students are well seen and heard;
- the teacher in the virtually-linked school needs to have competent IT skills in order to be able to actively engage in the process and to ensure the session proceeds smoothly;
- it needs a presenter who is cognisant of the virtual students to ensure those students are not lost in the moment-to-moment activities of the session.

Evaluation

Since its inception, USQ's MEP, and more recently the MCCP, has consistently been evaluated through: end-of-semester surveys given to participants (students, participating teachers, and pre-service teachers); end-of-session "emotion diaries" completed by student participants; and unsolicited emails received from people involved in the program (students, pre-service teachers, teachers, and the experts involved). Through these evaluations, the success the program has had in engaging with students and increasing their interest in mathematics is indeed evident. For example, of the students who participated in the 2016 iteration of the program, 95.1% (N = 43) agreed they would recommend fellow students participate in the program (the remaining 4.9% were neutral). In addition to the quantitative question regarding recommended participation, survey participants were asked to provide some qualitative feedback about their satisfaction with the program. The following responses to this open-ended question illustrate the general endorsement participants gave to the program. The first quote particularly epitomises what the program is trying to achieve:

> *The sessions really opened my eyes as to what maths could be. We were given the chance to explore so many interesting and varied sub-topics of maths and the group setting and open atmosphere really allowed us to get involved in what we were learning. The sessions were so engaging that they stayed with me and influenced my decisions from there on out. I am now in my third and final year of my Bachelor of Science at USQ, majoring in Mathematics and Statistics. I'm very lucky to have had many invaluable experiences and opportunities in my life but if I had to narrow them down to the one thing that got me started on this mathematical path, it would be the Maths Enrichment program from five years ago.* (3rd year USQ student, 2015)

> *The maths enrichment program gave me exposure to all sorts of maths problems and ways of solving them. The program has made me more confident in maths and has been very enjoyable.* (Student, 2010)

> *School is a small rural high school situated in the [rural area] of Queensland. Opportunities for our teachers and students to collaborate with colleagues and peers to solve mathematical problems are rare. For the past two years our students have participated in USQ's Mathematics Enrichment program and have benefitted enormously from this interaction. Our students have the opportunity to solve complex, real-life problems in real time with students from across the [rural] region. Our teachers have the opportunity to interact with University Staff and Students providing excellent professional development opportunities.* (Teacher: rural high school, 2015)

In 2015 participating students were asked to complete an emotion diary after completing the sessions. Emotional diaries capture self-analysis of affect (emotion-related responses) during certain critical moments of the lesson (Yeigh et al., 2016). In these diaries two common themes emerged: the first theme involved meeting and discussing mathematics with new, like-minded, and 'respectful' peers; and the second was undertaking new, different, 'real-life' problems that opened the students' minds and made them think and thus feel (and express) pride in being able to complete complicated mathematics problems. On average students rated their interest (out of 10) during the lesson between 7.3 and 8.1.

Conclusion and future direction

The project has already benefitted a wide range of stakeholders, including teachers, schools, universities, industry and regional/rural communities. Through its aims and innovative approach the project has been found to meet a number of needs. It provides an avenue for students in the Darling Downs and Springfield regions to engage with other enthusiastic students, to develop mathematical thinking, and to appreciate the value of mathematics before making decisions about taking higher levels of Mathematics subjects in years 11 and 12, where numbers have been declining for more than a decade (Office of the Chief Scientist, 2012). It brings together professional mathematicians and statisticians in the community and provides an avenue for them to discuss their passion for their discipline with younger learners. It provides universities with a novel method for improving the education of pre-service mathematics teachers. It engages the participating schools (and hence the school's teachers and students) in free, ongoing mathematics enrichment activities that are relevant to the local regions and finally, it provides value for money as it provides teachers with a link to free university professional development, as well as enrichment for school students (both through face-to-face and virtual classroom contact), while also providing universities with an avenue through which to improve student teacher education through access to relevant 'real world' teaching experiences. Arguably, the outcomes of this project and research will provide practical examples and innovative methods that can be utilised by curriculum developers, teacher educators and those responsible for professional development.

In 2018 the program is being extended to include a virtual hub that provides access for students through synchronous sessions and asynchronous follow-up sessions. After participating in their virtual lesson, students will be presented with opportunities to continue working on their problem/model and collaborate asynchronously using an online forum. In addition, more formal research and analyses with is being conducted to better understand student participants' perceptions of both the program and about mathematics as a subject and as a potential future career option. The project will continue to operate as an action-based research project with both qualitative and quantitative components and iterative cycles of the mathematics enrichment sessions.

References

AITSL. (2014). Australian Professional Standards for Teachers. Retrieved from https://www.aitsl.edu.au/australian-professional-standards-for-teachers/standards/list

Australian Academy of Science. (2006). *Mathematics and statistics: Critical skills for Australia's future: The national strategic review of mathematical sciences research in Australia*. Parkville, Vic.: Dept. of Mathematics and Statistics, University of Melbourne.

Australian Mathematical Sciences Institute. (2012). *Senate Inquiry: Teaching and learning - Maximising our investment in Australian schools*. Retrieved from http://www.amsi.org.au/images/stories/downloads/pdfs/general-outreach/AMSI_Sub_Teaching_and_learning_Oct2012.pdf.

Axelsen, T., Galligan, L., & Woolcott, G. (2017). The Modelling Process and Pre-service Teacher Confidence. In A. Downton & S. Livy (Eds.), *40 years on: We are still learning! (Proceedings of the 40th annual conference of the Mathematics Education Research Group of Australasia)* (pp. not yet available). Melbourne: MERGA.

Bonwell, C. C., & Eison, J. A. (1991). *Active Learning: Creating Excitement in the Classroom. 1991 ASHE-ERIC Higher Education Reports*: ERIC.

Christensen, R., Knezek, G., & Tyler-Wood, T. (2015). Alignment of hands-on STEM engagement activities with positive STEM dispositions in secondary school students. *Journal of Science Education and Technology, 24*(6), 898-909.

Downs, N., Parisi, A. V., Galligan, L., Turner, J., Amar, A., King, R., Butler, H. (2015). Solar radiation and the UV index: An application of numerical integration, trigonometric functions, online education and the modelling process. *International Journal of Research in Education and Science, 2*(1), 179-189.

Gallagher, S. A. (1997). Problem-based learning: Where did it come from, what does it do, and where is it going? *Journal for the Education of the Gifted, 20*(4), 332-362.

Galligan, L., & Woolcott, G. (2015). *It's part of my life. Engaging university and community to enhance mathematics education: the USQ experience*. Paper presented at the Building the Culture of Evidence-based Practice in Teacher Preparation for Mathematics Teaching (CEMENT) project steering committee, Conversations on Knowledge for Teaching Conference, Launceston. http://conversationsonkft.weebly.com/parallel-conversations-contributors.html

Maass, K., & Artigue, M. (2013). Implementation of inquiry-based learning in day-to-day teaching: a synthesis. *ZDM Mathematics Education, 45*(6), 779-795.

Marginson, S., Tytler, R., Freeman, B., & Roberts, K. (2013). *STEM: country comparisons: international comparisons of science, technology, engineering and mathematics (STEM) education. Final report.* Melbourne: Australian Council of Learned Academies Retrieved from http://dro.deakin.edu.au/eserv/DU:30059041/tytler-stemcountry-2013.pdf.

McGregor, D. (2016). *Exploring the Impact of Inquiry Learning on Students' Beliefs and Attitudes towards Mathematics.* (PhD), The University of Queensland, St Lucia.

Office of the Chief Scientist. (2012). *Mathematics, engineering & science in the national interest.* Canberra: Australian Government, Office of the Chief Scientist. Retrieved from http://www.chiefscientist.gov.au/category/archives/mathematics-engineering-and-science-report/.

Somers, M. A., Welbeck, R., Grossman, J. B., & Gooden, S. (2015). *An Analysis of the Effects of an Academic Summer Program for Middle School Students*. New York City and Oakland, CA: MDRC Retrieved from http://www.mdrc.org/sites/default/files/Bell_FR_0.pdf.

Yeigh, T., Woolcott, G., Donnelly, J., Whannell, R., Snow, M., & Scott, A. (2016). Emotional literacy and pedagogical confidence in pre-service science and mathematics teachers. *Australian Journal of Teacher Education, 41*(6), 107-121.

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Explaining learning achievement in student experience of blended learning: What can a sociomaterial perspective contribute?

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Drawing on theories of student approaches to learning and sociomaterial perspectives on learning, we investigated how a combination of sociocognitive and sociomaterial variables explain variation in 365 students' learning achievement in a first year human biology blended learning course in an Australian research intensive university. We used a close-ended questionnaire to measure students' approaches to learning through inquiry, approaches to using online learning technologies, and their use of on-campus physical learning spaces. We obtained use of online learning tools in terms of frequency and duration through analytics provided by a proprietary learning management system. Students' learning achievement was evaluated using six assessment tasks in the course. Correlation analyses were conducted to examine the relationship between approaches, use of online learning tools, use of on-campus physical learning spaces, and achievement. Based on the correlation results, we regressed learning achievement on approaches, use of online learning tools and physical learning spaces. The results showed that introducing sociomaterial variables into the regression model, a significant proportion of learning achievement was explained over and above the explanations offered by sociocognitive factor alone, highlighting the important role of both sociocognitive and sociomaterial factors in blended learning.

Introduction

To investigate students learning experience in blended learning, in which students move forth and back across in-class and on-line contexts, some bodies of research have predominantly focused on sociocognitive variables such as motivation (e.g., Albert, & Dahling, 2016), emotion (e.g., Schutz & Pekrun, 2007), and self-efficacy (e.g., Wu, 2017). Other bodies of research into learning have focused predominantly on material aspects of the experience, such as frequency and time spent on interacting with online learning tools (Greller & Drachsler, 2012). In comparison, few studies look at combinations of sociocognitive and sociomaterial variables and how these are related to qualitatively different outcomes. With the increasingly use of technologies, which form an integral part of the learning processes, and learning occurs in both physical and virtual learning spaces, students' decisions about sociomaterial aspects, such as their choices of what type of technologies to use, how to use them, their decisions about where to engage in learning are likely to be shaping and being shaped by sociocognitive factors, including how they conceive of blended learning, how they approach face-to-face (f2f) and online learning, and how they perceive the blended learning environment. However, there is little evidence of the relationship amongst sociocognitive and sociomaterial variables and their combined contributions to the learning outcomes.

To better understand the complexity of variables involved in students' learning experience in blended environments, this study contributes to previous research by considering associations amongst sociocognitive and sociomaterial variables, and their combined contributions to academic achievement. Drawing on student approaches to learning research (known as SAL, Pintrich, 2004) and sociomaterial research (e.g., Fenwick, 2014, Fenwick, Edwards, & Sawchuk, 2015), this study investigates a first year student blended learning experience which required them to move back and forth between in-class and on-line contexts.

Student approaches to learning (SAL)

A key outcome from many studies in SAL research is that students' learning achievement is closely related to a number of interrelated factors, including their prior learning experience, their perceptions of current learning contexts, and how they approach their learning (e.g., Prosser & Trigwell, 1999; Ramsden, 2003). Deep and surface approaches to learning have been consistently identified across disciplines and amongst students in different countries (e.g., Chan, 2014; Duarte, 2007; Trigwell, Ashwin, & Millan, 2013; Trigwell, Ellis, & Han, 2012); and variation in approaches to learning has been demonstrated to be logically related to qualitatively different levels of learning achievement (e.g., Ellis & Goodyear, 2013, Prosser & Trigwell, 1999).

In the contexts of blended courses, how students approach learning, how they use online learning technologies, and their levels of learning achievement have also been found to be logically interrelated: while some students understand the purpose of online learning technologies and use them in a meaningful way to broaden and deepen concepts and ideas in their study, other students limit their using of online learning technologies to merely fulfilling some practical purposes, such as downloading and information gathering (e.g., Ellis & Bliuc, 2016). These outcomes have promising implications for how they might link with research on sociomaterial aspect of learning.

Sociomaterial perspectives on learning

A collective body of theories have contributed to the development of sociomaterial research in learning. These include complexity theory (e.g., Siemens, 2014), cultural historical activity theory (e.g., Miettinen, Lehenkari, & Tuunainen, 2008), actor-network theory, and spatiality theory (e.g., Massey, 2005). Although these areas of research have approached the issues of sociomateriality from different perspectives, they have a common interest in recognising dynamic association between people and artefacts, and their combination in knowledge creation and consolidation (Fenwick, 2015). For example, cultural historical activity theory focuses on “activity” which is coordinated by both human and non-human elements as the primary unit of analysis.

Sociomaterial perspective on learning seeks to understand the interconnections between humans, tools, tasks, and learning environments involved in learning. This perspective is especially useful in the digitally-enabled learning, in which students’ learning take places in both physical and virtual spaces, shaped by material objects and the decisions they make about them, such as the approaches they adopt, the perceptions they have, and where they choose to learn. Drawing on sociomaterial framework, which is able to take into consideration the importance of materiality in learning, and drawing on SAL research on students’ approaches and perceptions of learning, we aim to investigate the relative contributions of student approaches to learning, use of online learning technologies, and use of on-campus physical learning spaces, to their learning achievement.

Method

Participants

The participants were 365 first year undergraduates (females: 69%, males: 31%), who were enrolled in a first year compulsory human biology course in an Australian research intensive university. Their ages ranged from 18 to 53 (Mean (M) = 19.72, standard deviation (SD) = 3.55).

The learning context

The course was semester-long and was an introductory course to human anatomy and physiology. Apart from learning the contents in human biology, the course also aimed to develop students’ inquiry skills, such as creative and critical thinking abilities, scientific writing proficiency, and capacities of research and inquiry.

The course was a blended course which had both f2f and online teaching and learning components. The f2f component included a two-hour lecture per week, a three-hour laboratory session per fortnight, and a two-hour workshop per fortnight when there was no laboratory session. Being an integral and essential part of the course, the online component served as both preparation and revision of the f2f teaching and learning, which was organized under the assumption that students had completed the relevant online learning.

Instruments

Three instruments were used to collect data and the details are described in the following:

Close-ended questionnaire. The closed-ended questionnaire, which was designed to capture students’ approaches to learning through inquiry, approaches to using online learning technologies, and their use of on-campus physical learning spaces. The development of the questionnaire was based on the SAL literature (e.g., Biggs, Kember, & Leung, 2001; Ellis, Bliuc, & Goodyear, 2012) and an internal study of the University on patterns of using on-campus physical learning spaces.

The *Deep approaches to inquiry* scale (5 items; α = 0.71) describes approaches to learning through inquiry as being proactive, with deep thinking to pursue a line of inquiry (e.g., “I often pursue independent pathways when researching something”).

The *Surface approaches to inquiry* scale (4 items; α = 0.63) are approaches that lack of thinking, and are heavily dependent upon teachers (e.g., “Researching something for a task means only using the resources given to me by the teacher”).

The *Deep approaches to using online learning technologies* scale (5 items; α = 0.72) assesses using technologies as a way to promote deeper understanding of the key ideas and to facilitate research (e.g., “I spend time using the learning technologies in this course to connect key ideas to real contexts").

The *Surface approaches to online learning technologies* scale (4 items; α = 0.66) describes using learning technologies as merely to satisfy course requirements (e.g., "I only use the learning technologies in this course to fulfil course requirements").

The single item on *students' use of on-campus physical learning spaces* asks students to choose from: (1) 2-3 days per week for 3-4 hours; (2) 3-4 days per week and stays for 5-6 hours; (3) 4-5 days per week and stays for 8-12 hours. These patterns were identified in a big data study conducted by the University.

Students' use of online learning tools. The data were captured through the learning analytics function in a proprietary learning management system – Blackboard, which recorded the frequency of accessing each online learning tool (count); and the duration of total time for accessing all the online learning tools (minute). The tools used in the course were grouped into three main educational purposes: interactive activities, curriculum information, and adaptive quizzes. The interactive activities consisted of different exercises (e.g., multiple-choice and terminology and image matching). The curriculum information included timetables, outlines of learning objectives and outcomes, reading materials, online videos of course contents, and lecture notes. The adaptive quizzes (through HBonline.com) distributed testing items matching with students' abilities.

Students' learning achievement. Students' learning achievement was measured by six assessment tasks: (1) five summative quizzes throughout the semester (15%); (2) an oral presentation of a case study (8%); (3) questions and reflections of each workshop (3%); (4) peer review of a draft scientific report (4%); (5) final scientific report (20%); and (6) final exam (50%). The learning achievement was scored on 100 point (M = 67.93, SD = of 10.13).

Procedure

Data collection strictly followed the ethical requirements of the University. We ensured that participation of the study was voluntary and all the information of the participants was used anonymously. The questionnaire data collection was taken place in one laboratory session towards the end of the semester so that the students could reflect upon their whole learning experience in the course. Students' use of online learning tools was obtained from the Blackboard using the learning analytics functions upon completion of the course. The students' learning achievement was obtained with the permission from the students.

Data analysis

To answer relative contributions of students' approaches to learning through inquiry and using online learning technologies, use of online learning tools, and use of on-campus physical learning spaces, to students' learning achievement, we conducted correlation analyses followed by hierarchical regression analyses. On the basis of correlation results, we constructed three regression models: in the first model, only students' approaches to learning through inquiry and using online learning technologies variables were entered because SAL research has consistently identified the importance of approaches to learning in learning achievement. In the second model, we added use of online learning tools into the model. In the last model, we added use of on-campus physical learning spaces as an additional variable to predict the learning achievement. This allowed us to examine the contributions of both sociocognitive factors and sociomaterial factors to learning achievement in a single model.

Results and discussion

Results of correlation analyses are presented in Table 1, which shows that the deep approaches to inquiry were positively and moderately correlated with the deep approaches to using online learning technologies (r = .22, p < .01). It had negative and moderate association with the surface approaches to inquiry (r = -.41, p < .01) and the surface approaches to using online learning technologies (r = -.29, p < .01). The surface approaches to inquiry had positive relation with the surface approaches to using online technologies (r = -28, p < .01), but negative and weak relation with the deep approaches to using online technologies (r = -.14, p < .01). The correlation between the two approaches to using online learning technologies was negative and moderate (r = -.46, p < .01).

Concerning the interrelationship between approaches, use of online learning tools, and use of on-campus physical learning spaces and learning achievement, the results showed that while only deep approaches to inquiry significantly and positively related to learning achievements (r = .23, p < .01), all the variables of use of online learning tools are significantly and positively associated with learning achievements (interactive activities: r = .22, p < .01; curriculum information: r = .23, p < .01; adaptive quizzes: r = .28, p < .01; and the total course access time:r = .15, p < .01). The use of on-campus physical learning spaces was also positively correlated with the learning achievement (r = .15, p < .01).

Table 1: Results of correlation analyses

Variables	SAI	DAT	SAT	Interactive activities	Curriculum informatio	Adaptive quizzes	Access time	Physical spaces	Learning achieveme
DAI	-.41**	.22**	-.29**	-.04	-.04	-.05	.04	.10	.23**
SAI	---	-.14**	.28**	.15**	.13*	.08	-.05	-.03	-.10
DAT	---	---	-.46**	.06	.05	.04	.06	.06	.-.05
SAT	---	---	---	-.05	-.03	.05	-.07	-.05	-.04
Interactive activities	---	---	---	---	.97**	.64**	.54**	.09	.22**
Curriculum information	---	---	---	---	---	.67**	.45**	.08	.23**
Adaptive quizzes	---	---	---	---	---	---	.24**	.15*	.28**
Access time	---	---	---	---	---	---	---	.07	.15**
Physical spaces	---	---	---	---	---	---	---	---	.22**

Notes: DAI = deep approaches to learning through inquiry, SAI = surface approaches to learning through inquiry, DAT = deep approaches to using online learning technologies, and SAT = surface approaches to using online learning technologies.

For regression analyses, we only used variables which showed significant correlations with the learning achievement, and the results of three regression models are displayed in Table 2. Table 2 shows that in model 1, the deep approaches to learning through inquiry significantly predicted academic performance, *F* (1, 363) = 16.05, $p < .01$, $f^2 = .08$, accounting for approximately 7% of the variation in the learning achievement. In model 2, introducing the four variables of use of online learning tools explained an additional 8% of variation in students' learning achievement, and this R^2 change was significant, *F* (5, 359) = 7.96, $p < .01$, $f^2 = .18$. However, among the four variables, only frequency of access to adaptive quizzes was a significant predictor to learning achievement (β = .34, $p < .01$). In the third model, including use of on-campus physical learning spaces made an additional 1% contribution to learning achievement, *F* (6, 358) = 7.47, $p < .01$, $f^2 = .19$. The third regression model reveals that altogether students' deep approaches to inquiry (β = .28, $p < .01$), frequency of access to adaptive quizzes (β = .31, $p < .01$), and use of on-campus physical learning spaces (β = .24, $p < .05$), could explain approximately 16% of students' learning achievement. The results of our last regression model demonstrate that in addition to sociocognitive aspects of learning (i.e., approaches), introducing sociomaterial aspects of learning (i.e., online tools and learning spaces) explained an additional 9% of students' learning achievement, suggesting the importance of materiality in blended learning.

Table 2: Results of hierarchical regression analyses

Variables	B	SE B	β	*t*	adjusted R^2	ΔR^2	*p*	f^2
Model 1					.07**	---		
Deep approaches to inquiry	2.47	.62	.27	4.00			.00**	.08
Model 2					.15**	.08**		.18
Deep approaches to inquiry	2.60	.59	.28	4.36			.00**	
Interactive activities	0.04	.08	.13	0.51			.61	
Curriculum information	-0.04	.05	-.22	-0.88			.38	
Adaptive quizzes	0.42	.11	.34	3.87			.00**	
Access time	0.01	.01	.07	0.90			.37	
Model 3					.16**	.01**		.19
Deep approaches to inquiry	2.59	.59	.28	4.39			.00**	
Interactive activities	0.05	.08	.17	0.67			.50	
Curriculum information	-0.05	.05	-.26	-1.03			.30	
Adaptive quizzes	0.39	.11	.31	3.60			.00**	
Access time	0.01	.01	.07	0.88			.38	
Physical spaces	1.88	.90	.14	2.09			.04*	

The results of correlation analyses showed that at the level of variables, students' approaches to learning through inquiry and approaches to using online learning technologies were logically aligned with each other: the two deep approaches and the two surface approaches were positively related; the deep approaches were negatively associated with the surface approaches; and more of using deep approaches to learning through inquiry was associated with better achievement. Apart from the approaches, students' use of different online learning tools and use of physical learning spaces, which are often not considered in most of SAL studies, are also logically related to the learning achievement, that more frequent access to multiple learning activities is related to better learning. Our regression analyses suggested that the predictive power of a combination of sociocognitive and sociomaterial elements to students' learning achievement was much larger than the sociocognitive factor alone.

Conclusion

In this study, we found that not only do the sociocognitive aspects of students' learning experience, as shown in their self-reported approaches to learning through inquiry and using online learning technologies, are important contributing elements to the quality of their learning achievement; but also the sociomaterial aspects of "things", both intangible things, as their use of a variety of online learning tools available in the LMS, and tangible things, as their use of physical learning spaces, such as library, learning hubs, computer laboratories, lecture theatres, are able to explain variations in their learning achievement. In fact, the materiality, which has been backgrounded in the research, even makes a slightly larger contribution to the learning achievement than the long-time focused sociocognitive factors. These results have both theoretical and practical implications. Theoretically speaking, our results suggest that research should be expanded by including elements of the neglected material dimensions when attempting to understand and explain students' learning success, especially in the technologically enabled blended learning where online tools and virtual environments take a significant proportion of learning experience. Only through a combination of human and non-human factors, can we continuously identify factors or a combination of factors which affect students' learning. Practically, teachers should consider improving both students' sociocognitive and sociomaterial learning experience. For the former category, teachers can ask more successful students to share ideas about how they approach the learning through inquiry, such as formulating meaningful research questions, integrating multiple perspectives from research, and exemplar and meaningful ways of using the learning technologies (e.g., using learning technologies to help with conceptual developments in learning). To improve students' sociomaterial learning experience, teachers should help students understand the values of online learning activities, which are not to be separated from their f2f learning, in order to maximise students' online participation.

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References

Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor Study Process Questionnaire: R-SPQ-2F. *British Journal of Educational Psychology, 71*, 133-149.

Chan, Y. K. (2014). Learning approaches and academic achievement in full-time and part-time sub-degree Hong Kong Chinese students. *International Journal of Continuing Education & Lifelong Learning, 6*(2), 75-86.

Duarte, A. M. (2007). Conceptions of learning and approaches to learning in Portuguese students. *Higher Education*, *54*(6), 781-794.

Ellis, R., & Bliuc, A. (2016). An exploration into first-year university students' approaches to inquiry and online learning technologies in blended environments. *British Journal of Educational Technology, 47*(5), 970-980.

Ellis, R., Bliuc, A., & Goodyear, P. (2012). Student experiences of engaged enquiry in pharmacy education: digital natives or something else? *Higher Education, 64*(5), 609-626.

Ellis, R., & Goodyear, P. (2013). *Students' experiences of e-learning in higher education: The ecology of sustainable innovation*. London: Routledge.

Fenwick, T. (2015). Sociomateriality in medical practice and learning: Attuning to what matters. *Medical Education, 48*(1), 44-52.

Fenwick, T., Edwards, R., & Sawchuk, P. (2015). *Emerging approaches to educational research: Tracing the socio-material*. London: Routledge.

Greller, W., & Drachsler, H. (2012). Translating learning into numbers: A generic framework for learning analytics. *Educational Technology & Society*, *15*(3), 42-57.

Massey, D. (2005). *For space.* SAGE, London.

Miettinen, R., Lehenkari, J., & Tuunainen, J. (2008). Learning and network collaboration in product development: how things work for human use. *Management Learning, 39*(2), 203-219.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3-10.

Prosser, M., & Trigwell, K. (1999). *Understanding learning and teaching: The Experience in higher education.* Buckingham: SRHE and Open University Press.

Ramsden, P. (2003). *Learning to teach in higher education.* London: Routledge.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3-10.

Trigwell, K., Ashwin, P., & Millan, E. S. (2013). Evoked prior learning experience and approach to learning as predictors of academic achievement. *British Journal of Educational Psychology, 83*, 363-378.

Trigwell, K., Ellis, R. A., & Han, F. (2012). Relations between students' approaches to learning, experienced emotions and outcomes of learning, *Studies in Higher Education, 37*, 811-824.

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The effect of digital game-based language learning mobile application on the development of complexity, accuracy, and fluency in foreign language monologic oral production among Chinese learners of English as a foreign language

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The study reported the effect of a digital game-based language learning (DGBLL) mobile application "Speaking English Fluently – An Automated Scoring Artificial Intelligent Tutoring System on Spoken English" on the complexity, accuracy, and fluency in foreign language (FL) monologic oral production among 31 second year Chinese university learners of English as a foreign language (EFL). The participants' monologic oral production was measured in the first (week 1) and last week (week 21) of a semester using the same narrative picture description task. The oral production was audio-recorded and transcribed. Both the transcripts and audio-files were analyzed on the complexity, accuracy, and fluency dimensions. The complexity was measured using the number of Mean (*M*) words per T-unit, the accuracy dimension was measured using the number of repairs and errors per 100 words; and the fluency dimension was measured via speech rate (i.e., number of words per minute), and *M* length of pauses. Students were required to download the mobile application and followed the monological practice section twice a week for 30 minutes each time. Using paired sample t-tests, we found that even though the participants' repair rate and speech rate remained unchanged, they produced more complex monologic speech, had significantly fewer errors, and reduced average length of pauses after 20 weeks treatment using the mobile application, demonstrating a positive effect of the DGBLL mobile application on FL learners' monologic oral production.

Introduction

Technology has undoubtedly opened a new era of human being's experience in every domain, including students' learning experience in higher education. With the advent of new technology in mobile and tablets, hundreds of thousands of mobile applications have been developed to facilitate students' learning. Mobile applications enable students to have more freedom than ever before to make decisions as to when, where, and how to study. Among different kinds of educational mobile applications, game-based learning applications have always been popular, because they are able to foster students' intrinsic motivation, to satisfy students' curiosity, to enhance learners' enjoyment, and to improve students' problem-solving abilities in the process of learning (Dickey, 2011; Gee, 2007; Sung, Hwang, & Yen, 2014). In recent years, the use of digital games for the purpose of learning and teaching in foreign language (known as digital game-based language learning, DGBLL) have been an emergent research area (Cornillie, Thorne, & Desmet, 2012). In a special issue focusing on DGBLL, Cornille et al. identified five major research themes in the DGBLL, namely (1) theory development, which integrate concepts of digital game-based learning and the theories of FL acquisition and teaching; (2) design theme, which evaluates technological aspects of one or a number of digital games in language learning and teaching; (3) pedagogical theme, which is concerned with teachers' self-reflection and evaluation of effectiveness of using certain digital games in language teaching; (4) experimental studies, which compare the effect of DGBLL intervention with a control group of traditional intervention; and (5) non-experimental empirical studies, which report the effects of DGBLL on development of one skill in FL learning. The research we reported is in the last theme, in which we examined the effect of using of a DGBLL mobile application for 20 weeks on the development of Chinese EFL learners' monologic oral production based on the complexity, accuracy, and fluency dimensions.

The effect of DGBLL on FL learning

An increasing number of researchers and educators have recognized how technology can be pedagogically exploited to facilitate acquisition and engagement in FL learning in recent years (Shadiev, Hwang & Huang, 2017; Ushioda, 2013). In FL classrooms, more and more teachers have also employed various digital games and applications. The advantages of using these digital games and applications has been described as interactive, enjoyable, exciting, stimulating, and well-structured (Vandercruysse, Vandewaetere, & Clarebout, 2012), and the game-based experience is said to be transferable into language learning (Chiu, Kao, & Reynolds, 2012). Past research has been carried out to examine the gaming environment on FL learning and suggests that when the primary focus of the gaming environment is not on linguistic aspects, the digital games may not necessarily be conducive to language learning (e.g., deHaan, Reed, Kuwada, 2010), whereas gaming environment which supplies sufficient opportunities of repetition of linguistic elements tends to lead to positive gains of language acquisition (e.g., Zheng, Young, Wagner, & Brewer, 2009). Research in DGBLL has also shown that different types of digital games have differential effects on language learning. In a meta-analysis, Chiu et al. (2012) demonstrates that drill and practice digital games only yield small positive effect (0.41 to 0.44) whereas meaningful and engaging digital games have large positive effect size (0.84 to 1.11). Studies in DGBLL have also targeted on the development of different language skills, in particular, there are more studies focusing on vocabulary learning (e.g., Cobb & Horst, 2011; deHaan et al., 2010; Yip & Kwan, 2006). There is a dearth of studies which examine the digital games on the development of FL oral production.

Measurement of FL production

In the literature of FL learning, it is widely acknowledged that learner production is multidimensional in nature, hence, it is difficult to capture such production using a single measurement (Housen & Kuiken, 2009; Norris & Ortega, 2009; Pallotti, 2009). Attempting to represent FL production comprehensively, a number of frameworks have been constructed and testified. For instance, established and developed by the Council of Europe (2011), Common European Framework of Reference for Languages (CEFRL), is a guideline which describes FL learners' performance using communicative competence construct. The framework states in details what constitutes different levels of competence and performance in the four skills (i.e., reading, writing, listening, and speaking) of FL learning.

From a componential perspective, learner performance and production in FL can also be measured by multiple components, namely complexity, accuracy, and fluency, which are known as CAF triad (Skehan, 1998). The three dimensions are widely adopted to describe and assess learner competence and performance, in particular in writing and speaking domains (Ellis & Barkhuizen, 2005; Housen & Kuiken, 2009; Housen, Kuiken, & Vedder, 2012; Ortega, 2003; Skehan, 2009; Yuan & Ellis, 2003). Complexity represents the breadth and depth of the language production (Ellis, 2003); accuracy describes the level of conformity of language production to certain norms (Pallotti, 2009); and fluency indicates the extent of automaticity of language production (Wolfe-Quintero, Inagaki, & Kim, 1998). According to different operationalization, each dimension can be gauged by using different indices (Rosmawati, 2014). In our study, we employed the CAF triad to investigate development of Chinese EFL learners' monologic oral production after using a DGBLL mobile application for 20 weeks.

Method

Participants

The participants were 31 second-year students, who were enrolled in a four-year Bachelor degree in English education in early childhood at a national university in China. All the participants were females as this major tends to attract female students. Their ages were between 19 and 21 with a *M* of 20. All the students reported that they had learnt English as a FL for approximately 10 years.

Instruments

Monologic narrative picture description task for pre- and post- oral production. We used a monologic narrative picture description task to measure the participants' oral production for two reasons. First, monologic tasks are not influenced by interactional factors as in the dialogical tasks. Second, we selected the narrative genre because the participants had intensive practice of narratives in English oral production than the other genre as indicated by their English teachers. We used the same picture description task in pre- and post-test because this reduced the variation of task difficulty to the minimal level. Due to the long period between pre- and post-test (20 weeks), the effect of task repetition would also be negligible. The task required the participants to describe four pictures by telling a story in English. The pictures depicted a story about a little girl who accidentally fell into a river and how she was rescued by her dog. The picture description task was piloted with 5 students with the similar background and English proficiency. None of the students had difficulties in understanding and describing the pictures in English, suggesting that the instrument was appropriate to elicit students' English oral production.

DGBLL mobile application. We used "Speaking English Fluently – An Automated Scoring Artificial Intelligent Tutoring System on Spoken English" mobile application to develop students' oral production. The application ranked as one of the most popular mobile applications in practicing spoken English in China with more than 420 million users. The application was specifically developed for Chinese EFL learners and its special speech recognition system has been created to recognize English speech of Chinese EFL learners. The application allows users to practice spoken English via mobile phone microphones and is able to record learners' speech, which is then analyzed using algorithms integrated with the application in order to compute a score and provide immediate feedback for learners' oral production. The gaming environment of the application is able to engage the learners. First, the application is able to stimulate learners' interests and passion to practice spoken English through game-based elements, such as rewarding users with gold coins and stars, using different ranking systems to give ranks of different users to simulate competitions among game players, and allowing users to break through into different stages like those in other digital games. Second, the topics are diverse so that they can satisfy various needs of different users; and third, the automated scoring system is able to provide immediate feedback and the application can also offer individualized dashboard, which is able to sustain learners' motivation. The students were asked to follow "Imitation of English Monologues" section twice a week for 30 minutes each time to practice monologic oral English.

Procedure

The study had a pre- and a post-test session in the first and last week of a semester with 20-week in between. At the beginning of the semester (week 1), the researchers explained to the students the purposes of the study and invited them to voluntarily participate the study. Then the pre-test, which asked the learners to describe four pictures in a narrative, was conducted to elicit the initial level of monologic oral production of the students. The picture description task was taken away after testing to ensure that students would not have opportunities to practice it between pre- and post-tests. Upon completion of the pre-test, the students were instructed on how to install the mobile application and on what they need to do. During the 20 weeks, the students practiced using their own time and were required to keep their practice recorded on their mobiles each time. After practice, they were also required to keep a log to write down the topics and the duration they practiced. Both the recordings of the practice and the logs were regularly checked by their English teachers to ensure that they followed the instruction. After 20-week practice, the participants' English monologic oral production was examined again by asking them to narrate the same pictures used in the pre-test. Students' narration was audio-recorded.

Coding and data analysis

The audio-recordings were transcribed and both the transcripts and the audio-files were coded in terms of the three dimensions, namely complexity, accuracy, and fluency dimensions (see Table 1). To examine the complexity dimension, we calculated the Mean (*M*) words per T-unit using an online calculator – Sentence Extractor (http://www.lextutor.ca/tools/ex_sent/). A T-unit is an independent clause and any dependent (subordinate) clauses or non-clausal structures that are attached to or embedded within it (Lennon, 1990). The more the number of *M* words indicated the more complex the oral production was.

To examine the accuracy dimension, we used two indices – number of repairs per 100 words and number of errors per 100 words. The number of repairs per 100 words was calculated by dividing the total number of repairs by the total number of words in the speech and then multiplying 100. According to Foster and Skehan (1996), there are five types of repair, including reformulation, replacement, repetition, false start, and hesitation. Reformulation is defined as repeating a phrase or a clause by modifying any of morphological, syntactical, or word order of the phrase or the clause (e.g., The girl **see**…the girl **saw** a ball). Replacement refers to substituting a phrase or a clause with another phrase or a clause (e.g., The girl is **following**…**chasing** the dog). Repetition is restating exactly the same phrase or clause without any modification (e.g., The girl…**The girl** is angry). False start means completely giving up a phrase or a clause (e.g., **The girl is**…**Her parents** are waving to her). Hesitation is referred to as repetition of a phoneme or a syllable of a word (e.g., The dog **ba**… barked to her parents).

Similarly, the number of errors per 100 words was calculated by dividing the total number of errors by the total number of words in the speech and multiplying 100. We included both grammatical (e.g., Her parents is (are) working on the farm) and lexical errors (e.g., The girl is **catching** (picking) the flower). The fewer the number of repairs per 100 words and the number of errors per 100 words means the more accurate the speech was.

To examine the fluency dimension, we used two indices: speech rate and the *M* length of pauses, which were coded under the assistance of the software Cool Edit Professional 2.0 of the recordings. Speech was expressed in terms of number of words per minute and was calculated by the total number of words divided by the speech length (in minutes). The higher the value of the speech rate represented the more fluent the speech was. The *M* length of pauses was expressed in seconds and was calculated by averaging the length of all the pauses in a speech. The longer the *M* length of pauses indicated the less fluent the speech was. In our study, a pause was identified as a break of 1 second or longer either within a sentence or between sentences. We entered the coded data into SPSS 22 and conducted paired sample *t*-tests to examine if there were significant differences on the five indices of the participants' monologic oral production in English between pre- and post-test.

Table 1. Five indices of the three dimensions of monologic oral production in English

Dimensions	Indices
complexity	*M* words per T-unit
accuracy	repairs per 100 words errors per 100 words
fluency	speech rate *M* length of pauses

Results and discussion

Table 2 presents the descriptive statistics of the pre- and post-test. Among these indices, we can see that students have large variation in terms of speech rate as shown in large *SDs* in both pre- and post-test. This index might not only reflect students' fluency in English monologic oral production, but might also be caused by the individual differences in speech rate. We conducted paired sample *t*-tests to examine if the participants' monologic oral production differed between pre- and post-test.

Table 2. Descriptive statistics of pre- and post-test

Dimensions	Indices	Pre-test		Post-test	
		M	*SD*	*M*	*SD*
complexity	*M* words per T-unit	11.94	2.91	15.57	4.05
accuracy	repairs per 100 words	6.07	3.73	5.46	2.30
	errors per 100 words	8.08	2.80	5.99	2.68
fluency	speech rate (per minute)	46.86	14.91	61.33	15.37
	M length of pauses (in seconds)	3.69	2.06	3.10	2.10

In terms of the complexity measure, the paired sample *t*-test showed that the *M* words per T-unit in the post-test (M = 15.57, SD = 4.05) was significantly more than that in the pre-test (M = 11.94, SD = 2.91), t = -5.1, p < .01, indicating that the participants' monologic oral production in English was more complex and they were able to produce longer English sentences after 20-week practice with the mobile application. With regard to the two indices of the accuracy, we found that while the number of repairs per 100 words remained unchanged between pre- (M = 6.07, SD = 3.73) and post-test performance (M = 5.46, SD = 2.30), t = 0.98, p = .33; the participants had significantly fewer errors in the post-test production (M = 5.99, SD = 2.68) than in the pre-test (M = 8.08, SD = 2.80), t = 3.99, p < .01. The significant reduction of the error rate, both grammatical and lexical, may be influenced by the improvement of students' grammatical knowledge and expansion of vocabulary knowledge. The non-change of the repair rate seemed to indicate that the knowledge learnt explicitly (i.e., declarative knowledge) had not been proceduralized (i.e., procedural knowledge), therefore, when the knowledge was used in an online processing task, as in our monologic oral production task, the learners' repair rate did not change.

Similarly, for the two indices of the fluency dimension, we observed that while students' speech rate did not change significantly between pre- (M = 46.86, SD = 14.91) and post- oral production (M = 61.33, SD = 15.37), t = 1.15, p = .25; the *M* length of pauses reduced significantly from the pre-test (M = 3.69, SD = 2.06) to the post-test (M = 3.10, SD = 2.10), t = -4.95, p < .01. In general, our study showed a positive effect of the DGBLL mobile application on the development of Chinese EFL learners' English monologic oral production on all the three dimensions. The mobile application not only enabled students to have much freedom as to when and where to practice spoken English with their mobiles in their free time, but was also able to provide immediate feedback using an automated scoring system. To extend the present study, we will compare the effects of traditional methods of practicing spoken English with the DGBLL mobile applications on FL learners' oral production. In future studies, we will also incorporate multiple indicators of the complexity dimension, such as syntactic complexity and lexical complexity.

References

Cobb, T., & Horst, M. (2011). Does Word Coach coach words? *CALICO Journal*, 28(3), 639-661.

Cornillie, F., Thorne, S. L., & Desmet, P. (2012). ReCALL special issue: Digital games for language learning: challenges and opportunities. *ReCALL*, 24(03), 243-256.

Council of Europe. (2011). *Common European Framework of Reference for Languages: Learning, teaching, assessment.* Strasbourg: Council of Europe.

deHaan, J., Reed, W. M., & Kuwada, K. (2010). The effect of interactivity with a music video game on second language vocabulary recall. *Language Learning & Technology*, 14(2), 74-94.

Dickey, M. D. (2011). Murder on Grimm Isle: the impact of game narrative design in an educational game-based learning environment. *British Journal of Educational Technology*, 42(3), 456-469.

Ellis, R. (2003). *Task-based language learning and teaching*. Oxford: Oxford University Press.

Ellis, R., & Barkhuizen, G. (2005). *Analysing learner language*. Oxford: Oxford University Press.

Foster, P., & Skehan, P. (1996). The influence of planning and task type on second language performance. *Studies in Second Language Acquisition*,18(03), 299-323.

Gee, J.P. (2007). *What video games have to teach us about learning and literacy (2nd ed). New York*: Palgrave Macmillan.

Housen, A., & Kuiken, F. (2009). Complexity, accuracy, and fluency in second language acquisition. *Applied Linguistics*, 30(4), 461-473.

Housen, A., Kuiken, F., & Vedder, I. (2012). Complexity, accuracy, and fluency: Definitions, measurement and research. In A. Housen, F. Kuiken, & I. Vedder (Eds.), *Dimensions of L2 performance and proficiency: Complexity, accuracy and fluency in SLA* (pp. 1-20). Amsterdam/Philadelphia: John Benjamins Publishing Company.

Lennon, P. (1990). Investigating fluency in EFL: A quantitative approach. *Language Learning*, 40(3), 387-417.

Norris, J. M., & Ortega, L. (2009). Towards an organic approach to investigating CAF in instructed SLA: The case of complexity. *Applied Linguistics*, 30(4), 555-578.

Ortega, L. (2003). Syntactic complexity measures and their relationship to L2 proficiency: A research synthesis of college‐level L2 writing. *Applied Linguistics*, 24(4), 492-518.

Pallotti, G. (2009). CAF: Defining, refining and differentiating constructs. *Applied Linguistics*, 30(4), 590-601.

Rosmawati, R. (2014). Dynamic development of complexity and accuracy. Australian Review of *Applied Linguistics*, 37(2), 75-100.

Skehan, P. (1998). *A cognitive approach to language learning*. Oxford: Oxford University Press.

Skehan, P. (2009). Modeling second language development: Integrating complexity, accuracy, fluency, and lexis. *Applied Linguistics*, 30(4), 510-532.

Sung, H. Y., Hwang, G. J., & Yen, Y. F. (2015). Development of a contextual decision-making game for improving students' learning performance in a health education course. *Computers & Education*, 82(1), 179-190.

Vandercruysse, S., Vandewaetere, M., & Clarebout, G. (2012) Game-based learning: A review on the effectiveness of educational games. In Cruz-Cunha, M. M. (Ed.), *Handbook of research on serious games as educational, business, and research tools* (pp. 628-647). Hershey, PA: IGI Global.

Wolfe-Quintero, K., Inagaki, S., & Kim, H.-Y. (1998). *Second language development in writing: Measures of fluency, accuracy, and complexity*. Manoa, HI: Second Language Teaching and Curriculum Center, University of Hawai'i.

Yip, F. W. M., & Kwan, A. C. M. (2006). Online vocabulary games as a tool for teaching and learning English vocabulary. *Educational Media International*, 43, 233-249.

Zheng, D., Young, M. F., Brewer, R. A., & Wagner, M. (2009). Attitude and self-efficacy change: English language learning in virtual worlds. *CALICO Journal*, 27(1), 205-231.

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Transforming exams - how IT works for BYOD e-Exams

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This paper focuses on the 'IT' side of a bring-your-own-device (BYOD) based e-Exam system developed as part of an Australian government funded project. In short, students in the exam room boot their own laptops using a specially crafted USB stick that contains a standardised operating system and application suite. By giving teachers and students access to contemporary software tools we are providing the opportunity to greatly expand the pedagogical landscape of the exam room encouraging more authentic assessment practices. The roles for the 'Us' (organisations) and 'Me' individuals within the process of running an e-exam are also outlined in order to provide a richer description on the approach.

Introduction

This paper is about the e-Exam solution that has been developed as part of a three year Australian government innovation and development grant (OLT, 2015). The project aims to develop a comprehensive approach to doing 'authentic' e-exams using bring-your-own-device (BYOD). The context for the use of our e-Exam solution is the supervised space of the exam room. A key element of the work is to enable authentic forms of assessment. To this end we have designed the solution to allow complex constructed problems that can be addressed using a range of contemporary 'e-tools of the trade'. We focus the majority of our discussion on the 'how' of our solution, however we will touch on the multi-faceted elements that need to be in place including that all stakeholders, including students, teachers, policy makers, leaders and institutional support must be equipped, trained and resourced, But first a little on the 'why' of the solution.

The need to computerise examinations

Paper based testing is no longer fit for purpose in many disciplines where a wide range of software tools and information resources are now commonly part of problem solving. We argue that current testing practices and the inertia of current education systems may be hampering the efforts bring about change. Educational research has shown that the concept of 'teaching-to-the-test' (TTTT) (Phelps 2011) plays a role in shaping the designed and taught curriculum. The format and nature of testing has consequences for what teachers and students do and don't do. This impact is known as 'washback' (Anderson, 2007, Longo 2010). Ripley (2007, p.10) argues that paper-based exams are a major barrier to curriculum change due to their limited affordances. While TTTT due to pedagogically narrow paper-based testing can limit the curriculum taught in the classroom, TTTT can equally be used to prompt positive reform if the characteristics of the test align with desired curriculum change (Anderson 2007). By designing a technological facility that serves to greatly expand the 'pedagogical landscape' in the exam room, we have elsewhere argued (Fluck & Hillier 2014, 2016) that such innovative, technology enhanced forms of high stakes assessment have the potential to 'unblock' and encourage curriculum transformation through a form positive of washback. In other words by expanding the 'pedagogical landscape' in the exam room through the provision of additional technological affordances the formative and summative parts of the course could be bought into better alignment with each other and the needs to contemporary twenty first century education and society.

If this paper were taken alone it may appear that the choice of deployment approach and the reasons of dropping computers into the exam room may at first seem cobbled together. The contrary is the case. We have argued over the past couple of years a rationale for using a 'whole computer' approach in the exam room (Hillier & Fluck 2013, Fluck & Hillier 2014). A sophisticated e-exam platform needs to offer contemporary text processing (such as office suites), rich media, discipline relevant software applications and interactive virtual environments (Llamas-Nistal, Fernandez-Iglesias, Gonzalez-Tato, & Mikic-Fonte, 2013). The direction the authors foresee exams taking in the next few years is outlined by Hillier and Fluck (2015) and we note that there is considerable progress being made in other countries such as Finland (Tamm, Lattu & Lavonen, 2016) where fully computerised and open internet exams are underway and in Iceland with home grown solutions (Alfredsson, 2014). We have also reported preliminary findings of the student experience of using the e-Exam system in Australian university courses (Hillier 2015).

Taking multiple perspectives on our e-Exam solution

The approach to this paper is to describe how the system works from the point of view of IT and to a lesser extent, Me and Us, in that order. This triad fits well with Harold Linstone's ideas around looking as complex systems from the multiple perspectives in the technical, organisational and personal (Linstone 1999). Linstone's framework builds on the common approach where an analyst looks at a situation from a technological perspective, or what Peter Checkland (1999) would call the traditional 'hard systems' approach. This builds up a description where technology artefacts and engineering thinking come to the fore. Both Checkland (ibid) and Linstone separately acknowledge that there needs to be more to the vision than just the technical view. They advocate taking into consideration the organisational groups and people who work and jostle in the operation of a complex system. Courtney (2001) would describe such situations as 'messy', while Rittel and Webber (1973) use the term 'wicked problem'. The e-Exam system project can certainly be descried as such with indications of this complexity presented early in the project in Hillier (2013). However, by taking the three elements of IT, Us and Me into consideration, a richer description of the complex system can be presented. Notably, it can be difficult to disentangle the multiple views once they have been obtained due to the 'cross-cuing' (Linstone 2003) that occurs in between them.

IT (technology view)

The technology used as the basis of the system is intended to provide flexibility, openness and compatibility with a range of other technologies commonly found in the hands of students and in universities. The provision of equipment for student examinations at a large scale is potentially a challenge for universities. Institutions currently run exams during defined periods each year with highly intensive but short periods of utilisation meaning that computer equipment purchased for use in exams would likely be idle for the majority of each year. The use of BYO laptops that students already own is a solution to this provision. However this then raises the matter of how to provide an equivalent and secure software environment for each exam candidate. The solution selected was to utilise Linux Live USB sticks that have been customised for exam use. This provides a whole operating system and suite of software applications that can run on the majority of laptops owned by students providing a consistent and controlled software environment. The customisation serves to improve security, usability and robustness of the software tool set. The use of bootable USBs also allows the personal property of students to be temporarily 'taken over' for use in an exam in a way that leaves the device completely untouched. There are no invasive 'lock down' root kits or browsers required that is typical of other solutions in the market place. Therefore the solution provides a more ethical approach to 'borrowing' a student's personal device for university business.

The process of running an e-Exam is outlined in Figure 1. It involves preparing exam materials and USB sticks containing a customised Linux operating system. In the exam room students boot their laptop using the live Linux USB stick. Following the exam, responses are retrieved, collated and sent to academics for marking or merged to a learning management system for automated marking.

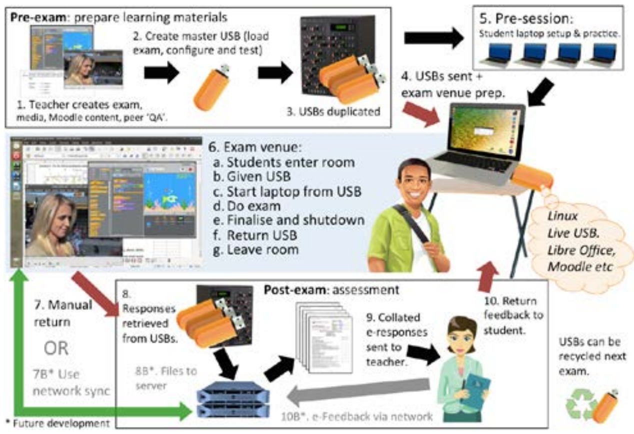


Figure 1: e-exam workflow using offline BYOD and bootable USBs

The e-Exam USB based system is made up of several elements. The Ubuntu Linux operating system forms the base with several customisations. The live bootable system comprises number of subcomponents. Some of the customisations made to create a student e-Exam USB system are listed in table 1. Details of an administrative helper tool are provided in table 2. The student portion of the e-exam system is able to run on very minimal computer hardware as low as 2GB of RAM, although 4GB is recommended. The Admin tool has higher requirements with 8GB as the recommended minimum. In both cases a computer with a 64bit processor and standard USB type A ports are needed (USB-C adapters can be used on compatible laptops). A large USB hub is also recommended, 19 port or 49 port hubs are available.

In considering the development of e-exam technology the roles and capabilities of the individuals who will be using the technology tools must be within scope of the design effort. Similarly the processes used to run large-scale examinations vary between institutions. Therefore for an e-exam approach to work within the 'real world' of an institution, the 'Us' and 'Me' elements of the broader 'assessment system' must be taken into consideration. The individual element in adopting e-exams covered next.

Table 1: Bootable student e-Exam system components and customisations

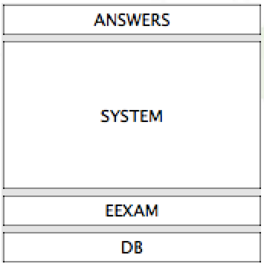
Component	Customisation
USB storage device. Commodity USB sticks. Note: USB-C adapters can be used.	Each USB device is partitioned into four 'drives' and made 'bootable'.  1. 'answers': a read/write space for student responses. 2. 'system': holds the read-only operating system, boot loaders and base applications (browser, office suite, media players etc). 3. 'eexam': containing read-only exam source/questions, resources, 3rd party apps, exam specific configuration file and unique wallpaper image. 4. 'db': Inaccessible to users. Only system writable for sensitive user and application data, e.g. Moodle database, logs, backups.
Grub boot manager. This directs the early handover from firmware BIOS/EFI to the operating system.	Customised to remove maintenance access options and to skip menu selection (the menu doesn't appear as it would for a standard live USB system). The EFI 64bit loader is secure boot compatible and supplemented by a 32bit loader for older EFI machines (but is not 'secure boot' compliant). Booting via legacy BIOS is also possible on older computers but they must have a 64bit processor as of e-Exam v6.
An initialisation system hands over to Ubuntu proper.	Remove access to maintenance options and 'root' user set with strong hashed password that would otherwise give the user admin access to what is a micro Linux system early in the boot sequence. A custom e-Exam boot logo added.
Ubuntu live Linux operating system (currently 16.04). Note: future Ubuntu versions will be adopted as they are released to increase hardware compatibility.	Removed user access to 'system', 'db' drives, local hard drive and secondary storage. Read-only access to 'eexam' drive. Removed root access as were Terminal applications and short cut access to the command line. A custom shut down routine added to facilitate 'self-cleaning/reset' during training scenarios. Depending on the system configuration; removal of networking and/or spell check files. Additional features include: start up checks, logging of hardware specifications, re-direction of system logs to writable storage, detection of high definition screens, extra response file backup and recovery, optional user monitoring (screen capture, web cam capture), the ability to disable network, Bluetooth, IR, virtual terminal switching, prevention of running in a virtual machine, whitelist IP space for online mode.
Desktop interface and controls.	Tool bars customised with exam specific buttons used and generic items removed to minimise distractions. A custom 'e-Exam Starter' collects the student ID/name information and directs the automatic launch of the teacher selected exam file. E.g. office document (doc, spreadsheet, etc), other local file (provided it has a default application installed), web browser to URL (local Moodle instance, or network location). Additional modes can be added in the future.
Applications: Libre office suite, media players, browsers etc.	Libre office customised to remove side bar, always enable save, improve 'autosave' frequency and redirect paths to writable storage. Upon close of a word processing document a PDF can be automatically created as a 'final' submission. This is significant where formatting, fonts and language settings are critical (e.g. language translation, complex table layouts and mathematical formulae).
Web applications (e.g. Moodle) running 'off-line'. Note: on-board Moodle is a work-in-progress.	Local host web applications can be installed to run without a network connection. Moodle LMS with minimal theme, as quiz engine. The student's user account is created on-the-fly based on their student ID number as a unique identifier. Local backup to the 'db' partition is done transparently each time the data base changes. Moodle course content can be automatically imported by placing a '.mbz' (Moodle course backup) file on the eexam drive. Future work: collate/merge databases.

Table 2: Bootable e-Exam Admin tool customisations

Component	Customisation
USB storage device. Commodity USB sticks are used.	Each USB device is partitioned into two partitions ('drives') and made 'bootable'. 1. 'user', a read/write space for storing a created/imported disk image and/or exam files/responses in case local hard drive access is not possible. 2. 'system', holding the read-only operating system, base applications (browser, office suite, media players etc) and Admin application.
Ubuntu live Linux operating system.	Removal of standard buttons on side bar and auto update, adding button for the admin tool and redirection of log file(s) to writable storage.
e-Exam Admin tool and scripts.	Provides a single graphical interface tool to create disk images from USBs, write disk images to batches of USBs, create/edit local configuration files, deploy exam materials to batches of USBs, retrieve exam responses from batches of USBs, clean/delete data from batches of USBs.

Me (personal view)

The roles of individuals in the workflow of examinations vary between institutions but in the main multiple people that must work together for things to work smoothly. Each will bring with them abilities and skills in relation to assessment and technology. Their ability to adopt a new paradigm of authentic e-exams will depend on their capacity to learn, access to professional development, technology support and so on. In larger institutions there will likely be several departments responsible for the smooth operation of the exam. When adding the complexity of information technology to the mix of already time pressured, high stakes assessment events the criticality of collaboration is heightened. By comparing typical workflows encountered in paper-based exams to those that will be required for a computerised exam we can begin to appreciate the touch points and required skill sets of each member of an e-exams team. In smaller organisations or during early e-exam trials a single technically literate individual may be responsible for the whole workflow in their unit/course, however it has been often that case that an academic may be assisted by technical support staff or an e-learning designer. Table 3 compares the typical stages of a paper based and potential e-exam workflows.

Table 3: Roles: Comparing paper and e-exam workflows

Paper exam	**e-Exam**
Curriculum planning done with exams increasingly thought of as 'separate' from the richer learning and assessment that happens during the semester. The 'teaching to the test' effect can also limit the curriculum during the semester.	Planning the exam as part of the overall curriculum design with the expectation that e-tools of the trade can be used to construct responses. This has a two fold benefit. First, that in-class learning can be designed with the expectation that the exam is not a roadblock to innovation. Second, the exam itself can better match in-class learning. The e-Exam system greatly expands the 'pedagogical landscape' of assessment, but benefits accrued will depend on task design taking advantage of the affordances of available 'e-tools of the trade'.
Exam questions prepared by academic – typically using a word processor. The questions/tasks are increasingly only found in exams, given the inherent limitations of pen-on-paper and the ever-expanding use of ICT in other areas of assessment in-class and as unsupervised projects.	Exam questions and activities prepared by academic – the most basic using a word processor. Much richer possibilities exist to design software enhanced tasks, multimedia integration, simulations, sophisticated multi-element constructed tasks using e-tools of the trade. A range of computer marked questions are possible. Tasks used in-class can be modified and deployed in exams or complementary tasks developed creating greater integration between assessment 'for' and 'of' learning. Example items can be made available to academics to facilitate design. E-Learning designer assistance may be needed for more advanced task development.
Quality control within academic departments in the first instance. Variation of rigor and methods used between departments, individuals and universities via printed copies, local network drives or emailed documents.	An e-exam offers the possibility for a structured online peer review process (e.g. as used for modern journal paper reviews). Depending of the nature of questions/tasks, drawing from a pool of proven good items may be possible. New items can be peer reviewed and need to be trialled 'live' in the e-exam system prior to being approved for production.
Exam sent to central exams office for production. Final error checking (page numbers, obvious typos). A number of content errors still reach the exam room that are difficult to amend after the fact. Exams sent for printing.	Exams transferred to production (potentially via the secure review system server). Exam items, resources and e-tools are loaded onto a master USB for final checks. Duplication to USBs (or transfer to online system if applicable) occurs by exams office or IT support staff.
Student preparation involves practicing the increasingly uncommon task of marathon handwriting and locating analogous exam questions.	Student preparation for an e-exam adds the need to be familiar with the software environment and to ensure that their laptop is compatible. Once a laptop is certified as compatible it should not need to be recertified (because core hardware rarely changes).
Doing the exam. The 'Exams office' arranges venues, timetables and often staffs the venues including training exam invigilators. The 'Property and facilities' department may be involved in venue set-up, furniture storage/transport. In the case of new buildings the use for exams is often an after thought.	The set up of exam venues needs to include power supply for BYO laptops. In regular exam halls each second walk-way is set aside as a 'power isle'. This helps ensure OH&S while maintaining circulation. Invigilator training should incorporate basic IT literacy, basic troubleshooting relevant to the e-exam system and determined 'change over' triggers. Level 1 (basic) IT support staff may need to be onsite for the 'boot up' phase and to a lesser extent for close down. A minimal IT presence is all that is normally required during the exam itself. New buildings should include more power sockets in teaching and informal learning spaces as BYOD is increasingly relied upon for all hours of the learning day.
Post exam, the exams officers collect, collate, process and courier back to academic departments the boxes of exam scripts. This can take several days with risk of paper loss. Academics collect boxes of paper and sort them for marking.	e-Exam USB sticks a re collected and plugged into a large hub. A software tool is used to retrieve responses in a matter of seconds from each batch of USBs. Files can be sent electronically to academics for marking. This can occur in as little as 15 minutes following collection of USBs. An online version of an e-exam would provide instant delivery.

Us (organisational view)

Adoption of new technology is a change process. In organisations, change takes time and learning on the part of individuals and organisations to occur (Kenny 2006). Jumping in at the deep end may be good of innovation in small bites, but rarely does this scale across an institution without immense resources, focus and planning on the part of the receiving organisation. The constraints on complex project management (Atkinson, 1999) paraphrased as "Good, quick, cheap – pick two" apply. Instead a stepwise approach to adoption along a path from 'now to the future' (Hillier & Fluck 2015) is recommended. This gives time for the multitude of interconnected organisational systems and processes to adjust to the change and is much less resource intensive. The system development process also takes time to occur and given the scale of the development team a gradual phased development program is required. Having both constraints of receiving organisations and the development team in mind a phased development and adoption strategy has been developed (See figure 2). In the case of organisations adopting the e-Exam system, the rate of progress along the stages depends on how quickly they are able to build capacity in the design and deployment of e-exams. The complex machinery of educational institutions includes strategies, policy, professional development, technology systems, educational practices and traditions. How quickly stakeholders and systems can adjust to facilitate the change will impact progress along the timeline. To assist in this area a loose community of practice (Wenger, 1998) is building around the project with shared network drive (AARNET Cloudstor), a website, user guides, and workshops run for project participants.

Get Ready	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Institutional approvals, research ethics, hardware and infrastructure.	Paper equivalent small scale. Basic doc exams to begin!	Post-paper small to medium scale. Expanding the app and media landscape.	Medium to large scale. Adding the power of an onboard LMS.	Whitelisted and logged Internet. Network BYOD exam.	Open but fully logged Internet. Network mixed mode BYOD exam.
	Crawling	Walking	Running	Jumping	Flying!

Figure 2: Roadmap to adopting e-exam system features

There are risks associated with the change and the rate of change. For example, if stakeholders are not adequately resourced and trained then they may resort to coping strategies such as using lower order multiple-choice questions. Similarly if the adoption process takes too long then changes in the broader technology environment may overtake the selected tool set. Utilising an open architecture for the e-exam system and ensuring it is kept up-to-date by drawing on the resources of other open source work will mean that changes such as the move from USB-A to USB-C will not derail the adoption program.

Conclusion

This paper has briefly overviewed the technical (IT) solution developed for a BYO laptop based e-Exam system. While the primary aim of the system was to develop a tool for authentic assessment, matters of scalability and fit within existing university exams processes (Us) and the roles and place of individuals (Me-s) were considered in its development.

References

Alfredsson, F. (2014). Bring-Your-Own-Device Exam System for Campuses. Nordunet presentation.

Anderson, T.R (2007) Bridging the Educational Research-Teaching Practice Gap, The power of assessment, *Biochemistry and Molecular Biology Education*, 35(6): 471-477.

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management*. 17(6): 337–342.

Checkland, P.B. (1999) Soft system methodology - a 30 year retrospective, in Checkland, P.B. & Scholes, J. *Soft systems methodology in action*, Wiley, Chichester, UK, pp. A1-A65.

Courtney, J.F. (2001) Decision making and knowledge management in inquiring organizations: toward a new decision-making paradigm for DSS, *Decision Support Systems*, 31(1): 17-38.

Fluck, A. & Hillier, M. (2014) eExams Transforming Curriculum, *26th Australian Computers in Education Conference*, 30 September - 3 October, Adelaide.

Fluck. A. & Hillier, M. (2016) Innovative assessment with eExams, *Australian Council for Computers in Education Conference*, Brisbane, 29 Sep to 2 Oct.

Hillier, M (2013) Arguing for e-Exams, *Transforming Assessment in the Digital Era*, Melbourne. http://www.transformingexams.com/files/Arguing_for_e-exams_slides.pdf

Hillier, M (2015) To type or handwrite: student's experience across six e-Exam trials, *ASCILITE Conference*, 29 Nov - 2 Dec, Perth.

Hillier, M. & Fluck, A. (2013) Arguing again for e-Exams for high examinations, *ASCILITE conference*, 1-4 December, Sydney.

Hillier, M. & Fluck, A. (2015) A pedagogical end game for exams: a look 10 years into the future of high stakes assessment, *ASCILITE Conference*, 29 Nov - 2 Dec, Perth.

Kenny, J. (2006) Strategy and the learning organization: a maturity model for the formation of strategy, *Learning Organization*, 13(4): 353-368

Linstone, H.A. (1999) *Decision making for technology executives: using multiple perspectives to improve performance*, Artech House Publishers, Boston, MA, USA.

Linstone, H.A. (2003) Technology, terrorism, and the multiple perspective approach, technology management for reshaping the world, in *Proceedings of the Portland International Conference on Management of Engineering and Technology*, 20-24 July, Portland, Oregon, USA, pp. 14-21

Llamas-Nistal, M., Fernandez-Iglesias, M. J., Gonzalez-Tato, J., & Mikic-Fonte, F. A. (2013). Blended e-assessment: Migrating classical exams to the digital world. *Computers & Education*, 62: 72–87.

Longo C. (2010) Fostering Creativity or Teaching to the Test? Implications of State Testing on the Delivery of Science Instruction, *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2): 54-57

Office of Learning and Teaching (2015) [OLT]. Successful Grants Round 1. http://www.olt.gov.au/system/files/Grants%20list%20R1%202015%20final%20version%20for%20website_0.pdf

Phelps, R. P. (2011) Teach to the Test? *The Wilson Quarterly* 35(4): 38-42.

Ripley, M. (2007) E-assessment – an update on research, policy and practice. *FutureLab*: Bristol.

Rittel, H. & Webber, M.M. (1973) Dilemmas in a general theory of planning, *Policy Sciences*, 4(2): 155-169.

Tamm, M., Lattu, M. & Lavonen, J. (2016). A new ICT based matriculation examination enables the use of ICT natural to science subjects. Electronic *Proceedings of the ESERA 2015 Conference*. pp. 652-659.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

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Social media in enabling education

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This paper argues that students from rural and low socio-economic status (LSES) backgrounds, who undertake enabling education, benefit from the social, cultural and network capital which digital, narrative and connective platforms may provide in pre-tertiary teaching and learning. In particular, this paper discusses the trial of the use of the social networking site Facebook as a learning management system within an enabling tertiary preparation program designed to raise the aspirations and widen the participation of economically and geographically disadvantaged young people. It also discusses the role of new media in an approach to Tertiary Preparation which recognises that to succeed in their university study, non-traditional students need to develop not only academic skills and confidence, but the skills and confidence to survive and thrive in the broader digital society.

Background: equity policy

Despite decades of federal government policy initiatives addressing access, equity and participation in higher education, students from rural and remote Australia still encounter significant obstacles and constraints to tertiary study. Moreover, while access to higher education has improved for some targeted equity groups, such as women and students with disabilities, people from low socio-economic status (LSES) backgrounds who live in rural or remote areas remain doubly disadvantaged (National Board of Employment, Education and Training [NBEET], 1996; Department of Education, Employment and Workplace Relations [DEEWR], 2008). These least advantaged students (LSES students from rural and remote areas) are less likely than their urban peers to believe that higher education is attainable and less likely to report that their parents and teachers have encouraged them to aim for university study (James, 2010). Commonwealth scholarships and other equity initiatives have not and cannot compensate for the cumulative effects of social class and the unequal distribution of social and cultural capital along class lines. While distance from universities is a significant constraint, the socio-economic background of the student has the most pervasive and profound effect on higher education participation (James, 2001). Moreover, although the most recent Review of Australian Higher Education (DEEWR, 2008), or 'Bradley Review,' makes scant mention of social class or cultural capital, these well-established sociological terms go a long way toward explaining the persistent problem of inequality in higher education and how it ought to be addressed.

In response to this recent Department of Education, Employment and Workplace Relations (Bradley) report into Australian higher education (DEEWR, 2008), the Australian federal government introduced funding programs designed to enhance LSES participation and mandated that by the year 2020, twenty percent of undergraduate students would be from low socio-economic status backgrounds. Australian universities have a long way to go in meeting this target however, their increasing investments in flexible learning and digital technologies notwithstanding. Over the past ten years higher education participation rates have stalled for LSES students and have actually declined for rural/regional and remote/isolated students (DEEWR, 2008), suggesting the *Fair Chance for All* (DEEWR, 1990) promised by national equity policy in the 1990s is far from realised. It appears contemporary Australian higher education equity policy is an inadequate response to the compounding sociocultural problems of geographical location and social class positioning in a nation increasingly divided along rural-urban lines (James, 2001; James, 2010; Australian Human Rights Commission 2001).

Like most other Australian universities, this regional university has introduced a range of equity programs designed to address this persistent problem of the underrepresentation of rural and LSES students. In Queensland, as in most other Australian states, state governments have also introduced programs and partnerships designed to improve rural education and support the transition from secondary schooling to tertiary study (DET, 2011). Both federal and state policy recognises that the failure to develop the abilities of rural and LSES students will have significant long term consequences for the Australian economy and society. More than half of Queensland state schools and almost one quarter of state school students are in rural and remote areas (DET, 2011). Improving the participation rates of these students in higher education is critical, and not just for the Australian economy in 'human capital' terms. The focus in this paper, is how pre-tertiary equity and enabling programs which include the explicit development of social, cultural and network capital through the use of new, social media platforms provide a powerful teaching and learning strategy for addressing both participation and retention issues for rural and LSES students.

Unlike their urban counterparts, rural LSES students are frequently required to leave home and leave behind their existing support networks of community, family and friends in order to acquire the benefits of a university education. Unless adequate social and cultural connections, networks or 'webs' are provided to support their transition, these students may be overwhelmed by what they have lost and left behind instead of guided toward what they have to gain from tertiary education. For rural working-class students in particular the middle class, urban and urbane culture of the university can feel intimidating, alien and alienating. The cumulative sociocultural and psychosocial effects for students disadvantaged by both social class and geographic isolation relate therefore not just to issues of access (and getting into university) but also to how the students feel once they get there (issues of retention). Hence, established modern utilitarian (human capital) approaches to equity policy which focus on economic rationality and rational consumer choices are inadequate when what is required to widen participation is a postmodern focus on feelings, friendship, relationships and emotions (social and cultural capital). As recent research conducted at the University of Queensland suggests, "the strongest influencing factors for retention of low SES students are *social*, rather than institutional" (Karimshah et al., 2013, p. 12). Research on student retention at the regional Queensland university discussed in this paper also suggests a focus on identity and relationships which develops a sense of place, community and connectedness is necessary to support students in their tertiary transitions and in their first year experience (Noble & Henderson, 2008; Noble & Henderson, 2011). Hence, to effectively address imbalances in higher education participation and retention, equity programs need to adequately and explicitly address sociocultural issues in contemporary, digitised learning environments. Using networking digital platforms, tools and strategies, the Tertiary Preparation Program discussed here has developed such an approach which gives equal emphasis to the development of academic skills and the cultivation of social, cultural and (digital) network capital.

Network capital

Since the 1990s governments across the political spectrum in Australia and in other Western countries have sought to support and expand social capital with the idea of creating stronger, more cohesive and better connected communities. Moreover, rural regions have always had what is now termed social capital in the sense of community ties, links and networks which can be mobilised for the common good. From a critical and sociological perspective however it is important to point out that not all networks are equal. In rural communities for example social networks may be more likely to lead young people back to labour in their local area or place of origin rather than raising aspirations to university study and alternative career pathways.

As James (2010) points out, depressed rural economies, reduced services (including reduced educational services) and reduced infrastructure have all contributed to a growing social and class divide in Australia between rural and urban regions. As a result the choices of rural students are often limited by their social and cultural as well as geographical location (James, 2010). The rhetoric of choice in this context tends to favour the already culturally privileged (James, 2010). While middle class families for example may be in a position to compensate for their geographic isolation by sending their children to private boarding schools and residential colleges, this is generally not an option for working class rural families.

The larger issue is that higher education still generally reproduces rather than redistributes all forms of capital in part because rural and working class students do not feel at home there. University entry and even the successful completion of an undergraduate degree may not translate into economic security and social mobility if students remain disadvantaged by a lack of social and cultural connections. As Bourdieu (1984, 1985) pointed out some time ago, the reproduction of class based inequalities in society and in education is not only a material, economic process but depends also on differential access to social and cultural capital. Inequality is maintained through the symbolic realm of culture, through beliefs, traditions, values, lifestyle and language. Moreover, an individual's life outcomes will be shaped by their social networks, contacts and connections to friends, family and peers who may (or may not) offer useful help, support, information and advice (Bourdieu 1984; Coleman 1990). Sadly, for rural working class students there is a fine and difficult line to tread between maintaining ties to their community and being tied down by their community.

At the level of policy and practice, equity initiatives therefore need to address not only limited access to educational credentials for underrepresented groups (like LSES rural youth), but also the unequal distribution of social and cultural capital across regions and social classes. Digital equity initiatives in particular must extend to the realm of culture where identities and aspirations are made, to impact significantly on students' life choices and chances. Although most digital literacy interventions and digital equity initiatives aim to improve the quality of life of socioeconomically disadvantaged groups relative to more advantaged groups, there is little evidence at this point that this has actually been achieved (Po-An Hsieh, Rai and Keil 2011, p. 248). As Po-An Hsieh et al. (2011, p. 247) suggest, attempts to address digital inequality for socioeconomically disadvantaged groups must simultaneously develop both cultural capital (self-belief) and social capital (support from peers) as the two forms of capital reinforce each other.

This paper suggests young people from rural and low socio-economic status backgrounds may also benefit from a form of digital network capital to establish and maintain ties online with new friends who are also adjusting to university life and raised aspirations. Twenty-first century teachers and learners are, as Castells (2004) suggests, living in the “network society” whose social structure and power relations are made up of networks connected and powered by communication technologies. It follows, if we accept that ours is a network society, equity issues must also be understood in terms of connectivity and access to the ‘right’ networks. As Castells (2004, p. 4) points out: “Networks work on a binary logic: inclusion/exclusion.” In other words, we define ourselves by who we are like and who we are not like, by those we socialise with and those we are socialised by. Within this network model, the accumulation of contacts, or “friends” to use the language of online social networking, maybe just as important as the accumulation of educational credentials in determining life outcomes. Moreover the size, diversity and resources of an individual’s network of contacts can determine the opportunities made available and the individual’s ability to capitalise on those opportunities. Digital literacy in this context requires not only knowing how to use a networked computer but knowing how to build and maintain a network of mutually beneficial social relationships online.

The project: social media in a tertiary preparation program

This short paper reports on initiatives developed within the enabling education division of a regional Australian university which aimed to address some of the social and cultural obstacles underlying inequality in higher education participation through engagement with new digital tools and approaches. It provides a necessarily brief overview of relevant outcomes of action research projects led, developed and delivered by the author of this paper, who is also an active enabling education practitioner. These projects have combined digital tools, digital pedagogy and emancipatory pedagogy in attempts to improve the participation of non-traditional, rural and LSES students in higher education. Through the embedded use of social media and a holistic approach to tertiary preparation overall, these project(s) successfully facilitated social integration and enculturation within an enabling program targeting rural and LSES students with low secondary school results. During the project(s), members of the teaching team gathered both qualitative and quantitative data in order to evaluate the program and its engagement of digital platforms and social networking technologies. To gather data on student perceptions and experience, a survey instrument, using a 5-point Likert scale gauging students’ level of agreement with each evaluative statement, was administered to the twenty 17 to 18 year old participants of the 2012 tertiary preparation (intensive pathway) program and to the forty-one 17 to 18 year old participants of the 2013 tertiary preparation (intensive pathway) program. These surveys also included open-ended questions to provide more in-depth insight into the students’ experiences. More recently, twenty participants in the 2017 semester 2 tertiary preparation program completed surveys and focus groups which also tested their perceptions and experiences of social media and digital literacy in the context of enabling education.

This paper argues digital tools and strategies have impacted significantly and positively on the learning and university experiences of targeted rural and LSES students in the enabling education program. However it is important to distinguish between the broad concept of digital or eLearning, which has been in ascendancy in recent decades, and the distinct digital *narrative* platforms of Facebook which facilitate the creative expression and sharing of personal *self*-narratives. Despite the early promise of eLearning in the 1990s to overcome the historical Australian ‘tyranny of distance’ (to allow students to study anywhere and anytime), in reality the digital revolution in higher education has not radically altered the participation share of rural and remote students. Increased internet access in the information age has not significantly reduced the historical rural-urban imbalance in Australian higher education participation, in part because more information is not, in and of itself, the answer. This paper suggests that the narrative and connective platforms of social media may provide more effective digital strategies for meeting the social, cultural and emotional needs of rural, non-traditional and LSES learners in enabling education programs. In particular, the ‘friending’ or social networking mechanisms of social media may promote the sense of connectedness or digital ‘network capital’ which contributes to student retention.

Facebook as a learning management system

As McLuhan (2001, p. xi) pointed out; “We shape our tools, and thereafter our tools shape us.” Young people today have been shaped by social networking and other new media tools. These tools have blurred boundaries between public (social) and private (personal) and between labour (work) and leisure (entertainment) within a postmodern network society. Against such a backdrop, support for disadvantaged and underrepresented groups in higher education should include the capacity to reinvent, perform and share new identities which digital networking tools allow. Moreover, the informal, personal or 'friendly' feel of networking technologies can potentially smooth the transition to university culture for non-traditional students, while simultaneously presenting a less intimidating approach to digital literacy than more traditional eLearning platforms.

Our experience suggests web-based social networking sites such as Facebook are valuable for building a sense of classroom community, demystifying higher education and democratising power relations between tertiary students and teachers. International research suggests Facebook is already part of the "social glue" which assists undergraduate students in their transition to university life and culture (Clare, Meek, Wellens and Hooley, 2009). Moreover, research into the use of social networking site Ning in higher education contexts found the social sharing features of Ning useful for enhancing student engagement, peer support and for "strengthening students' emotional connectedness" within a learning community (Hung and Yuen, 2010, p. 711).

Our experience with Facebook supports previous research (Hung and Yuen, 2010) which suggests that by uploading photos and videos and sharing personal interests and hobbies, students on web-based classroom social networking pages are engaged in a different kind of interaction than that provided for by established university eLearning platforms and more traditional digital learning management systems like Blackboard or the Moodle StudyDesk. While the online university learning management system (LMS) tends to revolve around courses and delineated units of information, Facebook foregrounds the person and his/her connections and personal interests. Essentially, with Facebook the true value is in the users and in the social network itself, not the information they exchange. Similarly, much university eLearning still tends to be largely dry and formulaic and word or text-based in stand-alone systems (with token web links) which cannot compete with the dynamic, visual, personalised, connective and narrative architecture of Facebook and other networking new media. Moreover, early focus group data from 2017 participants suggests non-traditional students may feel overwhelmed with the organization of course materials into very many tabs, boxes and windows, and prefer the narrative, personal and social presentation and building of ideas and information which social networking tools encourage.

The young participants of our tertiary preparation initiative found our group Facebook page a more natural, accessible and intuitive environment for interaction and learning than the mainstream online university learning management system or Moodle StudyDesk. Initially, an email was sent to all students with a link to the closed group Facebook site and students were added to the group by administration and teaching staff with group administration rights. There was immediate uptake and use of the site by the majority of the students who already had Facebook accounts and profiles. As one of the 2012/2013 student participants commented: "We were all on the same level - we made friendships before coming here."

Notifications were placed on the site in relation to arrival at campus, orientation and planned social events. By the first day of teaching during the trial, students had uploaded and shared photos of each other and their new environment. As one of the 2012/2013 students commented: "We all posted pictures into the group which made everyone feel involved." Informal peer learning and group work had also begun in response to teaching resources uploaded. Essentially, we were talking to students in their own language with technology they already knew. Overall this made for a less stressful transition and less intimidating learning environment for the rural and LSES participants. As most were already familiar with the informal, personal and 'friending' discourses of Facebook in their everyday social lives, our students were very comfortable using it to facilitate their transition to higher education as they shared experiences, information, opinions, memes, anecdotes and jokes about the accommodation, meet-ups, meals, assessment and workshops.

In the words of one of the 2012/2013 students: "It was a common place where we could all be new and interact." In post-program surveys 67 percent of 2012 respondents rated the Facebook closed group site as 'Excellent' while 33 percent rated it 'Good'. Moreover, 87 percent of the 2013 respondents listed the Facebook site as their preferred method of communication with University staff around teaching and learning matters. Even after accessing the official university online learning management system or StudyDesk, our students across both cohorts tended to check their Facebook profiles more regularly than StudyDesk through their ever-present 'smart' phones and other 'always on' mobile devices with Facebook applications. Students preferred the Facebook site over StudyDesk both for communicating with other students and teachers and for accessing learning resources such as lecture power points and YouTube videos. It is also worth noting that 78 percent of 2013 respondents found that the closed group Facebook site was useful for them to interact and communicate with other students before commencing the course and this social connectivity increased their confidence about starting university even though they were also frequently first in family, low attainment, low socio-economic status students. As one of the 2012/2013 students explained: "I prefer talking to people face to face or on Facebook because it's easier to talk to the person one on one. I don't really like the StudyDesk because at times it can be very confusing." Another 2012/2013 student commented: "Interacting with students via Facebook and chat was a great way to get to know everyone and to get help with anything you didn't understand." At the time of writing, the action researcher/author of this paper is currently gathering more up-to-date data from TPP workshop participants, through surveys and focus groups, which will be available by the time this paper is presented in late 2017. So far the engagement with the 2017 closed group Facebook page by participating TPP students has been very positive and illuminating.

The closed group web-based social networking tool assisted in constructing the learning communities and social support networks which are an important factor determining career and study success, especially for first-in-family non-traditional university students. The closed group Facebook site has also allowed us to chart the growth of our students as, even after completing the tertiary preparation program, students continue to visit the site to support each other, arrange physical and virtual meet-ups and compare experiences of their undergraduate study. Unlike more traditional online university learning management systems which expel students once they are no longer enrolled in the course, it is likely these students will stay connected to social media and the closed group page in particular.

Conclusions and updates

The utilitarian assumption behind much equity policy is the human capital imperative to avoid waste and produce more productive and skilled workers out of disadvantaged students. These students however do not exist in isolation, they come from and live within social and cultural webs or networks and enabling pathways must meet students on these digital and sociocultural terms. Questions about whether and what to study are ultimately questions about identity and self-belief, personal history, aspirations and hopes. For rural and LSES students, who do not fit into the academic mold of the traditional university student, a solution of sorts may lie in socialization and enculturation through digital networking technologies in teaching. Certainly, digital networking technologies need to be incorporated into the teaching toolbox we use to meet the learning needs of these rural and LSES youth in tertiary preparation programs. Perhaps the most important outcome, although more difficult to measure at this point, is the development of digital network capital – learning from and linking to mutually beneficial relationships online. Building and maintaining these digital social networks must be recognised as an important piece of the social inclusion puzzle for marginalised groups. When this paper is presented in semester 3 2017, new data from focus groups and surveys undertaken by participating tertiary preparation students will be presented which provides more recent and more revealing data on social media and digital literacy in enabling education. Within this tertiary preparation program discussed we have attempted to integrate new forms of identity, sociality and connectivity within an enabling education tertiary preparation program. Through the creation and sharing of digital identity narratives, and social networks online, participants have articulated a sense of the future which is potentially transformative and enabling.

References

Australian Human Rights Commission. (2001). Rural and Remote Education – Qld. Retrieved from https://www.humanrights.gov.au/publications/rural-and-remote-education-qld-19

Bedford, T. (2008). Using Thought Pictures to Help with Thinking Tasks. *TPP7120 Studying to Succeed Selected Readings 2.* Toowoomba QLD: University of Southern Queensland.

Bourdieu, P. (1984). *Distinction: A Social Critique of the Judgement of Taste*. Cambridge: Harvard University Press.

Bourdieu, P. (1985). The Forms of Capital. In J. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education*. New York: Greenwood.

Castells, M. (2004). Informationalism, networks and the network society: A theoretical blueprint. In M. Castells (Ed.), *The Network Society: A Cross-cultural Perspective*, (pp. 3-45). Cheltenham: Edward Elgar.

Clare, M. Meek, J. Wellens, J. Hooley, T. (2009). Facebook, social integration and informal learning at university: 'It is more for socialising and talking to friends about work than for actually doing work'. *Learning, Media and Technology*, 34 (2), 141-155. doi: 10.1080/17439880902923606

Coleman, J.S. (1990). *Foundations of Social Theory*. Cambridge: The Balknap Press.

DEEWR (Department of Education, Employment and Workplace Relations). (2008). *Review of Australian Higher Education, Final Report*, 2008. Canberra: DEEWR. Retrieved from: http://www.industry.gov.au/HigherEducation/Documents/Review/PDF/Higher%20Education%20Review_one%20document_02.pdf

DEEWR (Department of Education, Employment and Workplace Relations). (2010). *Regional Participation: The Role of Socioeconomic Status and Access*. Canberra: DEEWR.

DEET (Department of Education, Employment and Training). (1990). *A Fair Chance for All*. Canberra: Australian Government Publishing.

DET (Department of Education and Training). (2011). *Action Plan for Rural and Remote Education* 2011-2015. Brisbane: DET.

Hung, H. & Yuen, S. (2010). Educational use of social networking in higher education. *Teaching in Higher Education* 15 (6): 703-714.

James, R. (2001). Participation disadvantage in Australian higher education: An analysis of some effects of geographical location and socioeconomic status. *Higher Education* 42, 455-472.

James, R. (2010). Non-traditional students in Australian higher education: Persistent inequities and the new ideology of 'student choice'. *Tertiary Education and Management* 6 (2), 105-118. doi: 10.1080/13583883.2000.9967016

Karimshah, A. Wyder, M. Henman, P. Tay, D. Capelin, E. Short, P (2013). Overcoming adversity among low SES students: A study of strategies for retention. *Australian Universities Review* 55 (2): 5-14.

McLuhan, M. (2001). *Understanding Media: The Extension of Man*. Cambridge, MA: MIT Press.

NBEET (National Board of Employment, Education and Training). (1996). *Equality, diversity and excellence: Advancing the national higher education equity framework*. Canberra: AGPS.

Noble, K., & Henderson, R. (2011). The promotion of 'character' and its relationship to retention in higher education. *Australian Journal of Teacher Education* 36 (3), 79-91. Retrieved from http://dx.doi.org/10.14221/ajte.2011v36n3.3

Noble, K. & Henderson, R. (2008). Engaging with images and stories: Using a Learning Circle approach to develop agency of beginning "at-risk" pre-serviceteachers. *Australian Journal of Teacher Education, 33* (1). Retrieved from http://ajte.education.ecu.edu.au/

Po-An Hsieh, J.J., Rai, A & Keil, M. (2011). Addressing digital inequality for the socioeconomically disadvantaged through government initiatives: Forms of capital that affect ICT utilization. *Information Systems Research* 22 (2), 233-253. doi:10.1287/isre.1090.0256

Van Dijck, J. (2013). 'You have one identity': Performing the self on Facebook and LinkedIn. *Media, Culture & Society* 35 (2), 199-215. doi: 10.1177/0163443712468605

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The synergistic and dynamic relationship between learning design and learning analytics

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The synergistic relationship between learning design and learning analytics has the potential for improving learning and teaching in near real-time. The potential for integrating the newly available and dynamic information from ongoing analysis into learning design requires new perspectives on learning and teaching data processing and analysis as well as advanced theories, methods, and tools for supporting dynamic learning design processes. Three perspectives of learning analytics design provide summative, real-time, and predictive insights. In a case study with 3,550 users, the navigation sequence and network graph analysis demonstrate the potential of learning analytics design. The study aims to demonstrate how the analysis of navigation patterns and network graph analysis could inform the learning design of self-guided digital learning experiences. Even with open-ended freedom, only 608 sequences were evidenced by learners out of a potential number of hundreds of millions of sequences. Advancements of learning analytics design have the potential for mapping the cognitive, social and even physical states of the learner and optimise their learning environment on the fly.

Introduction

One of the next frontiers in educational research may be a synergistic and dynamic relationship between learning design and learning analytics. These two perspectives – design and analytics - have heretofore primarily operated independent of each other, separated by time and space due to the complexity of dealing with interactional data in educational settings. However, now with the advent of near real time data and new ways of representing the decisions and actions of learners in digital learning environments, learning designers have new ways to use dynamic learning analytics information to evaluate learner characteristics, examine learning designs, analyse the effectiveness of learning materials and activities, adjust difficulty levels, and measure the impact of interventions and feedback. This new level of sophisticated information about learners, learning processes, and complex interactions within the learning environment has the potential to provide valuable insights for 'on the fly' educational planning and curricular decision-making fully integrated into the digital learning experience.

This paper reports on a case study demonstrating the synergetic relationship between learning design and learning analytics, with a focus on the application of navigation sequence and network graph analysis. Particularly, it illustrates how analytics may support the design of learning environments, which is followed by a discussion of implications and conclusion.

Learning design and analytics

Goodyear and Retalis (2010) emphasise that good educational design is the missing link between the learning sciences and the learning environments needed for success in the 21st century. Design patterns may offer a way of capturing design experience including (1) connecting recognisable problems with tested solutions, (2) relating design problems at any scale level (e.g., micro, meso, and macro), and connecting design solutions across scale levels, (3) supplementing design with research-based evidence, (4) balancing guidance with creativity, (5) having a wide application of designs but being customisable to meet specific needs, and (6) improving design performance while also educating the designer (Goodyear & Retalis, 2010). Dalziel et al. (2016) noted that:

> *The ultimate goal of Learning Design is to convey great teaching ideas among educators in order to improve student learning … successful sharing of good teaching ideas can lead not only to more effective teaching, but also to more efficient preparation for teaching*.

Learning design aims to provide a description of optimal designs for learning and teaching with a potential for reuse and adaptation of design, however, it does not offer real-time insights how students are engaged and learn (Lockyer, Heathcote, & Dawson, 2013). Therefore, linking design for learning with learning analytics may provide actionable information for optimising learning environments in real-time. Hence, we propose that the next frontier in educational research may be a synergistic relationship between learning design and learning analytics.

Learning analytics use available information from various reactive and non-reactive educational sources including learner characteristics, learner behaviour, learner performance, as well as detailed information of the learning design (e.g., sequencing of events, task difficulty, learning outcomes) for supporting pedagogical interventions and re-designs of learning environments (Berland, Baker, & Bilkstein, 2014). Learning analytics are expected to provide the pedagogical and technological background for producing real-time interventions at all times during the learning process. Students benefit from learning analytics through optimised learning pathways, personalised interventions, and real-time scaffolds (Gašević, Dawson, & Siemens, 2015). Learning analytics provide facilitators detailed analysis and monitoring on the individual student level, allowing them to identify particularly instable factors, such as motivation or attention losses, before they occur (Gašević, Dawson, Rogers, & Gašević, 2016). However, ethical and privacy issues have been identified as a major concern with the adoption of learning analytics (Ifenthaler & Schumacher, 2016; Slade & Prinsloo, 2013). Learning analytics should be aligned with organisational principles and values as well as include a wide variety of stakeholders. In sum, learning analytics need to collect, use, and analyse data transparently and free of bias, and have multilevel relevance (Ifenthaler & Schumacher, 2016; Pardo & Siemens, 2014).

Learning analytics design is thus expected to generate valuable insights for planning and optimising of pedagogical designs, including adapting and optimising the sequencing of activities on the fly (Ifenthaler, 2017). The synergetic relationship between learning design and learning analytics is exemplifying the notion that teaching in higher education in the twenty-first century with ever changing cultural and technological changes has become a *design science* "because [teaching] uses what is known about teaching to attain the goal of student learning, and uses the implication of its designs to keep improving them (Laurillard, 2012, p. 1). Adaptation and optimisation of learning and teaching may occur, for example, based on educator-selected benchmarks that help to identify alignment or misalignment towards learning outcomes. In addition, detailed insights into pedagogical processes may facilitate micro interventions whenever the learner needs it (Bannert, 2009; Ifenthaler, 2012; van den Boom, Paas, van Merriënboer, & van Gog, 2004).

Case study

This case study aims to demonstrate how the analysis of navigation patterns and network graph analysis could inform the learning design of self-guided digital learning experiences. In particular, two research questions were addressed: 1. Can navigation patterns identify individual user paths and contribute to optimised learning design? 2. Do visualisations of network graphs help to understand user patterns within a digital learning environment? Ethics approval for the case study has been obtained.

Context

The Curtin Challenge digital learning platform (http://challenge.curtin.edu.au) supports individual and team-based learning via gamified, challenge-based, open-ended, inquiry-based learning experiences that integrate automated feedback and rubric-driven assessment capabilities. The Challenge platform is an integral component of Curtin University's digital learning environment along with the Blackboard learning management system and the edX MOOCs platform. The Challenge development team at the Curtin Learning and Teaching are working towards an integrated authoring system across all three digital learning environments with the view to create reusable and extensible digital learning experiences.

Curtin Challenge includes three sets of content modules: Leadership, Careers and English Language Challenge. Over 2,600 badges have been awarded for the completion of a challenge. This case study includes analysis from the Careers Challenge, which has 12 modules each of which can normally be completed in 60 minutes or less. The design features of each module contain approximately five activities designed to include one to three different interactions.

The module "Who am I" in the Careers Challenge is a collection of five web pages (called 'activities') containing interactions, such as choosing from among options, writing a short response to a prompt, spinning a wheel to create random prompts, creating, organising and listing ideas, matching items, and so forth. The average time to complete the 'Who am I' module is 1.4 hours. The five activities in the module are 1. Why is self-awareness important for your career, 2. Career values, 3. Self-awareness in action, 4. Employability skills, 5. Final thoughts.

Analytics snapshot of the case study

Analytics data for the presented case study includes 2,753,142 database rows. Overall, 3,550 unique users registered and completed a total of 14,587 navigation events. Figure 1 provides an overview of modules started (M = 3,427, SD = 2,880) and completed (M = 2,903, SD = 2,303) for the Careers Challenge. The average completion rate for the Careers Challenge was 87%. The most frequently started module was "Who am I?" (10,461) followed by the module "Resumes" (7,996). The module "Workplace Rights and Responsibilities" showed the highest completion rate of 96% followed by the module "Interviews" (92%). A total of 60 activities were included in the analysis of the twelve modules of the Careers Challenge. The average completion rate for the 60 activities was 89% (M = 580, SD = 476). The most frequently started activity was "Why is Self-awareness Important for your Career?" (3,225) which is part of the "Who am I?" module. The activity "How do People see You?" within the module "Interviews" showed the highest completion rate of 99%.

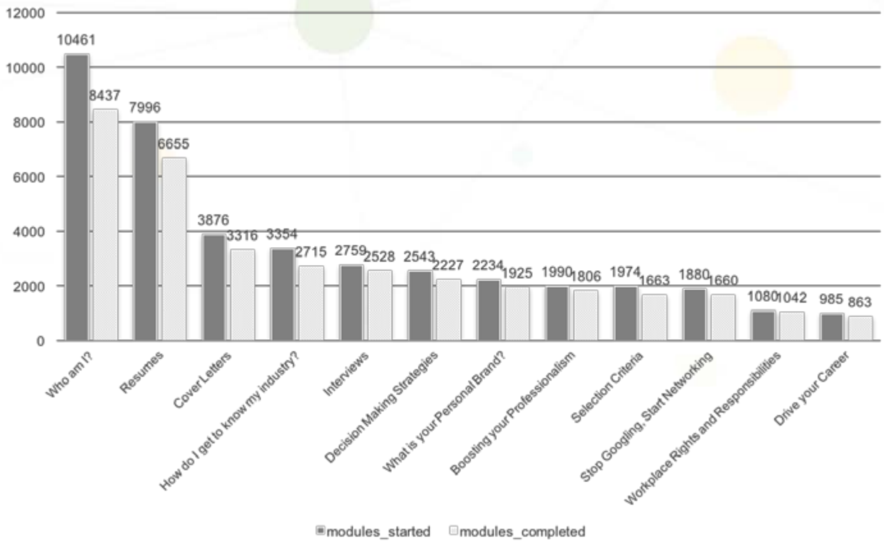

Figure 1: Module completion of Careers Challenge

Activity network graph analysis

The network analysis identifies user paths within the learning environment and visualises them as a network graph on the fly. The dashboard visualisations help the learning designer to identify specific patterns of learners and can reveal potentially problematic learning instances, such as learner disengagement. The nodes of the network graph represent individual interactions. The edges of the network graph represent directed paths from one interaction to another. The indicator on the edges represents the frequency of learners taking the path from one interaction to another and in parenthesis the percentage of learners who took the path. An aggregated network graph shows the overall navigation patterns of all learners. A network graph can be created for each individual learner, for selected groups of learners (e.g., with specific characteristics), or for all learners of the learning environment. Updates of the network graph are generated in near real-time. This has the potential to help the learning designer to identify people who require further help within the learning environment. In addition, the learning designer may identify learning materials or activities that do not contribute to an optimal learning experience. A learning design dashboard (in preparation) will enable the learning designer to zoom into specific learning events of individual learners or of specific groups of learners.

The aggregation of all individual network graphs provides detailed insights into the navigation patterns of all learners. Figure 2 shows the aggregated network graph network including paths taken by all 3,550 learners showing 14,587 navigation events. The five modules are highlighted using different colours. This example of a network graph can assist the learning designer to optimise the current design as well as reflect on the planning of future learning designs. Accordingly, such a network graph can also function as an instrument for professional development of learning designers.

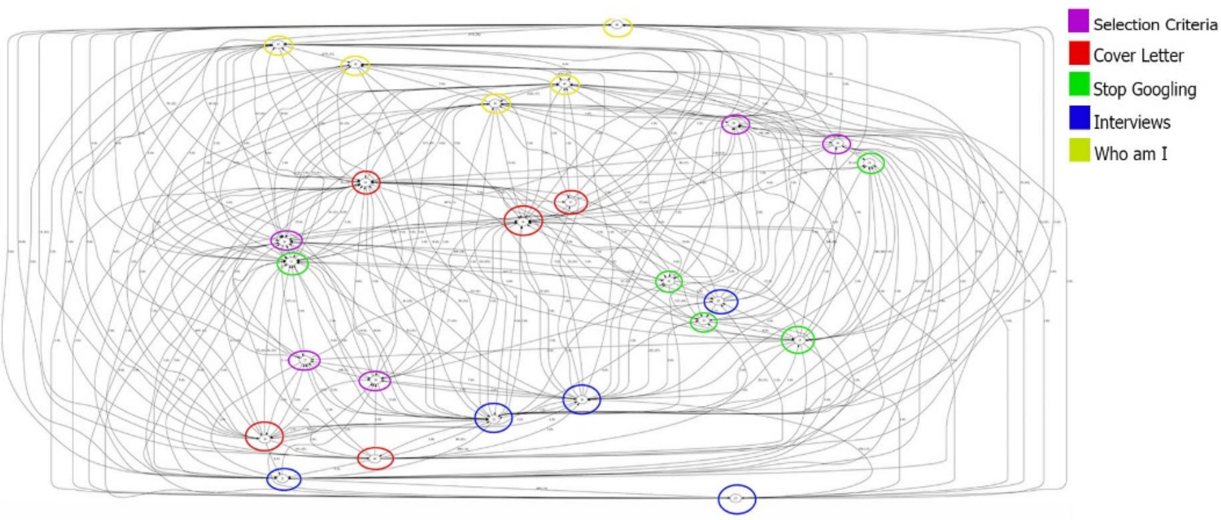

Figure 2: Aggregated network graph

Discussion and conclusion

The learning designers of the example case could have directed users to flow through the modules of Careers Challenge in a particular order, or in some small subset of orders of the modules, but instead chose to leave the entire set of modules open at all times to all users. This design decision resulted in Figure 2 that shows a few preferred paths (the thicker lines), but on the whole, a wide variety of paths. However, even with open-ended freedom, only 608 sequences were evidenced by learners out of a potential number of hundreds of millions of sequences (e.g., the combination of sequences of 5 interactions in any order out of 50 is (50*49*48*47*46) = over 254 million sequences). Of the 608 sequences created by users, far fewer have large percentages of the population traversing the same paths. For example, 17% of the total population gave one activity a try and then left the Challenge; another 16% engaged with a sequence of only four interactions and then exited. With the extremely small subspace traversed by users, it is perhaps understandable to think that there is meaning in that pattern (e.g., why are there not more sequences evidenced and why these particular sequences?).

The initial authored content in the Careers Challenge represents an incremental step from typical online content – where the learner reads content and then answers some questions, or perhaps creates lists of ideas when prompted. The advance in the Careers Challenge learning design took place at the interaction level rather than the activity path level. For example, fourteen new learner interactions were mapped, including drag and drop, spinning wheels for randomising content, list construction, list item creation, priority ranking of items, and more. The analysis of these interactions is a level deeper than tracking which activity page someone lands on; it might be a starting point for mapping how a crowd of learners utilises the learning resources within an activity, and is closer to a cognitive analysis than simple landing page analysis.

Using analytics data to support learning design decisions requires a deep understanding about the meaning of the network graph and underlying algorithms. This is a new challenge for future learning designers but also a new opportunity to reflect on design decisions in near-real time and thus, optimise learning environments on-the-fly.

To sum up, the integration of analytics data into the design of learning environments is a promising approach. Learning design may offer the right set of theoretical foundations for planning optimal design and reuse of cross-platform learning and teaching sequences. Learning analytics in turn is able to offer detailed insights into individual and collective learning processes and evidence for validating assumptions about the effects of learning designs in various contexts. Accordingly, the synergistic relationship between learning design and learning analytics, i.e., *learning analytics design* (Ifenthaler, 2017), opens up a bright future for the design of personalised and adaptive learning. It is up to educators-as-designers to make the links between learning design and learning analytics operational and use learning analytics design to further advance the educational arena.

References

Bannert, M. (2009). Promoting self-regulated learning through prompts. *Zeitschrift für Pädagogische Psychologie, 23*(2), 139–145.

Berland, M., Baker, R. S. J. d., & Bilkstein, P. (2014). Educational data mining and learning analytics: Applications to constructionist research. *Technology, Knowledge and Learning, 19*(1–2), 205–220. doi:10.1007/s10758-014-9223-7

Dalziel, J., Conole, G., Wills, S., Walker, S., Bennett, S., Dobozy, E., Bower, M. (2016). The Larnaca Declaration on Learning Design. *Journal of Interactive Media in Education, Article 7*, 1–24.

Gašević, D., Dawson, S., Rogers, T., & Gašević, D. (2016). Learning analytics should not promote one size fits all: The effects of instructional conditions in predicting academic success. *Internet and Higher Education, 28*, 68–84.

Gašević, D., Dawson, S., & Siemens, G. (2015). Let's not forget: Learning analytics are about learning. *TechTrends, 59*(1), 64–71. doi:10.1007/s11528-014-0822-x

Goodyear, P., & Retalis, S. (Eds.). (2010). *Technology-enhanced learning: design patterns and pattern languages*. Roterdam: Sense Publishers.

Ifenthaler, D. (2012). Determining the effectiveness of prompts for self-regulated learning in problem-solving scenarios. *Journal of Educational Technology & Society, 15*(1), 38-52.

Ifenthaler, D. (2017). Learning analytics design. In L. Lin & J. M. Spector (Eds.), *The sciences of learning and instructional design. Constructive articulation between communities* (pp. 202–211). New York, NY: Routledge.

Ifenthaler, D., & Schumacher, C. (2016). Student perceptions of privacy principles for learning analytics. *Educational Technology Research and Development, 64*(5), 923–938. doi:10.1007/s11423-016-9477-y

Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. New York, NY: Routledge.

Lockyer, L., Heathcote, E., & Dawson, S. (2013). Informing pedagogical action: Aligning learning analytics with learning design. *American Behavioral Scientist, 57*(10), 1439–1459. doi:10.1177/0002764213479367

Pardo, A., & Siemens, G. (2014). Ethical and privacy principles for learning analytics. *British Journal of Educational Technology*. doi:10.1111/bjet.12152

Slade, S., & Prinsloo, P. (2013). Learning analytics: Ethical issues and dilemmas. *American Behavioral Scientist, 57*(10), 1510–1529. doi:10.1177/0002764213479366

van den Boom, G., Paas, F. G., van Merriënboer, J. J. G., & van Gog, T. (2004). Reflection prompts and tutor feedback in a web-based learning environment: effects on students' self-regulated learning competence. *Computers in Human Behavior, 20*(4), 551-567. doi:10.1016/j.chb.2003.10.001.

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Me in a Minute: A simple strategy for developing and showcasing personal employability

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Graduates require evidence of employability beyond marks and grades to differentiate themselves in the highly competitive labour market. Universities cannot guarantee employment, but they can engage students in learning and recognise achievement that is relevant to employment. Here, we share preliminary insights from interviews investigating student perceptions of an extra-curricular video strategy designed to develop and showcase graduate employability. The *Me in a Minute* video strategy provides students with support to film a one minute video pitch aimed at potential employers. Student perceptions of the strategy suggest that in addition to providing an individualised artefact that can be used to showcase achievement, the strategy engages students in reflection that helps them to better understand and articulate evidence of their achievements relevant to employment. Furthermore, students value the learning associated with pitching, more than the video itself.

Introduction

Universities are producing more graduates than ever before, and whereas attainment of a degree once assured a job, conferral of a degree is no longer the differentiator it once was (Brown, Hesketh, & Williams, 2003; Burning Glass Technologies, 2014; Tomlinson, 2008). Increasingly employers are seeking graduates who have transferable skills, can adapt to change, and can provide evidence beyond the academic environment (Shah, Grebennikov, & Nair, 2015). To stand out in a competitive employment market, graduates must understand how to identify and articulate their capabilities, and be able to provide evidence of achievement that differentiates them from other graduates (Bowden, Hart, King, Trigwell, & Watts, 2000; Sullivan & Baruch, 2009).

Most universities articulate the broad categories of generic attributes or capabilities that their graduates should acquire over the duration of their degree (Oliver, 2011; Su, 2014), and processes for embedding these into the curriculum have improved. For example, coordinated degree-wide approaches for enhancing curriculum have become more common and often focus on the development of generic attributes (Bath, Smith, Stein, & Swann, 2004; Oliver, 2013, 2015; Spencer, Riddle, & Knewstubb, 2012). However, universities often fail to effectively communicate the intention of that curriculum to students or to engage them in their own conscious skills development (Jorre de St Jorre & Oliver, 2017). Furthermore, universities commonly assess students on the same tasks, against the same criteria: so assessment neither celebrates individuality nor provides students with opportunities to differentiate themselves from other graduates.

Effective strategies for prompting student engagement with employability are needed, and should be informed by the experience of students themselves. In this paper we share preliminary insights from student perceptions of a strategy, Me in a Minute, designed to develop and showcase personal graduate employability.

The strategy: Me in a Minute

Me in a Minute is a video strategy developed at Deakin University to emphasise graduate employability to students and employers. Students are provided with support to produce a one-minute video pitching their knowledge, capabilities and experience to prospective employers. The video strategy is offered to all students across the university, regardless of discipline or course. In their video, students select three of Deakin's eight graduate learning outcomes to focus on and must provide evidence of their achievement. Deakin's graduate learning outcomes are described as follows:

1. Discipline-specific knowledge and capabilities: demonstrating systematic understanding of their discipline or profession, relative to the level of study.
2. Communication: using oral, written and interpersonal communication to inform, motivate and effect change

3. Digital literacy: using technologies to find, use and disseminate information
4. Critical thinking: evaluating information using critical and analytical thinking and judgment
5. Problem solving: creating solutions to authentic, real world and ill-defined problems
6. Self-management: working and learning independently, and taking responsibility for personal actions
7. Teamwork: working and learning with others from different disciplines and backgrounds
8. Global citizenship: engaging ethically and productively in the professional context and with diverse communities and cultures in a global context.

The video was initially offered as an extra-curricular opportunity, and creative and digital arts students were employed to assist their peers in the production of the videos. More recently, the activity has also been embedded in assessment. To support adoption at scale, resources have been developed to assist students to produce their own videos. Participants are encouraged to disseminate their video through digital networks such as LinkedIn and digital resumes, to market themselves to prospective employers. To facilitate this, videos are uploaded to the Me in a Minute YouTube channel and the final screen of each video closes with 'Connect with [Student name] on LinkedIn'. In addition to giving graduates an opportunity to promote themselves to employers, it was hoped that the initiative would promote Deakin's graduate learning outcomes, and encourage students to reflect on those capabilities and how to articulate and evidence their employability. Me in a Minute is one of a suite of strategies developed at Deakin University to enhance graduate employability through engaging students with the graduate learning outcomes described above.

Data collection

To understand how students were sharing the videos, we investigated the Linkedin profiles of all 114 students who had participated in Me in a Minute strategy at the time of data collection, recording whether they had a profile and if the video appeared on it. We then used semi-structured interviews to explore the experience of thirteen students who had filmed a Me in a Minute, making sure to include participants who were and were not sharing their video through LinkedIn. Student responses were recorded and subject to qualitative analysis to identify commonly recurring themes (Miles et al., 2014).

Interviewed students had all used the initial fully-supported production service (i.e., had access to videographers and editing). Of those interviewed, eight (62%) were sharing the video through their LinkedIn profile at the time of the interview, four were not and one did not have a LinkedIn profile at all. Eleven of the interview participants had graduated from the course they were enrolled in when they filmed the video: eight of these were employed, two were enrolled in further study, and one was unemployed. The other two participants were still studying the same course as when they filmed the video. Participants had been enrolled in a wide range of postgraduate and undergraduate courses and included domestic and international students when they filmed their video. The disciplines represented included: education, commerce, accounting, finance, financial planning, international studies, media and communications, health, human nutrition, and science.

This research was carried out in accordance with the National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council, 2007) and was approved by the Deakin Faculty of Arts & Education Human Ethics Advisory Group (HAE-15-158).

Preliminary findings

At the time of data collection, 87% of 114 students who participated in Me in a Minute had a LinkedIn profile, but only 43% had shared their Me in a Minute on LinkedIn. However, interview participants were overwhelmingly positive about the video strategy. Of course, we acknowledge that students who participate in research of this kind are more likely to participate if they have an extremely positive or negative experience to share. For this reason, we ensured that we spoke to students who were and were not sharing the video at the time of data collection. Interestingly, students who were not sharing the video still spoke highly of the experience. These students reported they had either removed the video from their profile because it did not reflect their more recent experience, or had never shared it because they were not actively seeking work or engaging with LinkedIn as a professional platform.

Here we share two themes that emerged from preliminary analysis of the interview data:

1. Students value short videos as a medium for promoting their employability
2. The process of pitching was more valuable than the video itself

The video as an artefact

Participants thought that the use of a short video was an effective strategy for promoting their employability and most indicated that they, had, would or should, create another video. Participants thought the video was a good way to showcase relevant experiences such as study tours, internships and volunteer work, and to make a more personal connection with employers than could be achieved on paper:

> *You're just a piece of paper and a name, so being able to click on the Me in a Minute link, if they choose to do so, they see just a minute of you talking and you get that ultimate or immediate kind of personal connection*.

However, few were able to actually report on reactions from potential employers, and the influence of the videos on strengthening professional networks was not clear or prominent. Reported reactions to the video were predominantly in the form of comments from friends and family. Some participants had not applied for any employment opportunities yet, and others admitted that they were unable to differentiate between the impact of a range of strategies they had used to promote their employability. However, where feedback was provided, the videos had been perceived as a novel and effective strategy for self-promotion:

> *I've definitely had a lot of attention drawn to the video, because yeah, employers have just been like, "Oh, no we've never seen that before, it's a really good idea."*

The process of pitching
Participants reported finding more value in the process of creating the video than in the use of the video itself. Students explained that the exercise of recording the video had provided a valuable opportunity for them to reflect on their experiences, skills and capabilities, and had helped them learn how to articulate these clearly and succinctly.

> *I'm quite a confident speaker, but there's a lot of people who aren't, and I think if it puts them in the deep end to make them reflect on, "Wait, am I actually employable? What do I actually offer an employer? What are the gaps I need to fill between now and when I graduate?" Because a lot of people just don't think about these things… So I think Me in a Minute makes people reflect and think about okay, this is actually me, this is what I'm selling, this is what employers are going to buy, in theory.*

Students also reported having gained confidence – in themselves, their employability and in their ability to articulate themselves to employers.

> *I found it a great mechanism just for building up my own self-worth and allowing me to look at myself from an external perspective.*

> *I would say it gave me more of a confidence boost to be honest. Because I realised wow, I'm more than just some other graduate, when you just highlight my best areas… I did tick all the boxes of what graduate employers wanted.*

Numerous students felt that the strategy helped them to prepare for interviews and improved their understanding of how to articulate their skills and capabilities to prospective employers. For example, one student spoke about Me in a Minute having improved his "career game face". Another student referred to nervousness associated with public speaking and the benefits of employers being able to see him communicate in a setting in which he was less nervous than in an interview setting.

Discussion

Preliminary analysis of student and graduate perceptions suggest that the video strategy described provides much more than just an artefact for promoting employability. Perhaps more importantly, the video strategy engages students in reflection on their achievements relevant to employment, and appropriate language for articulating evidence to employers. The strategy offers a simple, adaptable vehicle that can be personalized for each student. The product is portable and can be readily replaced to incorporate subsequent learning and experience.

A shortcoming of the initial introduction of the strategy is that, like all extra-curricular initiatives, it was most likely to attract students who are already proactive in seeking opportunities. We suggest that all students need to be engaged in learning related to skills and career development. However, in other research we have shown that even students who want more guidance on course and employer expectations often do not seek it out (Jorre de St Jorre & Oliver, 2017). In reality, only a small proportion of students access career services provided outside the curriculum, and students who need these services most are least likely to seek them out (Doyle, 2011).

For this reason, Deakin has started to embed the video strategy into the taught curriculum as an assessment task. Adoption in a large, first year commerce unit is designed to develop self-reflection and orient students to career education from the outset of their degree. It is yet to be seen if the strategy is perceived as positively and effectively by students who are required to participate, or whether these students continue to produce videos to document their achievements as they approach graduation.

References

Bath, D., Smith, C., Stein, S., & Swann, R. (2004). Beyond mapping and embedding graduate attributes: bringing together quality assurance and action learning to create a validated and living curriculum. *Higher Education Research & Development, 23*(3), 313-328.

Bowden, J., Hart, G., King, B., Trigwell, K., & Watts, O. (2000). Generic capabilities of ATN university graduates. Canberra: Australian Government Department of Education, Training and Youth Affairs.

Brown, P., Hesketh, A., & Williams, S. (2003). Employability in a knowledge-driven economy. *Journal of Education and Work, 16*(2), 107 - 126.

Burning Glass Technologies. (2014). Moving the Goalposts: How Demand for a Bachelor's Degree is Reshaping the Workforce. Boston, MA: Burning Glass Technologies.

Doyle, E. (2011). Career Development Needs of Low Socio-Economic Status University Students. *Australian Journal of Career Development, 20*(3), 56-65. doi:10.1177/103841621102000309

Jorre de St Jorre, T. & Oliver, B. (2017). Want students to engage? Contextualise graduate learning outcomes and assess for employability. *Higher Education Research & Development,* doi:10.1080/07294360.2017.1339183

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). Qualitative Data Analysis. London, UK: Sage Publications.

National Health and Medical Research Council. (2007). National statement on ethical conduct in human research. Retrieved from https://www.nhmrc.gov.au/guidelines-publications/e72

Oliver, B. (2011). Assuring Graduate Outcomes Good Practice Report. Sydney: Australian Learning and Teaching Council.

Oliver, B. (2013). Graduate attributes as a focus for institution-wide curriculum renewal: innovations and challenges. Higher Education Research & Development, 32(3), 450-463. doi:10.1080/07294360.2012.682052

Oliver, B. (2015). Assuring graduate capabilities: Evidencing levels of achievement for graduate employability. Sydney, Australia: Office for Learning and Teaching.

Shah, M., Grebennikov, L., & Nair, C. S. (2015). A decade of study on employer feedback on the quality of university graduates. *Quality Assurance in Education, 23*(3), 262-278.

Spencer, D., Riddle, M., & Knewstubb, B. (2012). Curriculum mapping to embed graduate capabilities. *Higher Education Research & Development, 31*(2), 217-231. doi:10.1080/07294360.2011.554387

Su, Y. (2014). Self-directed, genuine graduate attributes: the person-based approach. *Higher Education Research & Development, 33*(6), 1208-1220. doi:10.1080/07294360.2014.911255

Sullivan, S. E., & Baruch, Y. (2009). Advances in Career Theory and Research: A Critical Review and Agenda for Future Exploration. *Journal of Management, 35*(6), 1542-1571. doi:10.1177/0149206309350082

Tomlinson, M. (2008). The degree is not enough: students' perceptions of the role of higher education credentials for graduate work and employability'. *British Journal of Sociology of Education, 29*(1), 49 - 61. doi:10.1080/01425690701737457

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The power of Us: Investigating the value of interaction and community in postgraduate studies

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The power of community – of *Us* – has long been assumed to be important in adult learning. Student interactions on discussion forums are encouraged, and it has been claimed that they foster a learning community which makes a difference to student outcomes through collaboration and joint construction of knowledge. This paper reports on interim results of a research project to establish, firstly, if there is a correlation between student participation in forums and their overall course outcomes, and secondly, shares a matrix designed to code both social and cognitive forum activity, to support an investigation into the existence of a learning community in student forum conversations – the power of *Us*.

Introduction

A central feature of online learning is the use of discussion forums and the interactions and relationships they support. Discussion forums, especially at post graduate level, are viewed as a way to facilitate knowledge construction through sharing, critiquing, evaluation and synthesis (Schrire, 2004). Students can support each other both socially and academically, creating a sense of belonging to the community they may be forming online (Ke &Hoadley, 2009). If these interactions are valuable, it should firstly be possible to establish a relationship between participation in forums and the overall grade the student receives for the course. Secondly, it should also be evident if there is indeed a learning community developing, and if so what are the signs of that? This paper discusses a work in progress investigating the effect of student to student interaction in discussion forums on final grades, and endeavours to establish if indeed a learning community has developed which might be supporting those outcomes.

Links to success

Researchers have concluded that in online discussion forums, login frequency has predictive value for a final grade attained by the student (Smith, Lange, & Huston, 2012; Romero, Luna & Ventura, 2013) Although Davies and Graff's (2005) study suggested that greater online interaction did not lead to significantly higher final grades, the study did show that students who failed courses participated less online. However later studies have showed links between forum participation and final grade. Nandi, Hamilton, Harland and Warburton's (2011) study showed a correlation between activity in forums and grades, as did Green, Farchione, Hughes and Chan (2014) and Cheng and Chau (2015). Macfadyen and Dawson (2010) showed that the total number of discussion messages posted had positive correlations with final grades. Xial, Fielder and Siragusa (2013) found a similar correlation between student results and participation in discussion boards.

Joksimovic´, Gaševic´, Kovanovic´, Riecke & Hatala (2015) examined the relationship between social presence (based on Garrison's (2011) indicators) and academic performance i.e. the final course grade, concluding that indictors such as continuing a thread and complimenting or expressing appreciation were significant predictors of academic performance. They further implied though, that cognitive presence might be a more dominant predictor of academic performance. This suggests that investigation into the kind of relationships present and the nature of the posts themselves is warranted, and if there is indeed evidence that participants are creating an online learning community that collaborates in their own knowledge construction.

Defining a community of learning

Learning communities can be defined as, "a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct meaning and confirm mutual understanding" (Garrison, 2007 p. 62). Yuan and Kim (2014) add that online learning communities give members a sense of belonging, where ideas, values and beliefs are shared and mutual trust and respect are fostered. Sadera, Robertson, Liyan Song, and Midon (2009) defined community as “a group of participants, relationships, interactions and their social presence within a given learning environment”, (p278). Garrison (2016) claims a community “provides conditions for participants to exchange ideas, sustain discourse, collaboratively construct meaning and validate knowledge” (p54). What is common to the ideas noted above, and a definition that is considered pertinent to this research, is that a learning community is a cohort of people engaged in collaborative, purposeful, learning through interaction and relationships. It has long been believed by some that learning communities are vital to student success (Harasim, 2002; Palloff & Pratt, 1999). Ryman, Burrell, Hardman, Richardson & Ross’ research, (2010) showed that learning communities encourage critical discourse and also personal transformations. The use of technology extends the reach beyond just the face to face interactions.

Evidence of a learning community

According Flynn and La Faso, online forums can best be described as conversational modes of learning that “lead to enhanced learning such as increased motivation and engagement in learning tasks, deeper levels of understanding, the development of higher order thinking skills and divergent thinking” (as cited in Naughton, Dolan & Robinson 2009, p.16). It should therefore be possible to identify this in a collection of online conversations as evidence of the existence of a learning community. Garrison (2016) considers a functioning community is “expressed by reflection and discourse (thinking collaboratively)” (p.54) where learning is a process of inquiry, a collaborative constructionism. This suggests a balance between “the cognitive and social demands of an educational experience” (p.55) as learners collaboratively construct meaning and validate understanding. Crosta, Manokore and Gray (2016) used interviews and an audit of interaction patterns in a series of online groups to establish if a Community of Inquiry Framework [CoI] (Garrison, Anderson & Archer, 2001) was present which would indicate an authentic online learning community. The students reported cognitive and teaching presences, but considered the third presence, social, to be less evident. Peacock and Cowan (2016) have further expanded the CoI model to consider the interweaving of the three dimensions – which they call Influences – which harness the “joint potential found in the two Presences, with appropriate support from the third Presence” (p.272). Khoo and Forret (2015) examined a semester long online forum and how the students came together to support each other’s learning through active participation and diverse interactions to develop shared understandings. They stress that participation (development of relationships and identities) differs from interactions, which “emphasises the mutual reciprocity between people via the type of dialogue occurring to serve particular purposes” (p.234) which can be intellectual, emotional or social needs. They did not though consider the knowledge building aspects in their research. The research approach discussed in this paper, considered both the social and cognitive (knowledge building) aspects displayed by students in their online posts.

Methodology

The research questions sought to find if there was a relationship between engagement in the assessed discussion forums associated with postgraduate courses and the student’s final outcomes of the course, and, secondly, if there was evidence of a learning community to be found by analysing the social and cognitive contributions of selected distinction graded students in the discussion forums. The project adopted a mixed methods approach utilising both quantitative and qualitative data.

The quantitative aspect compared the results of all 820 students across three years of postgraduate online courses. Assessment for these courses comprised three items. Regular participation on the forum for the 12 weeks of the semester was expected and was graded for both number and quality of post (adding value to the community, engaging with the readings and each other) and constituted 20% as Assessment one. This grade was compared with the results of the two remaining (written) assessments, one midway in the courses (35%) and one at the end (45%) making up the rest of the final mark. Regression analysis was applied. The results are included as *Figure 2*.

Over 800 discussion forum posts by students who had highly successful course outcomes in their online courses were then purposefully selected from the data for further, qualitative analysis. Drawing on the work of Hughes, Ventura and Dando (2007), (who remodelled Rourke et al’s 1999 rubric) for aspects of social elements, Swann and Albion’s (2013) work on a caring dialogue and adapting Garrison’s Community of Inquiry cognitive elements, a matrix was developed to investigate the presence of a learning community, indicated by both social and cognitive aspects in the actual posts from students who received distinction level outcomes for their courses. *See Figure 1*. The postgraduate students were tasked with academic discourse (rather than structured problem-solving) each week in the assessed discussions, and the project focused on student contribution alone for the signs of a learning community. A subsequent project will examine the teacher contribution.

The **social activity** discourse codes included **affective** features such as expressing emotions or empathy, use of humour and self-disclosure. **Interactivity** included agreement, appreciation, asking questions of one another as well as softening statements by hedging. The highest category in this aspect was considered to be referring directly to others' messages. **Cohesiveness** was indicated by the use of names and the group as a whole was considered inclusivity.

Cognitive activity ranges from simple **exploration of ideas** or information exchange, to **adding value** by sharing an example, **integration** (connecting ideas from posts or readings - synthesis) with the higher order skills such as **evaluation** (evaluating viewpoints, or giving opinions with evidence) and **application** (applying new ideas or reporting back on trials of them in practice) deemed more significant. It is possible for one student post to have evidence of all four code categories, but higher order codes would supplant lower order ones in the same category, in the coding. Analysis of this data is still in progress, with paired coding, cross sampling and course comparisons (early course forum contributions vs later courses) yet to be completed.

Figure 1: Presence of a learning community (Adapted from Hughes et al, 2007; Swann & Albion,2013; Garrison et al 2001)

Category		Indicator	Definition	Criteria	Example	Keywords
Social activity						
Affective	**A1**	Expression of emotion, empathy	Conventional or unconventional expressions of emotion: Words, punctuation emoticons	Direct reference or word Use of emoticon Use of punctuation for effect	I enjoyed studying Happy sharing and learning Excited about sharing Sorry everyone That sounds awesome! What a shame	Scared Sorry Pleased Happy Nervous Excited
	A2	Use of humour	Joking, understatement, sarcasm	Deliberate use of humour emoticon	I can't open the PDF.... Lol that would make going to work every day easier hahaha	Ha ha LOL ☺
	A3	Self-disclosure	Revelation, confession or admission	Reveals emotional state without naming it,	I am still trying to understand the reading but… Would it be fair to say that	Trying Suggest Actually finding
Interactive	**I1**	Expressing agreement	Agreeing with each other, with content		I agree…….That's what I mean! I totally understand what you are saying	
	I2	Appreciation	Complimenting the point made		Thank you for your post It was interesting and got me thinking Very well said……..Good question	
	I3	Asking questions	Of each other		Do you mean...? Did you feel …?	
	I4	Hedging	Tentativeness	Avoids certainty, offence	I think….I don't think I wonder if…… I hope To make sure I understand you Can I just add, Just a question but…	Think Wonder Can I
	I5	Referring to other's messages	Reference to previous posts Quotes from previous posts		I tried to give you different perspectives I understand your comments on… Interesting to read about the teacher you mentioned	
Cohesive	**C1**	Addressivity	Using names, salutations, signoffs	Using the name in the paragraph	But as *name* said.. As *name* has mentioned	
	C2	Group inclusivity	Addresses the group as a whole		Lucky us Shall we.. Sorry everyone …Hi everyone	We us our
Cognitive activity						
	CA1	Exploration of ideas	Info exchange Speculating Questioning Quotes – relevant but no explanation		As teachers we always reflect.. Very true what you have said about...also another addition is What I am trying to point out is….	
	CA2	Adding value	Sharing pertinent examples from experience	Example only shared, without lesson learned	It reminded me of… On the other hand when..	
	CA3	Integration	Connecting ideas from other posts/readings		Another thing to consider is Similar to name's post…	
	CA4	Evaluation	Evaluation of viewpoints in readings/posts. Opinion with evidence		Like what is stated in *reading*, about… As *reading* states, " quote" this reinforces that… I have noted that ..and I found it really hard to apply these..	
	CA5	Application	Applying new ideas for real or in reflection Reporting back	Example with strategy, hindsight, what worked what didn't.	This made me realise that I have found a better way to.. Everyone can get affected, just this week….what it shows though is…..	

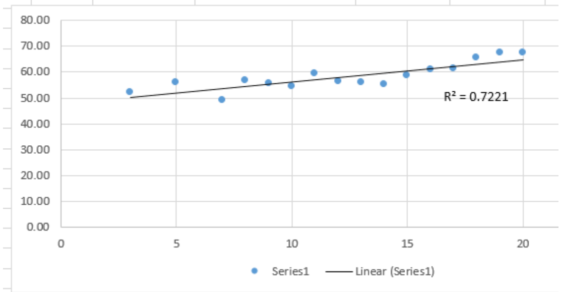
Preliminary results

Quantitative analysis of over 800 student results, over three years, for all courses for the three assessments in each course of the program has been completed. Figure two below shows a summary of the regression analysis which was applied.

Initially the spread of all marks achieved by students in assessment one (out of 20) were plotted against the 80 possible marks for the other two assessments, for every course in the program. Then the **average** total mark achieved by all students in all courses for assessments two and three was calculated for each point of the 3 to 20 possible marks achieved for the discussion forum assessment (# now16). The data show a high correlation. There is a positive relationship between the independent variable (the score out of 20 in the forum assessment) and the dependent variable (the score out of 80 for the other two assessments). 85% of the time, a student who achieved a high mark for assessment one, the discussion, also achieved a high mark for their other two written assessments.

Figure 2: Regression analysis

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.85
R Square	0.72
Adjusted R Square	0.70
Standard Error	2.84
Observations	16.00



This analysis shows that those students regularly posting on the discussion forums and having quality engagement with the content as well as frequent interaction with their fellow students and who therefore scored well for assessment one, performed better overall in their remaining two assessments. Whilst only one factor in the student's overall final grade, engagement can be used as an indicator for overall achievement. This tends to suggest that active participation in an online community at postgraduate level does have a flow on effect to student outcomes. What is actually in evidence in terms of both social and cognitive contribution in those online communities will be revealed better by the proposed qualitative analysis.

Investigation into the nature of the social activity and cognitive activity in the anonymised posts from highly successful students from two selected postgraduate courses is as yet only partially completed. Trends are emerging however. Higher order codes in the cognitive activity categories (integration, evaluation and application) appear to be more present in the forums attached to courses which feature later in the programme than in those that students tend to take early in their programme. This suggests that richer cognitive contributions are made as the community matures. Social activity though appears to be more consistently spread. Both aspects being present however suggest that highly achieving students are engaged in relationships, exchanging ideas, and are participating in purposeful, collaborative learning, which may also contribute to their overall success.

Conclusion

Results of this study already reveal that being able to engage in critical discourse and reflection, exchange ideas and collaboratively construct knowledge through discussion forums at postgraduate level allows students to achieve better by working together. There is a correlation between contributing well to online discussions and a student's overall achievement in a course. The exact nature of that interaction and further proof that a learning community exists and contributes to student success is still under investigation. However, the positive relationship shown between the forum assessment result and the outcomes achieved in the other two assessments in our courses confirms that engagement does make a difference. This is the power of *Us*.

References

Cheng, G. & Chau, J. (2015). Exploring relationships between learning styles, online participation, learning achievement and course satisfaction: An empirical study of a blended learning course. *British Journal of Educational Technology*, 47(2), 257-278.

Crosta, L., Manokore, V., & Gray, M. (2016). From an online cohort towards a community of inquiry: International students' interaction patterns in an online doctorate program. *Journal of Interactive Online Learning,* 14(2), Winter.

Davies, J., & Graff, M. (2005). Performance in e-learning: online participation and student grades. *British Journal of Educational Technology*, 36(4), 657-663.

Garrison, D. R. (2007). Online community of inquiry review: Social, cognitive, and teaching presence issues. *Journal of Asynchronous Learning Networks*,11(1), 61- 72.

Garrison, D. R. (2011). *E-learning in the 21st century: A framework for research and practice*. New York: Taylor &Francis.

Garrison, D. R. (2016). *Thinking Collaboratively; Learning in a Community of Inquiry*. New York: Routledge.

Garrison, D.R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence and computer conferencing in distance education. *American Journal of Distance Education*, 15(1), 7-23.

Green, R., Farchione, D., Hughes, D., & Chan, S. (2014). Participation in asynchronous online discussion forums does improve student learning of gross anatomy. *Anatomical Sciences Education* 7, 71-76.

Harasim, L. (2002). What makes online learning communities successful? The role of collaborative learning in social and intellectual development. In C. Vrasidas & G. V. Glass (Eds.), *Distance education and distributed learning* (pp. 181–200). Greenwich, CT: Information Age Press.

Hughes, M., Ventura, S., & Dando, M. (2007). Assessing social presence in online discussion groups: A replication study. *Innovations in Education and Teaching International*, 44 (1),17–29.

Joksimovic, S., Gaševic, D., Kovanovic, V., Riecke, B. E., & Hatala, M. (2015). Social Presence in Online Discussions as a Process Predictor of Academic Performance. *Journal Of Computer Assisted Learning*, 31(6), 638-654.

Ke, F., & Hoadley, C. (2009). Evaluating online learning communities. *Educational Technology Research and Development*, 57(4), 487–510.

Khoo, E., & Forret, M. (2015). Evaluating an online learning community: Intellectual, social and emotional development and transformations. *Waikato Journal Of Education*, 221-236.

Macfadyen, L.P., & Dawson, S. (2010). Mining LMS data to develop an "early warning system" for educators: A proof of concept. *Computers and Education*, 54(2), 588-599.

Nandi, D., Hamilton, M., Harland, J., & Warburton, G. (2011). *How active are students in online discussion forums?* Paper presented at Australasian Computing Education Conference (ACE2011), Perth Australia January 2011.

Naughton, C., Dolan, S., & Robinson, P. (2009). *Web-Enhanced distance learning in early childhood education*. Research Report. NZTC.

Palloff, R. M., & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom*. San Francisco, CA: Jossey-Bass.

Peacock, S., & Cowan, J. (2016). From presences to linked influences within communities of inquiry. *International Review of Research In Open & Distance Learning*, 17(5), 267-283.

Romero, C., López, M., Luna, J., & Ventura, S. (2013). Predicting students' final performance from participation in on-line discussion forums. *Computers & Education*, 68, 458-472.

Ryman, S., Burrell, L., Hardham, G., Richardson, B., & Ross, J. (2010). Creating and Sustaining Online Learning Communities: Designing for Transformative Learning. *International Journal of Pedagogies & Learning*, 5(3), 32-45.

Sadera, W, A., Robertson, J., Song, L., & Midon, M. (2009). The Role of Community in Online Learning Success. *Merlot Journal of Online Learning and Teaching* 5(2).

Schrire, S. (2004). Interaction and cognition in asynchronous computer conferencing. *Instructional Science* 32(6), 475–502.

Smith, V. C., Lange, A., & Huston, D. R. (2012). Predictive modeling to forecast student outcomes and drive effective interventions in online community college courses*. Journal of Asynchronous Learning Networks*, 16(3), 51-61

Swann, J., & Albion, P., (2013). Caring dialogue: A step toward realising the dream of online learning communities. In H. Carter, M. Gosper and J. Hedberg (Eds.), *Electric Dreams. Proceedings ASCILITE 2013 Sydney*. (pp. 854-864)

Xial, C., Fielder, J., & Siragusa, L. (2013). Achieving better peer interaction in online discussion forums: A reflective practitioner case study. *Issues In Educational Research*, 23(1), 97-113.

Yuan, J., & Kim, C. (2014). Guidelines for facilitating the development of learning communities in online courses. *Journal of Computer Assisted Learning*, 30(3), 220-232. doi: 10.1111/jcal.12042

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Knowing when to target students with timely academic learning support: Not a minefield with data mining

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The strategic scheduling of timely engagement opportunities with academic learning support, targeting specific student cohorts requires intentional, informed and coordinated planning. Currently these timing decisions appear to be made with a limited student focus, which considers individual course units only as opposed to having an awareness of the schedule constraints imposed by the students' full course workload. Hence, in order to respect the full student academic workload, and maximise the quantity and quality of opportunities for students to engage with learning advisors, a means to capture and work with the composition and distribution of student full workload is needed. A data mining approach is proposed in this concise paper, where public domain information accessed from the back end html language of course unit information webpages is collected and consolidated in graphical form. The resulting visualisation of the students' academic learning activities provides a quick and convenient means for academics to make informed scheduling decisions. The case study presented describes the implementation of the data mining in the context of discipline specific academic learning advisors at the University of Southern Queensland servicing three campuses under the 'One-University' model.

Introduction

Despite the intention to plan and schedule learning activities for the student, the logistical arrangements do not tend to consider a holistic view of the student's total commitments under the full study load. Instead academic schedules are generally designed based on the micro academic resource level. Gill (2015) flagged this as an issue where a review of academic practices indicated that units/courses are managed in an independent, and largely isolated, modularised manner. The consequence of this lack of communication about a student's total academic commitments is the high susceptibility for clashes to occur or the incidence of lengthy, highly concentrated blocks of learning activities, both resulting in less than optimal student engagement and performance. This closed nature of scheduling means that students are forced to prioritise the application of their attention, which has varying levels of success depending upon the time management skills of the student (Gill, 2015; Kyndt, Berghmans, Dochy, & Bulckens, 2014). By investigating methods to consolidate and communicate the distribution of academic workload of students, a greater awareness of student behaviour may be achieved. Currently, there are no tools available to do so, hence the arduous task is completed manually.

In this concise paper, we explore the implementation of educational data mining to curate and distil scheduling data, and present the collective students' academic commitments with data visualisation, ready for use in human decision making. Despite having a number of potential uses in the higher education sector, in particular, this concise paper will consider the scheduling of on-campus classes during the week, and the scheduling of assessment throughout the semester, and the value of this information for the university's academic learning advisors.

Typically, the scheduling of learning activities has a limited consideration of total students' academic commitments due to the following restrictions:

- The strategic consolidation of information will require considering a variety of combinations of courses/units to cater for the diverse composition of students' academic commitments within the targeted cohort.
- The opportunities afforded by the awareness of students' total workload and scheduling of activities will only eventuate if academics are provided convenient access to information.

- The collection of the relevant open access data is problematic due to its sparse storage on a plethora of individual course/unit related webpages.

Overcoming these restrictions would enable more convenient access to information which would be used to inform the management of student academic workload.

Exploration of novel methods of engaging with the total student academic commitments' is considered essential in incorporating a holistic student centred approach into strategic pedagogical practice. A technological strategy which adopts data mining and data visualisation practices would permit academics to access reliable public domain information and create knowledge in a consolidated and easily interpreted form (Mohamad & Tasir, 2013; Cristobal Romero & Ventura, 2007). While data intelligent methods are used in literature to optimise the class timetables scheduling (Deris, Omatu, Ohta, & Samat, 1997; Lai, Wu, Hsueh, Huang, & Hwang, 2008; MirHassani & Habibi, 2013; Pillay, 2014; Rudová, Müller, & Murray, 2011), they generally consider a single course/unit as opposed to the holistic student course workload composition, or are teacher or resource centric (Thompson, 2005). Hence they do not capture the true nature of the distribution of student workload throughout the semester.

However, as noted by Kitto, Lupton, Davis, and Waters (2016), there is an interdisciplinary gap between educators and computer scientists, which compounds the problems mentioned before. Academics interested in scheduling events which consider the students' total academic commitments do not possess the technical computing skills required for developing their own novel technologies.

Another significant issue is the widespread lack of awareness and appreciation of data science and visualisation which would be invaluable for engaging in evidence based practice (Peña-Ayala, 2014; Cristóbal Romero & Ventura, 2010). The lack of engagement with evidence based practice means that decisions are likely to be made based on anecdotal and redundant historical information, rather than catering for the current cohorts of students. Academic services offered from the University of Southern Queensland (USQ) library, such as timely offering of workshops and other scheduled learning activities would benefit from access and usage of complete student academic workload information. This prompts us to introduce the case study that will be referenced to for the remainder of the paper.

Case study: logistics of academic learning advisors

The University of Southern Queensland's (USQ) Academic Learning Advisors are disciplined based specialists who service the university's three campuses at Toowoomba, Ipswich and Springfield, in addition to the significant online cohort which represents up to 70% of USQ's student body (*The University of Southern Queensland Annual Report*, 2016). As members of USQ's Library academic staff, the learning advisors provide students and staff with academic learning advice in mathematics and discipline aligned academic language. With time being a precious commodity, the learning advisors require complex time management strategies to maximise productivity and maximise the engagement opportunities with their clients across the three campuses throughout the semester.

To achieve higher productivity, learning advisors would prefer to travel to service campuses at times and on days when their designated cohorts will have a strong presence to improve the likelihood of student engagement. Learning advisors would also need to be aware of major assessment deadlines for each cohort, to allow necessary planning for surges in demand. Hence the provision of student academic scheduling information is useful at weekly, daily and hourly temporal scales.

Method

The use of a particular data mining technique called web scraping or web mining was implemented using the programming language Python 2.7, aided specifically by functions from the BeautifulSoup module, which specialises in web scraping capabilities. Web scraping involves inspecting html code for specific fields such as those shown in Figure 1, and retrieving the corresponding arguments.

```
<event id="7400" timesort="09001100" colour="D4FFD4" date="26/02/2017 ... 4/06/2017">
<day>0</day>
<prettytimes>9:00 AM-11:00 AM Workshop</prettytimes>
<starttime>9:00 AM</starttime>
<endtime>11:00 AM</endtime>
<category>Workshop</category>
<prettyweeks>1-6, 9-15 (Sem 1 Teaching 2017)</prettyweeks>
<rawweeks>YYYYYYNNYYYYYYYNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN</rawweeks>
<resources>
<module title="Course">
<item>CMS1000</item></module>
<staff title="Staff">
<item>Warnest, Bev</item></staff>
<room title="Room">
<item>A5LR2 (Springfield)</item></room></resources></event>
```

Figure 1: Sample of html code behind the timetable for Springfield Semester 1, 2017 offering for CMS1000 (https://www.usq.edu.au/timetables/Sem12017Sfield/m7399.xml)

In alignment with the various USQ learning advisor designated disciplines, the courses/units have been segregated into their corresponding themes: mathematics (MATH), research and higher degrees (HDR), education (EDU), engineering, built environment and information technology (ENGBENVIT), management, commerce and law (MGTCOMLAW), creative arts, society and culture

(ARTCOMMN, also includes enabling programs such as tertiary preparation programs), sciences and health (HEAWBLSCI). These have been identified and colour coded in Figures 2 and 3.

Program and course classification

Simple text files (*.txt) lists are generated from iterating through the course specifications pages at https://www.usq.edu.au/course/specification/. Courses may also be classified according to faculty/section, school or department, Australian Standard Classification of Education (ASCED) code or year level. More customised automated clustering also possible with finer definitions of rules.

Class timing

USQ's class timetable web pages are openly accessible from launch page at https://www.usq.edu.au/current-students/organise-enrolment/timetables/class , which provides individual class timetables for Toowoomba and a combined Springfield/Ipswich into the three semesters over the academic year. Incremental counters are used to each acknowledge each instance in the hourly clusters. Clusters may be used to filter by discipline, class type, semester number, year level, campus.

Assessment timing

Workload information may be interrogated on a course by course basis from the freely available course specifications web pages, separated into year and then course offering at https://www.usq.edu.au/course/specification/. Specific assessment information may be extracted using filters, including assignment due date, type (for example quiz, essay, report, assignment or presentation), total marks and weighting. Fully scaleable, the data can be used to present assessment spread for nominated courses, up to a comprehensive distribution of all courses' assessment deadlines across the semester.

Results and discussion

The web scraping and compilation of information from the 805 course specification webpages detailing the courses/units offered by USQ was achieved in the order of minutes, which may vary depending upon the processing power of the computer used. The course specification page data mining activity yielded lists of all courses offered at USQ have been separated according to their corresponding themes, and are used in the process of grouping the courses for the graphical representations of class and assessment timings.

Class timing

From the daily bar charts (Figure 2) depicting the distribution of classes throughout each day, the discipline based learning advisors are able to decide best days to service different campuses based on the courses scheduled. Learning advisors may strategically choose days where their cohort are highly represented on campus, and schedule academic learning advisor engagement events during the gaps noticed in the distribution of the class times. While the data extracted from the website alone does not indicate class sizes, further data sets incorporating student study mode status are possible to further inform users.

Assessment timing

The quick inspection of the semester wide, and university wide, assessment deadlines (Figure 3) presents the academic learning advisor with information that is useful as a guide for predicting peaks in demand. At a micro level, this may be customised for specific cohorts, and used to help students become aware of the academic deadlines throughout the semester, and provide feedback to academics regarding competing academic demands.

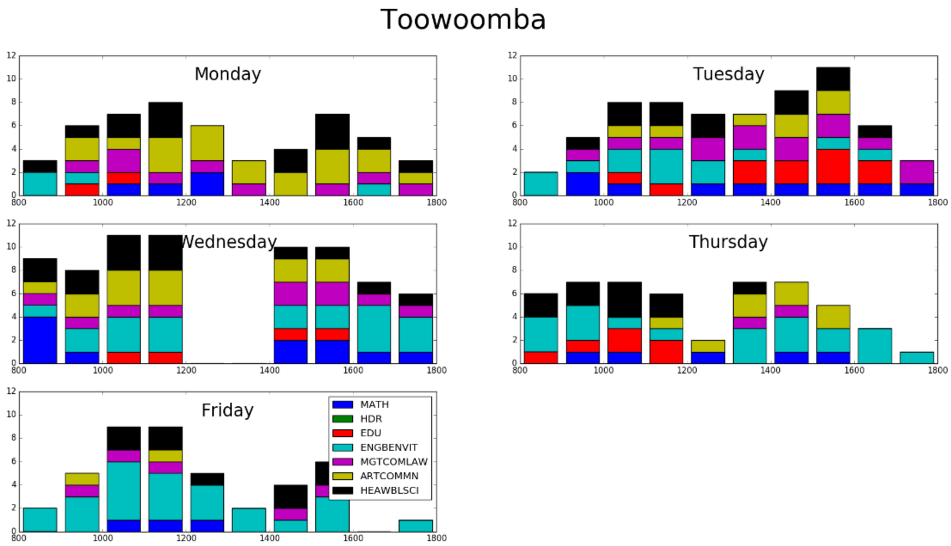

Figure 2: Distribution of number of first year on campus classes (lectures only) scheduled each day of the week at Toowoomba during Semester 1 2017, classified by course themes

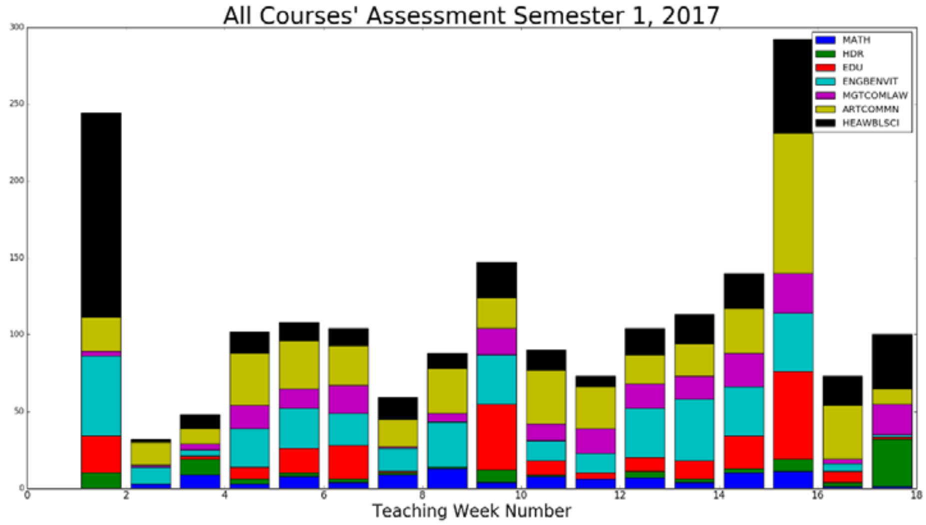

Figure 3: Distribution of all courses' assessments (excluding end of semester examinations) across Semester 1, 2017, classified by course themes

Conclusion and future scope

The adoption of web scraping, as a form of data mining, has enabled the academic learning advisor, and potentially other members of the university community, to have access to information regarding student's academic commitments, in bulk. In addition to providing this information to learning advisors, who may assess the best application of their time (both day, and periods throughout the semester) at different campuses, this also has the potential to be inform other student and staff centred operations. To date, this consolidation of information has been requested by members of learning advising, student services and student experience teams at USQ.

Further applications of this work could involve using the filters in these algorithms to present more comprehensively the nature of students' academic workload, and may provide insight into the theoretical workloads of the academics servicing these courses. With the integration of other data science methods, such as using machine learning clustering techniques, means there is potential to smooth the distribution of assessment throughout the semester, based on assessment weighting (proportional to expected student effort in hours) and due dates, to reduce the incidence of high concentrations of deadlines. Capturing the true distribution of workloads provides the opportunity to use this measurable evidence in the negotiation of course workloads and more effectively understand student and academic workload stress.

References

Deris, S., Omatu, S., Ohta, H., & Samat, P. (1997). University timetabling by constraint-based reasoning: A case study. *Journal of the Operational Research Society*, 48(12), 1178-1190.

Gill, B. (2015). Talking about the elephant in the room: Improving fundamental assessment practices. *Student Success*, 6(2), 53-63.

Kitto, K., Lupton, M., Davis, K., & Waters, Z. (2016). Incorporating student-facing learning analytics into pedagogical practice.

Kyndt, E., Berghmans, I., Dochy, F., & Bulckens, L. (2014). 'Time is not enough.' Workload in higher education: A student perspective. *Higher Education Research & Development*, 33(4), 684-698.

Lai, L. F., Wu, C.-C., Hsueh, N.-L., Huang, L.-T., & Hwang, S.-F. (2008). An artificial intelligence approach to course timetabling. *International Journal on Artificial Intelligence Tools*, 17(01), 223-240.

MirHassani, S., & Habibi, F. (2013). Solution approaches to the course timetabling problem. *Artificial Intelligence Review*, 1-17.

Mohamad, S. K., & Tasir, Z. (2013). Educational data mining: A review. *Procedia-Social and Behavioral Sciences*, 97, 320-324.

Peña-Ayala, A. (2014). Educational data mining: A survey and a data mining-based analysis of recent works. *Expert systems with applications*, 41(4), 1432-1462.

Pillay, N. (2014). A survey of school timetabling research. *Annals of Operations Research*, 218(1), 261-293.

Romero, C., & Ventura, S. (2007). Educational data mining: A survey from 1995 to 2005. *Expert systems with applications*, 33(1), 135-146.

Romero, C., & Ventura, S. (2010). Educational data mining: a review of the state of the art. *IEEE Transactions on Systems, Man, and Cybernetics*, Part C (Applications and Reviews), 40(6), 601-618.

Rudová, H., Müller, T., & Murray, K. (2011). Complex university course timetabling. *Journal of Scheduling*, 14(2), 187-207.

Thompson, G. M. (2005). Using information on unconstrained student demand to improve university course schedules. *Journal of Operations Management*, 23(2), 197-208.

The University of Southern Queensland Annual Report. (2016). Retrieved from https://www.usq.edu.au/about-usq/about-us/plans-reports/annual-report

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Quantext: Analysing student responses to short-answer questions

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We introduce a web-based tool for teachers to support the rapid analysis of student responses to short answer or mini-essay questions. Designed to support teaching in large-class settings, it aims to bring to practicing teachers analytic tools that can reveal insights in their student text data. We background development of the tool to date, briefly describe its architecture and features, and report on a bench-test evaluation. Finally, we introduce a pilot study to evaluate the tool in classrooms at three NZ universities and one polytechnic. We conclude with options for accessing the tool and outline plans for ongoing development.

Background

Quantext— a text analysis tool for teachers—has grown out of a demonstrable need, especially in large class settings, to rapidly evaluate written student responses to short-answer questions (McDonald, Bird, Zouaq & Moskal, 2017). Student success in higher education is predicated on interpreting, synthesising and producing text within specific disciplinary contexts. Yet, despite generating enormous volumes of text with each student cohort, the current preoccupation of learning analytics is with proxies of student engagement and learning; for example, counting clicks to access course materials, counting assignments completed, or ranking test scores (Ferguson, Brasher, Clow, et al., 2016). This project takes a different approach; we focus firmly on the words of the students themselves; arguably, the 'site of learning' (Knight & Littleton, 2015 p.).

Even though analysis and synthesis of text are central to teaching and learning in higher education, and even though this work is conceptually difficult, little attention is paid to how students understand and interpret teacher language in constructing their own academic writing (Laurillard, 1993). While there is certainly educational research around how students come to understand academic discourse (e.g. Marton & Säljö, 1976), around teaching academic writing (Lea & Street, 1998), and around the link between language and learning (e.g. Gee, 2015; Wells, 1994; Halliday, 1993), translating this research into actionable insights for teachers, particularly of larger classes, remains elusive.

However, this is not for want of data. Both student writing and text-based teaching materials are routinely uploaded to institutional Learning Management Systems (LMS). These data are used for assessment purposes or checking for plagiarism but are rarely consulted in systematic ways for improving teaching or informing learning design. We argue that it is essential that we not overlook the opportunity to analyse these data to illuminate student learning.

Furthermore, from a dialogic perspective (Bakhtin, 1981), what we write or speak about, is intimately related to what we have read or listened to. Therefore, our analysis must also include the teacher and teaching materials or we will fail to capture the dialogic at the centre of teaching and learning. In short, we suggest that analysis of student text must go together with the analysis of teacher text.

Our goal in developing Quantext is to bring to practicing teachers analytic tools that utilise the vast quantities of text data already being collected, as well as facilitate the analysis of text in settings, such as large classes, where this is currently impractical. Analysis of these data should expose and illuminate the site of learning, ultimately enhancing both teaching and learning.

Quantext development and prototyping

Our concept developed from a case study exploring student text responses to short-answer questions in the context of a large first year health sciences course (McDonald, Bird, Zouaq & Moskal, 2017). The case study was part of a larger NZ-wide learning analytics project (Gunn et al., 2016) funded by Ako Aotearoa (NPF15-008). This case study revealed multiple relationships between student responses, course materials and questions asked. We concluded that a tool, based on established methods of corpus linguistics and natural language processing

(hereafter referred to broadly as text analysis), could provide timely, actionable insights for teachers and help foster deep learning approaches for students.
As part of Ako NPF15-008, we held a total of four workshops at NZ-tertiary institutions during 2016 to introduce text analysis tools and approaches to teachers. While there was interest and enthusiasm from workshop participants, most existing text analysis tools were beyond the reach of most practising teachers. Furthermore, even getting text data into a form suitable for analysis presented challenge.

The challenges identified in the workshops helped define what the key requirements for Quantext should be: i) the tool should be available and accessible online; ii) uploading text data should be straightforward and eventually integrated with student data held in institutional LMS; iii) no prior knowledge of linguistic terms or metrics should be assumed; iv) interface tools should use familiar analysis paradigms (e.g. spreadsheets) and basic charts/visualisations; v) workflow should be straightforward and result in a specific output (e.g. label responses with teacher-defined categories or marking rubric); vi) text analysis settings should be accessible and easily customisable as skill with the tool develops; and vii) the tool should enable insights which can form the basis of feedback to students, and inform learning design and teacher development.

An initial prototype was developed following informal discussions with specialist academic developers at the University of Auckland and Victoria University of Wellington, as well as from interested tertiary teachers at several NZ institutions. Quantext is currently at the minimum viable product (MVP) stage; that is, some aspects are incomplete, but there is sufficient functionality for teachers to assess its suitability for classroom use (Münch et al., 2013). We describe the key features and workflow below.

Key features and workflow

There are multiple, often conflicting approaches to evaluating student responses to short answer questions (whether formative or summative). As Orr (2007) points out, the territory between positivist and poststructural approaches to assessment is complex and multilayered. Nevertheless, there is little recognition of this complexity in the computational assessment literature, which almost always evaluates automated methods of assessment against ‘gold-standard’ human markers. Typically, if interrater reliability between an automated marker and human marker is comparable to the interrater score between human markers, then the automated marker is performing well. Note, however, that interrater scores between humans, can be highly variable, due in part to the complexity of the assessment landscape (Jonsson & Svingby, 2007). To be fair to those working in computational assessment, while teachers may operate anywhere along the epistemological spectrum, in practice, institutional, disciplinary and curricula constraints combine to result in practical approaches to assessment characterised by a distinctly positivist stance. It is hardly surprising then that automated evaluation of short-answer questions emphasises standards and measurement.

In contemporary undergraduate classes, if evaluation of short-answer question responses occurs at all (in large classes, students may simply be given model answers to self-assess), it typically involves one of these approaches: i) a binary approach to evaluate whether responses are the same or different to a model/reference response; ii) a grading approach where a marking rubric is applied to evaluate whether all or some components of a model answer are present; or iii) a best judgement approach where the rater simply allocates grades or marks (although interrater checks may be made to ensure consistency across a cohort). With each approach, the rater may be a teacher, a tutor, a peer, or a machine.

Because of the complexity of the assessment space, response evaluation in Quantext deliberately makes no assumptions about the specific evaluation approach or epistemological stance. For example, the similarity metric may be used with a model answer, a representative mis(conception), or another student response—the choice of reference response is up to the teacher. Quantext simply compares the reference to each student response, and returns a number between 1 to -1: student responses sharing linguistic and semantic features with the reference response score closer to 1; responses unalike score closer to 0; and responses completely opposite score closer to -1. The teacher can sort all responses by this similarity metric to find those most similar, and label/categorise them accordingly.

The Quantext workflow is: i) upload questions and responses in spreadsheet format; ii) select which responses to analyse (you can choose more than one dataset for comparing different student cohorts); and iii) run the analysis. Default analysis provides descriptive statistics and charts for each dataset, including number of responses, length of response (word or sentence count), and readability indices (e.g. lexical diversity and lexical density). There is also a customisable keyword/key phrase display. By default, keywords are a frequency count of the most commonly occurring words excluding stopwords (i.e. functional words like ‘the’, ‘and’, ‘of’, etc.), and key phrases are word pairs (bigrams) or triples (trigrams) which occur together more commonly than by chance. Finally, there is a worksheet view of all student responses along with derived descriptive statistics (number of words, lexical diversity, etc.), and similarity to reference response (if given). The worksheet is searchable, easily filtered and sortable on any column.

Responses can be filtered to show only those containing a selected word or phrase. A label tool allows teachers to define categories for any student response. Figure 1 shows a screenshot of the Quantext analysis screen.

Figure 1: Quantext analysis: most frequent words, phrases and readability indices of two datasets

Through filtering and sorting the responses by the basic indices, word, bigram and trigram frequency, and similarity, we anticipate that teachers will be able to rapidly evaluate and categorise large numbers of student text responses. The resulting analysis can also be exported for comparison with other student data.

Teachers also have the option to augment their analysis through uploading teaching material related to the questions being asked, which serves two key functions: i) this provides a reference corpus with respect to student responses (e.g., one might anticipate key words and pairs from the teaching corpus to appear in the student responses and vice versa), facilitating identification of pedagogenic (mis)conceptions (Laurillard, 2002) through a keyword-in-context display; and ii) the readability indices of the teaching corpus can be checked against the readability indices of the student responses.

Bench-test baseline evaluation

To assess potential benefits to teachers and students, evaluation of Quantext in authentic educational settings is planned (we describe a forthcoming pilot study below). However, a key feature of the Quantext workflow, as mentioned above, is measuring the similarity of student responses to a reference response.

We conducted a baseline evaluation of this feature ahead of the pilot study, as a 'bench-test', using a dataset of 924 student responses to 10 open questions (in McDonald, Bird, Zouaq & Moskal, 2017). The questions related to a first-year undergraduate health sciences programme and were relational or multi-structural in nature (see SOLO Taxonomy, Biggs & Collis, 1982). In other words, they went beyond testing simple recall of facts to ask deeper questions. All student responses were labelled by two human markers who negotiated the appropriate label/s. It is important to note that more than one label could apply to any given response. In assessing similarity[1], for the purposes of our bench test, a single human assigned label was chosen for each response and compared to a reference response with the same label. A summary of our results for the 'correct' label is presented in Table 1.

[1] Similarity is calculated from a word2vec model of word embeddings using the GloVe algorithm (Pennington, Socher & Manning, 2014) and is pre-trained on the Common Crawl Corpus (Spiegler, 2013). An average response vector is calculated from the word vectors in each response and then the cosine distance between the response vector and the reference response is computed to give a similarity score between 1 and -1. Quantext uses the Spacy library (https://spacy.io) for the pre-trained word2vec model.

Table 1: Labelled responses with similarity measure of >= 0.90 to reference answer, 'correct

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
True Positive	15	19	3	2	3	2	12	14	8	14
False Negative	2	25	5	9	3	22	2	1	12	5
True Negative	138	95	108	93	69	50	36	36	27	11
False Positive	37	4	11	1	1	0	15	11	0	3
Accuracy	0.8	0.8	0.87	0.9	0.95	0.7	0.74	0.81	0.74	0.75
Recall	0.88	0.43	0.37	0.18	0.5	0.08	0.86	0.93	0.4	0.74
Precision	0.29	0.83	0.21	0.66	0.75	1	0.44	0.56	1	0.82

Evaluation with other labels (e.g. 'incomplete', 'don't-know', 'incorrect', 'naïve' etc) produced similar results. While far from perfect, we believe that overall accuracy of 0.70–0.95 for an out-of-the-box similarity algorithm on open-ended questions is acceptable for computer assisted evaluation. In particular, we suggest this is the case when other options to support label assignment such as keywords and response length are available to the teacher. One goal of the pilot study will be to test this belief through adopting a similar approach to Basu, Jacobs and Vanderwende (2013). We also hope to improve on baseline similarity performance through augmenting model training on domain-specific corpora.

Pilot study

We have recruited interested teachers from four NZ tertiary institutions to pilot Quantext in semester two (starting July, 2017)—at the time of writing, five teachers from five different courses, spanning the humanities, sciences, health sciences and commerce, and with cohorts of under 100 students to over 1000. All courses are on-site rather than distance courses. This reflects the courses taught by pilot volunteers rather than a deliberate choice. Specific considerations to explore in the pilot study are:

1. Evaluate the utility of Quantext, along the following dimensions to support student learning and engagement: (i) utility and accessibility of the tool; ii) validity and reliability of data; iii) intended vs actual use of the tool; iv) identification of actionable teaching insights; v) identification of insights to improve course design; and vi) utility at different stages of the teaching/learning design cycle).
2. Though teacher reflections, explore the impact, if any, of tool use on: i) student learning; ii) participant teaching practice; and iii) participant professional development.

Broadly, the pilot will adopt a development or design-based research approach. This means we will treat each course in the pilot as an individual case study. The pilot will begin with an introductory seminar/workshop at each site, covering administration details, and planning the questions to be asked of students. This will include discussing frameworks about the framing and motivation for asking short-answer questions (e.g. SOLO taxonomy), and addressing ethical or operational issues.

For the duration of the pilot, participants will ask formative, open-ended questions of their students and use Quantext to help evaluate student responses. It will be entirely up to participating teachers how they choose to incorporate short-answer questions for analysis with Quantext into their course. Examples include: i) questions may be asked at the start and again at the end of the course/module to see if there are changes or development in student language; or ii) questions may be asked at any time throughout the teaching period to explore emerging student understanding of specific concepts.

We envisage teachers will use existing systems such as Canvas, Blackboard, Moodle or similar, to facilitate collecting student responses in digital form. Relevant teaching materials will also be uploaded as reference corpora for the student responses. Ideally a complete set of teaching materials will be used, such as lecture notes, transcripts or textbooks (although some material may be not be available for inclusion), and we will assist teachers with creating their reference corpora.

Teachers using Quantext to analyse student responses will evaluate their analyses according to pilot goals. Throughout the pilot, teachers are welcome to give feedback or seek advice from the pilot project team, and the developers will be available to fix and update the software as problems are identified. We will capture teacher analyses conducted using the tool to form part of the pilot dataset. Concluding focus group sessions with teachers will be held at each site at the end of semester two.

Conclusion

We introduce a novel, web-based tool for teachers to support the rapid analysis of student responses to short answer or mini-essay questions. Results from a planned NZ pilot study will inform ongoing tool development. We hope to present early results from the pilot during Ascilite 2017. An evaluation version of Quantext and a link to the source code hosted on Github is available at http://www.quantext.org

References

Bakhtin, M. M. (1981). *The dialogic imagination*. Austin: University of Texas Press.

Basu, S., Jacobs, C & Vanderwende, L. (2013) Powergrading: a Clustering Approach to Amplify Human Effort for Short Answer Grading. *Transactions of the Association for Computational Linguistics*, 1 (2013) 391–402.

Ferguson, R., Brasher, A., Clow, D., Cooper, A., Hillaire, G., Mittelmeier, J., Rienties, B., Ullmann, T. and Vuorikari, R. (2016). *Research Evidence on the Use of Learning Analytics: Implications for Education Policy*. Joint Research Centre, Seville, Spain

Gee, J. (2015). Social linguistics and literacies: Ideology in discourses: Routledge.

Gunn, C., Blumenstein, M., Donald, C., McDonald, J., & Milne, J. (2016). *The Missing Link for Learning from Analytics.* In Show me the learning: Ascilite 2016. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds), Adelaide.

Halliday, M. A. K. (1993). Towards a language-based theory of learning. *Linguistics and Education*, 5(2), 93–116 .http://doi. org/10.1016/0898-5898(93)90026-7

Jonsson, A., & Svingby, G. (2007). The use of scoring rubrics: Reliability, validity and educational consequences. *Educational research review*, *2*(2), 130-144.

Knight, S., & Littleton, K. (2015). Discourse-centric learning analytics: mapping the terrain. *Journal of Learning Analytics*, *2*(1), 185-209.

Laurillard, D. (1993) Rethinking University Teaching: a framework for the effective use of educational technology. Routledge, London.

Laurillard, D. (2002) Rethinking University Teaching: a framework for the effective use of educational technology. RoutledgeFalmer, London.

Lea, M. & Street, B (1998) Student writing in higher education: An academic literacies approach. *Studies in Higher Education.* 23(2), 157-172

Marton, F. and Saljo, R. (1976). On qualitative differences in learning: I Outcome and process. British Journal of Educational Psychology, 46(1), 4–11.

McDonald, J., Bird, R. J., Zouaq, A., & Moskal, A. C. M. (2017). Short answers to deep questions: supporting teachers in large-class settings. *Journal of Computer Assisted Learning*. 33(4) 306–319. doi: 10.1111/jcal.12178.

Münch J., Fagerholm F., Johnson P., Pirttilahti J., Torkkel J., Jäarvinen J. (2013) Creating Minimum Viable Products in Industry-Academia Collaborations. In: Fitzgerald B., Conboy K., Power K., Valerdi R., Morgan L., Stol KJ. (eds) Lean Enterprise Software and Systems. Lecture Notes in Business Information Processing, vol 167. Springer, Berlin, Heidelberg

Orr, S (2007) Assessment moderation: constructing the marks and constructing the students, Assessment & Evaluation in Higher Education, 32(6), 645-656, DOI: 10.1080/02602930601117068

Pennington, J., Socher, R., & Manning, C.D. (2014) GloVe: Global Vectors for Word Representation. In proceedings, *Empirical Methods in Natural Language Processing (EMNLP)*. pp. 1532-1543

Spiegler, S (2013) Statistics of the Common Crawl Corpus. Retreived from http://bit.ly/2rRWsX9 4th June, 2017.

Wells, G. (1994). The complementary contributions of Halliday and Vygotsky to a “language-based theory of learning”. Linguistics and Education, 6(1), pp. 41–90.

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Monash Rocks: The first step in an augmented reality journey through deep time

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This paper describes the development of the "Monash Rocks" app - designed to bring our landscape to life through augmented reality. We describe the highs and lows of the development process, the lessons we learned along the way, and our plans for further development of the app to showcase the Monash Earth Sciences Garden and extend the space into further innovative, immersive teaching and learning experiences.

The creation of Monash University's Earth Sciences Garden (MESG), a "living" geological map of Victoria collating nearly 500 rock specimens, gave us the perfect vehicle for an Augmented Reality (AR) experience. Students and visitors to the MESG can now use the *Monash Rocks* App on their phones to view a 3D display that overlays the live camera feed on the device enhancing the experience of the environment, taking it to another dimension.

The value in augmenting a learning environment is in its ability to pull virtual objects into real scenes (Green & Chandler, 2014, p.549), in this case expanding the physical environment through time and space on a journey back millions of years. The rock now becomes alive, telling its story and supplying information that is missing in the "real life" walk through the garden.

Background

The Monash Earth Sciences Garden (MESG), opened in October 2015, represents the most complex "rock garden" in the world. The MESG is composed of 20 different igneous, sedimentary and metamorphic rocks and its design reflects the spatial locations of the geology of Victoria. The rocks are set out to form a unique geologic map that our students use to learn basic field mapping and rock identification skills before commencing fieldwork.

We envisioned the creation of an Augmented Reality (AR) experience to immerse our students and visitors back millions of years; back through sea beds brimming with now-extinct fish, back to the time of volcanoes to watch lava flow and cool, and back to chase Victoria's prehistoric fauna between fossiliferous rocks. The value that is added through this technological innovation deepens the understanding of the relationship between the formation of the Earth and our place in its ever-evolving environment. It places the learner in a context of deep time and accentuates our role in the future of our planet.

The pedagogic value of designing a virtual environment facilitates independent learning in an experiential context that is recognised for its motivational value and ability to develop high-level cognitive skills of exploration, analysis, interpretation and reflection. We planned to seize this opportunity by embracing the propensity of our students to use mobile technology, while applying contextual, situated, and authentic learning principles to Monash's newest learning space.

The affordances of mobile devices make it possible to create learning resources that can respond to markers or geospatial information to enhance each user's experience, taking it to another dimension. The value in augmenting a learning environment is in its ability to pull virtual objects into real scenes (Green & Chandler, 2014, p. 549), providing information that expands the physical environment back through time and space. The augmented MESG now becomes able to tell its story and supply information that is missing in the "real life" walk through the garden. This enhanced experience deepens the perspective of the learner and this extra-sensory interaction consolidates the learning, making it memorable.

The initial project proposal was to build a full App to act as a guide for the MESG, incorporating one complete environmental reconstruction of the Devonian seafloor 410 million years ago. Through consultation with experts in the field of Earth, Atmosphere and Environment (EAE), leading palaeontology and palaeoecology reconstructive artists, and experts in the field of Augmented Reality and 3D animation (SensiLab), the original environment of the rocks formed during the Devonian period were designed and brought to life as an immersive experience.

We received funding from the Monash University - Office of Learning and Teaching (formerly Office of the Vice-Provost Learning and Teaching) to conduct a discovery stage and complete a proof of concept (Phase 1) to demonstrate the capabilities and relevance of the app for teaching and learning.

Phase 1 includes:

- A complete experience for one rock type: The App developed in beta for Apple and Google Play devices - a fully interactive experience that acts as a template for the further development of each rock type
- Videos, graphics, settings, and educational fact sheets with a take home AR artefact
- A suite of learning materials and a website to support pre-visit and post-visit learning for visitors
- Storyboards, graphics, 3D animation proofs, icons, wireframes
- A content database that can be updated and applied to any software interfaces that are developed in the future.

Now that the ground-work is complete, the next stage is the development of AR and immersive environments for a further five rock types and their environs:

- Volcanic lava flows of the Newer Volcanics Province, western Victoria (intraplate volcanism)
- Victoria's Cretaceous dinosaurs and forests
- The eruption of Mount Dandenong
- The formation of Victoria's goldfields
- The formation of the Great Dividing Range.

As the Monash Rocks App has now been constructed, further stages only require 3D modelling, animation, and insertion into the existing App framework. We also now have a very clear idea of the pitfalls to avoid, and where to best invest our energy. We are currently in discussion with interested parties to establish funding for Phase 2.

Monash Earth Sciences Garden - the inspiration

There are seven igneous rocks (lava, scoria and bombs), eight sedimentary rocks (sandstones, limestones and a conglomerate), and six metamorphic rocks (slate, schist, hornfels, migmatite, quartzite and quartz) in the MESG. The rocks have been extensively geo-located using GPS so that when the onsite version of the app is used, it locates the user and highlights the nearby rocks. When each rock is selected, the user is given information that includes when it was formed and information about the position of Australia during that time; detailed information about its formation; and finally, its uses in building and manufacturing. Icons at the foot of the Rock Info page direct the learner to a Gallery of images and web-links for further information. Care has been taken to ensure that each rock has been assigned a colour according to the seamless geological map of Victoria (Department of Primary Industries). External links from the App connect to the Australian Stratigraphic Units Database (Geoscience Australia), and further information about the processes that formed each rock. Gallery images are of the rock as it appears in the MESG, in its natural location, and as used in buildings where appropriate. Information was obtained from published papers and government websites and rewritten for a more general audience. In the case of the Buchan Limestone, the user can also access the icon pointing to details of the fossils associated with the rock and the icon that launches the AR experience. The phone accesses the AR through a VuMark, a type of QR code.

Augmented Reality - bringing it alive

Selection of relevant species groups from fossil record

The function of Augmented Reality (AR) elements within the app is to provide a tangible example of the relationship between the fossil record contained in the rock garden, and the extinct Devonian animals and ecosystem these represent. The Devonian seafloor was selected as our exploratory test case for two primary reasons. The first was that convincing 3D animation is a lot easier to achieve with swimming and floating creatures than with walking, terrestrial ones. The second reason was to explore the visual analogy of 'immersion' in an underwater space, where the viewer is essentially suspended in virtual space where movement, physics and even sound are conveyed differently.

After a thorough literature review of the known and inferred Devonian fossil record of the Buchan area, we selected the following dominant animal groups for the inclusion into the app: armoured fish, cephalopods, crinoids, solitary corals and trilobites. These groups represent all contemporaneous ecological niches: armoured fish and cephalopods are free-swimming (pelagic) or bottom-dwelling (benthic) hunters and foragers, crinoids and corals are sessile filtration feeders, and trilobites are ground-moving scavengers. From these groups, we selected several representative species or animal groups.

Fossil record curation, digital reconstruction and 3D animation

In a combination of scientific and artistic work, we rebuilt selected animals as digital representations. Model construction began with an exhaustive review of published fossil images from scientific publications and museum collections. In some cases, CT-scans of fossils or full fossil reconstructions were available (e.g. Béchard et al., 2014). To guarantee a faithful reconstruction process the creative work was guided and supervised by team palaeontologists and biologists. Natural history artist and palaeontologist Dr Peter Trusler reviewed the collected resources and the creative process and provided feedback.

A team of modellers used the curated images to create three-dimensional models in the modelling software Maya™. Each creature model went through several iterations of feedback, with each stage further refining the shape and detail. Based on movement studies of living relatives (or where available, fossil-based animations, e.g. Anderson & Westneat, 2009), we designed an animation profile for each animal. Behaviour was inferred from known traits of represented individuals (cf. Benton, 2010, Trusler et al. 2011, for an overview of general principles).

Introductory, intermediate and closing scenes

The AR scene can be triggered in two different ways: either by pointing the device camera at a visual marker, or by starting it manually from the app menu. In the former case, an animation displayed over the visual marker shows the assembly of a crinoid from fossil components in the target rock, fading into view from the rock exhibit (Figure 1a). Via a trigger button, the view was replaced by the underwater scene (Figure 1b). In absence of a visual marker (e.g., if the app is used outside the rock garden), a manual start immediately leads to the same scene.

Once the Devonian seafloor fades into view, the user is able to make out the colourful forms of corals, crinoids, trilobites, and groups of fish and cephalopods swimming overhead. Mobile individuals following their behavioural program meander through the water column, while sessile animals gently wave their arms in search for floating food. Figure 1b gives an impression of the underwater scenery.

When the user selects (via another trigger button) to conclude the AR experience, we display an animation of an incoming turbidity current sediment influx. This represents a known method of fossilisation at Buchan, where organisms are rapidly buried following a catastrophic surface or submarine event (Gray et al. 1998). After the cloud has settled a barren seafloor remains, in which all life has been buried by a thick layer of sediment.

User information for each animal

When accessing the Buchan Limestone AR environment, the user is able to click on an animal and obtain more information. This data is laid out similarly to the information in the rock guide and the user is given information, images and web links. Each section begins with a map showing the position of Australia when the animal began to evolve, followed by a description of each animal, its diet, and lifestyle. Reference images show some of the diversity of fossils of each organism, and the user is pointed to websites such as Museum Victoria and similar sites should they wish to access more information.

Teaching worksheets with take-home AR

AR Worksheets have been created for primary and secondary school students (Years 5-6, 7-9, 10-12). These are composed of questions suitable for each year level based around either the Dunkleosteus, crinoid, or ammonoid specimens. Each worksheet has an AR marker that students use to access a 3D augmented reality model of the creature (Figure 1c), allowing them to examine it in detail and sketch it. Answers to the questions can be found either in the Monash Rocks app or through the linked websites. Suggested answers for teachers are also available. Again, information was obtained from published papers and websites and rewritten to make it suitable for a more general audience.

Conclusion

This project aims to bring a new dimension to learning and teaching at Monash. It showcases a unique learning environment and demonstrates the possibilities to faculty members across the University. A key outcome will be the development of templates and protocols for development of similar resources in faculties other than Science.

The nature of this project and its direct application to teaching and learning is in accordance with Monash University's Better Teaching Better Learning Agenda that aims to enhance Monash's learning and teaching reputation through the designing of innovative, learner-centred resources across all faculties.

Our Augmented Reality artefacts situate the learning about deep time in a present-day context. Learners are able to see 3D fossils come to life and watch them moving as they hover over the authentic background of the rock in which they are buried. This visualisation highlights the similarities between these long-gone creatures and their modern iterations enabling the learner to develop a deep understanding of how our environment was formed.

This is not really the conclusion but the beginning of a transformative learning experience that harnesses the use of innovative technology to bridge the gap between reality and virtuality, and brings an immediacy to the learning environment.

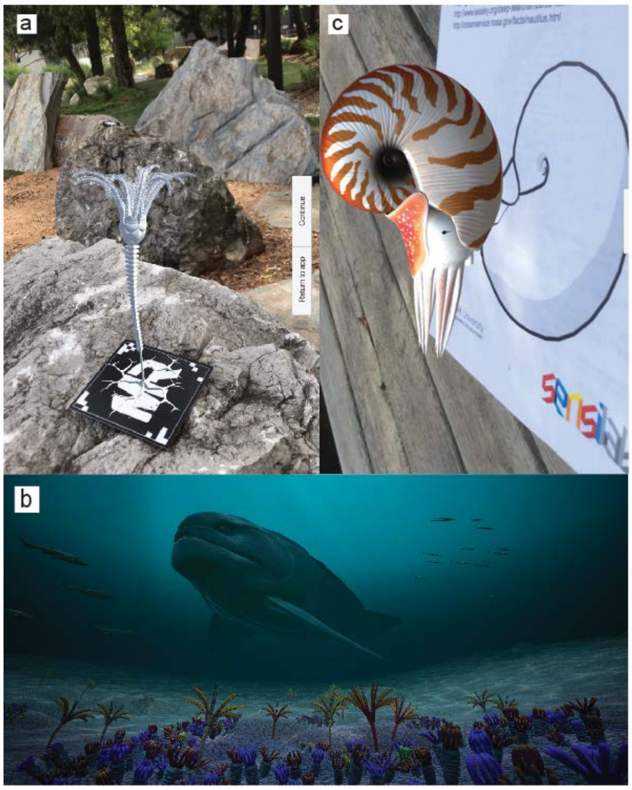

Figure 1: a) Crinoid AR marker in action on the Buchan Limestone,
b) Nautiloid AR marker on a worksheet
c) Screenshot of the Devonian sea floor animation

References

Anderson, P. & Westneat, M.W. (2009). A biomechanical model of feeding kinematics for Dunkleosteus terrelli (Arthrodira, Placodermi). *Paleobiology*, 35, 251–269.

Béchard, I., Arsenault, F., Cloutier, R. & Kerr, J. (2014). The Devonian placoderm fish Bothriolepis canadensis revisited with three-dimensional digital imagery. *Palaeontol Electron*, 17, 1–19.

Benton M.J. (2010). Studying function and behavior in the fossil record. *PLoS Biology*, 8, e1000321.

Gray, D.R., Foster, D.A., Gray, C., Cull, J. & Gibson, G. (1998). Lithospheric structure of the southeast Australian Lachlan Orogen along the Victorian global geoscience transect. *International Geology Review,* 40, 1088–1117.

Green, D. and Chandler, T. (2014). Virtual ecologies and environments. In M. Grimshaw (Ed.), *The Oxford Handbook of Virtuality* (pp. 549-568). New York, NY: Oxford University Press.

Trusler, P., Vickers-Rich, P. & Rich, T.H. (2011). Where art and science meet. *American Scientist*, 99, 410–411.

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A Community of Inquiry approach to learning design in a community-engaged learning program

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The Medicine in Context (MiC) program is the flagship community-engaged learning and teaching program at the Western Sydney University School of Medicine. MiC students attend placements at community organisations, General Practice clinics and face-to-face tutorials and lectures for two five-week blocks. Responding to students' lack of engagement and preference for more flexible delivery modes, a blended learning approach using the Community of Inquiry framework to guide the design has been gradually introduced since 2014. The MiC webpage was revised to simplify access to key information and resources. Five lectures were transformed into online modules and one workshop was converted into a flipped classroom. Multi-media open educational resources were added to replace some reading materials. Online "Weekly Study Guide" scaffolds, paces and aligns students' self-directed learning with MiC learning outcomes. Moving program evaluation and some assessments to an online platform enables more timely feedback. These developments have resulted in novel, engaging learning activities. Preliminary evaluation indicates students' greater engagement with the MiC program and deeper levels of learning indicated by increased levels of reflection and the demonstration of MiC learning outcomes being satisfied.

Introduction

Western Sydney University School of Medicine embeds community-engaged learning components in its five-year undergraduate medical (MBBS) curriculum. The flagship community-engaged learning and teaching program, called Medicine in Context (MiC), was co-designed by the School and a wide range of community partners to meet the specific needs of the Greater Western Sydney community (McCarthy et al., 2010). Although sharing the same social accountability principles as other medical schools' community engagement programs (Mahoney, Boileau, Floridis, Abi-Abdallah, & Lee, 2014; Preston, Larkins, Taylor, & Judd, 2016; Thandi, Forrest, & Williamson, 2016), the embedding of the MiC program in its local context makes it quite unique.

The MiC program is delivered in the third year. MiC students are fully immersed in community organisations (two to three days/week) and general practice (GP) clinics (one to two days/week) with face-to-face tutorials and lectures (one day/week) for two five-week blocks to learn about social determinants of health and how medical professionals collaborate with community-based service providers. Since MiC students are immersed in various peri-urban community organisations and GP clinics which offer different but equally valuable learning opportunities, there is a need to ensure equitable level of students' learning through scaffolding and sharing of experiences. The peri-urban setting, medium-length exposure and diversity in learning opportunities set the MiC program apart from other models such as longitudinal integrated clerkship and rural engagement programs (Mahoney et al., 2014; Preston et al., 2016) and short bursts of community engagement (Thandi et al., 2016).

The MiC program began in 2009 and for the first five years was delivered utilising face-to-face and paper-based teaching, learning and assessment. The program's learning management system (LMS) site content was limited to the provision of the program guide, lecture slides and reading materials.

In 2014, a review of the MiC program was conducted by the program convenor. This review revealed a range of significant issues that needed to be addressed with the objective of improving levels of student engagement. The process of improving the learning environment was driven by the following questions:

1. How can the MiC program be designed to improve levels of student engagement?
2. Which theoretical framework can assist in the analysis of the MiC program and provide a guide for improvements in learning design? The objective of

designing more structured learning opportunities was pursued and the Community of Inquiry (CoI) model (Garrison, Anderson, & Archer, 1999; Lipman, 1991) was adopted as the theoretical framework to guide learning design improvements. This paper outlines these changes and the preliminary results from the evaluation of the new design of the program.

Method

A review of the MiC program was conducted using the yearly review of student feedback data. The subsequent comprehensive analyses of qualitative and quantitative data were conducted for the 2011-2013 data. Additional information was sought from the student placement supervisors, the MiC general practice senior lecturer and the MiC administrative officer. The data from these sources revealed the following areas that needed attention:

- The Learning Management System (LMS) website was navigationally incoherent
- Issues with students' engagement during the placements and face-to-face sessions
- Absence of scaffolding in learning activities that engage students in community and general practice placements
- Lack of alignment between self-directed placement learning activities and the program's learning outcomes
- Lecture delivery method not meeting students' expectations of flexible delivery modes
- Under-utilisation of online learning and teaching facilities available in the University

As part of a multi-faceted strategy to address these needs, a blended learning approach, guided by the CoI model, was gradually adopted during 2014-2016.

Community of Inquiry model

Lipman defined a Community of Inquiry (CoI) as a rigorous, democratic and reflective form of discussion built up over time with the same group of learners (Lipman, 1991). Lipman's ideas were expanded and applied to online learning by Garrison et al. (1999) who provided a conceptual framework and a tool for the use of computer-mediated communication in supporting educational experiences.

The objective of a CoI is to create a learning environment in which the three presences (social, cognitive and teaching) interact to provide a deep and meaningful learning experience. Social presence is defined as the ability of learners to identify with the community (Akyol, Garrison, & Ozden, 2009). Cognitive presence represents the process of the construction of meaning through reflection (Akyol, Vaughan, & Garrison, 2011) and teaching presence refers to directing and facilitating learners to realise and process the meaning of learning outcomes (deNoyelles, Zydney, & Chen, 2014; Garrison & Kanuka, 2004; Mills et al., 2016).

Previous work has already been carried out in the use of the CoI framework as a guide in the development of higher education learning environments (Vaughan, 2010) and the objective of this project was to redesign a community-engaged component of the medical degree (MiC) in which face-to-face, blended and online components could be combined to form an inquiry-based learning environment (Mills et al., 2016).

The CoI model should not be used mechanistically during the design process; rather, it should be used as a heuristic tool to inform curriculum design and relevant delivery modes (Vaughan, 2010). All of the elements outlined in this paper intersect with one or more of the presences in the model.

How was the MiC program redesigned?

Online study modules

A number of face-to-face lectures posed some technical challenges due to the structure of the third year curriculum. Third year students rotate through MiC blocks in four batches each year. This means all lectures need to be delivered four times. Most of the lecturers are community service providers and their work commitments often preclude them from delivering four sessions, even with back-up speakers. The provision of video recordings was able to cover for some of these absences but the students suggested that fully online delivery would give them more flexibility in their learning patterns. In order to support student engagement with the complex domains of the program, five face-to-face lectures were converted to fully online resources. This included video lectures by the unit coordinator, screencasts and interactive weekly study guides designed using the Learning Activity Management System (LAMS).

Open educational resources

Past students complained about the large amount of reading materials for the program. As part of the revision of reading materials, some readings were replaced with multi-media open educational resources (mainly from YouTube©) to serve as triggers for reflection and self-directed learning. Examples included resources on global health, gender and social inequality.

Website improvement

The previous MiC Blackboard© site created confusion due to a lack of navigational coherence. A series of changes were implemented to modify the site. Each website item and folder was given a concise description of the content and when students needed to access them. Adaptive release (timed release of content) was extensively used to focus students' attention at different points in the program; these limits were released at the end of each program block for review and exam preparation. Permanent links to reading materials were provided to facilitate copyright monitoring by the library. Additionally, the newly developed resources were made available through the website.

Weekly study guides

Third year MiC students are prepared for self-directed learning during the first and second years through the problem-based learning curriculum. However, students find this transition challenging during their first clinical year and community placements. Some students rushed their community-based learning and superficially recounted their experiences thereby missing any meaningful experiences with community engagement. This attitude led to comments such as *"I could have learned all there is to know about aged care in 3 days, so a 5-week placement was a waste of time"*. There was also an indication that students saw the GP placements as completely unrelated to their community placements, whereas the intention was for them to see the GPs' role in the community vis-à-vis other community-based service providers.

In order to address these issues, a set of weekly study guides was developed using LAMS. Each week's guide consists of the topic of the week, questions to be discussed in tutorial sessions and a checklist of learning activities that students are expected to complete within that week.

There are five topics for the five-week block and, since the students are required to attend two blocks, a spiral learning approach was used where the same topics are repeated in more depth in the second block. The weekly tasks and questions are designed to synthesise the community and GP placement learning by asking students to compare and contrast the two placements or translate one social determinant of health into the two contexts. Students' answers are discussed and marked in the tutorials and these marks form part of the students' final marks for the MiC program.

This design enabled students to share and build their understanding based on other students' experiences. These guides are released each week, thereby assisting students to focus their attention and giving them ideas so as to optimally capitalise on their experiences.

Flipped classroom

Another request from students was to have more case-based interactive activities rather than content-focused lectures. A pilot was developed by converting a workshop on Gender and Health into a flipped classroom. The basic concepts of gender and sexuality, and the epidemiology of gender-related health issues were provided as online lectures. Three practitioners were interviewed about pertinent gender-related issues in their practice and research. In the face-to-face session, students in small groups rotate through five stations with a video clip each (from open educational resources) to illustrate a clinical or social case, and worked with a facilitator through some questions about the case. This approach was chosen to balance between students' preference for practical exercises and their need for learning the basic concepts.

Application of the CoI model and guides for practitioners

All of the elements outlined above intersect with one or more of the presences in the model (see table 1). For example, the modification of the navigational arrangement of the MiC section on the LMS is an example of the development of teacher presence. The weekly study guides, however, fall into the categories of cognitive and teacher presence. As an example of cognitive presence, their aim was to scaffold the learning experience to enable students to frame what are often complex domains of knowledge and experience. The framing mechanisms or questions in each of the weekly study guides are examples of teaching presence.

Table 1: Learning design elements related to presences in the CoI model

Learning design element	CoI presence
Online study modules	Cognitive and teacher presence
Open educational resources	Cognitive presence
Website improvement	Teacher presence
Weekly study guides	Cognitive and teacher presence
Flipped classroom	Cognitive, teacher and social presence

There is a range of components that constitute the MiC program. Learning opportunities that students experience are varied and the teaching elements that make up the program need to complement this complexity by providing students with opportunities for structured reflection (weekly study guides and flipped classrooms) and ongoing, program-wide support. In complex knowledge domains such as the MiC program, the use of the CoI can:

- assist practitioners to balance the overall learning design of programs;
- ensure the role of the teacher is maintained in learning environments that require a high level of self-regulation and;
- encourage student-led enquiry in engaging and stimulating learning environments.

The learning design of the MiC program aimed to engage the three presences identified in the CoI framework. The use of technology underpinned the delivery of the program and the combination of learning designers working in conjunction with the academic unit coordinator aligns well with the conference theme of collaborative practice.

Online program evaluation

Past paper-based evaluation created a very large administrative load that led to data entry errors and inability to promptly analyse the data. At times the delay was more than six months, which prohibited early identification and solution of problems. To solve this problem, all evaluations were moved to an online version using Survey Monkey©. Apart from a marked decrease in person-time required for data management, the evaluation data is now available for review by the Program Convenor by the end of the last clinical attachment day. This enables follow-ups to start as early as the next working day.

Marking and feedback of final assignment

Past essays were submitted through Turnitin© to check for plagiarism, then printed out and marked as hard copies. Feedback to students was only available by scanning the marked hard copies and emailing them to individual students. This process was time-consuming and created a long delay between assignment submission and feedback provision. In addition, a review of markers' standard was prohibited due to the amount of manual work required. From 2015, the marking has been conducted using the Turnitin© GradeMark function which enables marks and feedback to be released to students in two weeks. The electronic data format enables the Program Convenor to randomly check marks across the 4-5 markers to ensure consistency and fairness.

Results

The percentage of weekly tasks completed in each group ranges from 72% to 94%. This indicates that student engagement in the weekly tasks is high and this level of engagement can be contrasted against the lower levels of engagement that were evident prior to the introduction of the blended learning weekly study guides component. Anecdotal feedback from tutors suggests that students are making connections between the learning that they experience in community settings and patients in the hospital environment.

This greater level of engagement in the weekly tasks is significant because it indicates that teaching presence in the form of structured tasks is contributing to the development of cognitive presence which, in turn, is promoting tutorial sessions that allow students to explore the deep connections between health and the community.

Next steps

A content analysis of the qualitative data from the weekly tutorial responses is being analysed. This will also be paired with a thematic analysis of tutor feedback on student engagement and participation during the tutorial sessions.

Conclusion

A blended learning approach using the CoI model to guide the review and development of the MiC curriculum was implemented to address students' concerns and feedback in a community-engaged learning program. This approach has enriched the classical combination of placements and face-to-face sessions and provided structured learning environments for complex practice and knowledge domains such as MiC. Initial evidence from tutors suggests that the goals of the MiC program - connections between health and the wider community - are being met more adequately during tutorial sessions and student responses to weekly tasks. A similar approach could be considered by other educators in courses or programs in scaffolding diverse learning experiences that need to be shared and reflected by groups of students.

References

Akyol, Z., Garrison, D., & Ozden, M. (2009). Online and blended communities of inquiry: Exploring the developmental and perceptional differences. *The International Review Of Research In Open And Distributed Learning, 10*(6), 65-83.

Akyol, Z., Vaughan, N., & Garrison, D. R. (2011). The impact of course duration on the development of a community of inquiry. *Interactive Learning Environments, 19*(3), 231-246. doi:10.1080/10494820902809147

deNoyelles, A., Zydney, J., & Chen, i. (2014). Strategies for Creating a Community of Inquiry through Online Asynchronous Discussions. *Journal of Online Learning and Teaching, 10*(1), 153-n/a.

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education, 2*(2–3), 87-105. doi:http://dx.doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet and Higher Education, 7*(2), 95-105. doi:10.1016/j.iheduc.2004.02.001

Lipman, M. (1991). *Thinking in Education*: Cambridge University Press.

Mahoney, S., Boileau, L., Floridis, J., Abi-Abdallah, C., & Lee, B. (2014). How social accountability can be incorporated into an urban community-based medical education program: An Australian initiative. *Education for Health, 27*(2), 148-151. doi:10.4103/1357-6283.143746

McCarthy, L., Jones, A., Yeomans, N. D., Bambrick, H., Pacey, F., Ramanathan, J., & Wills, T. (2010). Engaging for health: medicine in context as a case study in engaged teaching and learning for students in medicine. *Australasian Journal of University Community Engagement, 5*(2), 67-87.

Mills, J., Yates, K., Harrison, H., Woods, C., Chamberlain-Salaun, J., Trueman, S., & Hitchins, M. (2016). Using a community of inquiry framework to teach a nursing and midwifery research subject: An evaluative study. *Nurse Education Today, 43*, 34-39. doi:http://dx.doi.org/10.1016/j.nedt.2016.04.016

Preston, R., Larkins, S., Taylor, J., & Judd, J. (2016). Building blocks for social accountability: a conceptual framework to guide medical schools. *BMC Medical Education, 16*(1), 227. doi:10.1186/s12909-016-0741-y

Thandi, C. S., Forrest, S., & Williamson, C. (2016). The role of early inter-professional and inter-agency encounters in increasing students' awareness of the clinical and community context of medicine. *Perspectives on Medical Education, 5*(4), 240-243. doi:10.1007/s40037-016-0285-1

Vaughan, N. D. (2010). A blended community of inquiry approach: Linking student engagement and course redesign. *The Internet and Higher Education, 13*(1–2), 60-65. doi:http://dx.doi.org/10.1016/j.iheduc.2009.10.007

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What's in a name: The ambiguity and complexity of technology enhanced learning roles

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With the growing ubiquity of educational technology, there has been an increased need for specialised practitioners to advise on and support technology enhanced learning within Higher Education. Academic developers, instructional designers and educational technologists are all examples of these skilled individuals typically working in 'third space' that crosses complex boundaries - between the pedagogical and technological, and the academic and professional. However, role titles and descriptions of duties are often unclear at best, with a lack of consistent terminology used across institutions and in the literature. This can lead to confusion and tensions when working with multiple institutional stakeholders who are uncertain about the abilities and knowledge of people in these roles; potentially exacerbating 'the academic/professional divide' in Higher Education and weakening the collaborative relationship between TEL workers and academics.

This paper presents a synthesis of key literature related to contemporary TEL advisor and support roles in Higher Education alongside a preliminary analysis of 37 recent position descriptions of these roles. The application of social practice theory as our conceptual framework enables us to further explore the significance of practices in defining and differentiating these roles. This paper offers a step forward to the ways in which clarity and consistency of these roles might be sought. Future implications of this study are included for further consideration.

Introduction

The availability of technology has exponentially transformed the learning and teaching space in Higher Education (HE) over the last few decades (Roberts, 2005). HE institutions and staff are moving towards technology enhanced learning (TEL) practices often in an attempt to meet market competition and student needs (Bradley, Noonan, Nugent, & Scales, 2008). Such change has necessitated an increase in support or advisory roles for technology enhanced learning and teaching initiatives. These roles include academic developers, instructional designers and educational technologists, among others (Rizhaupt and Kumar, 2015). These are sometimes described as 'hybrid' roles that do not "fit neatly into existing organizational structures" (Oliver, 2002, p.245) and their scope is often not clearly defined (Bird, 2004; Davidson, 2003). Whitchurch (2008) notably describes the professional staff and academics working in these roles as inhabiting a 'third space' – one overlapping traditional professional and academic domains within HE. In this paper we therefore refer to those who work in this complex and hybrid space with knowledge and experiences of TEL practices as 'third space TEL workers'.

Working within third space territories, the 'newness' and lack of clarity surrounding these roles and duties brings a number of challenges. People in these roles often feel marginalised and "defined by what they are not" (Gornall, 1999, p. 44). Fraser and Ling (2014) and Roberts (2005) highlight potential tensions in building relationships across institutional stakeholder groups due to this instability, which can impact the outcomes of learning and teaching initiatives. This instability and tension potentially disempowers third space TEL workers, particularly professional staff members (Oliver, 2002). There are key gaps in existing research that fail to clarify how third space TEL roles work in practice. Clearly defining third space TEL roles may allow for improvements to professional relationships and educational quality for third space TEL workers and institutions – or conversely, highlight additional challenges.

This paper aims to explore current definitions and practices of TEL roles in the third space, building on our existing understanding through literature review and preliminary analysis of position descriptions. The current paper therefore sets out to answer the below questions:

- What are the skills, capabilities and expectations held of workers in third space TEL roles?
- What are the practices of third space TEL workers as described in the existing literature and recent job advertisements for these roles?
- How do these practices align with the position titles?

Literature review - roles and duties of third space TEL workers

The plethora of discourse around the complex nature of the third space in the past literature (Willcox, Sarma & Lippel, 2016), exposes a lack of clarity around the language used in explicating its workers. In broad terms however, the literature identified the following key third space TEL worker roles:

- Academic developer
- Designer: Learning/educational designer, and instructional designer
- Technologist: Learning/educational technologist

Due to the space and scope limitations for this paper, we have: (a) elicited common definitions of these roles, and (b) identified important absences of indicative practices in the role definitions.

Academic developer

Academic developers undertake a broad range of learning and teaching and curriculum improvement tasks including: improving and support of teaching, learning, curriculum and assessment; research and evaluation of teaching and learning; and engagement with the scholarship of teaching and learning (cf. Bath & Smith, 2004; Fraser & Ling, 2014). The literature emphasises that the academic developer role is one of curriculum development, training and staff capacity building, and yet there is little to no reference to their competent use of educational technology.

Designer

Designer roles have titles such as instructional designer and educational or learning designer but it is unclear if these terms are interchangeable or denote role nuances. In HE, designers often work with a subject matter expert, generally a teaching academic (Ritzhaupt and Kumar, 2015) to design pedagogical approaches and learning resources in TEL initiatives (Torrisi and Davis, 2000). They must possess "a solid foundation in instructional design and learning theory... soft skills and technical skills, and have a willingness to learn on the job..." and "...keep abreast of multiple emerging information and communication technologies" (Ritzhaupt and Kumar, 2015, p. 51). The key difference of the design role to the academic developer role is the inclusion of technology. This therefore necessitates technological skills as well as an understanding of design, curriculum and pedagogy for online/blended learning – thereby encroaching on the skills sets and role of the academic developer.

Technologist

Technologist role titles include learning technologist, e-Learning technologist and educational technologist. Competing descriptions of the ET role have indicated it is primarily a strategic one responsible for technology provision (Shurville et al., 2009), but also noted overlap with other 'third space' TEL roles including designers (Ritzhaupt & Martin, 2014; Shurville et al., 2009) and academic developers due to an increasing focus toward pedagogy (Soyoz, 2010).

Oliver (2002) touches on the tensions around the status of learning technologists, finding that LTs felt they were perceived by some academic staff as 'only' having a "technical role" (p. 250), with their pedagogical knowledge not recognised. These technologists perceived this as a significant challenge that impacted their ability to effectively engage with academics.

The existing literature brings to the fore that even though efforts have been made to scrutinise and define the various roles and practices of third space TEL workers, there is still little consensus about what each role entails. This gap in the literature led us to carry out a preliminary analysis of advertised position descriptions and their stated practices. Our discussion stems from the stance that examining the primary practices associated with each role offers greater insight into the roles than their seemingly arbitrary position titles.

Theoretical framework – social practice theory

In order to better understand these roles and their practices in context, we draw on social practice theory as our theoretical framework. Social practice theory, as defined by Shove, Pantzar, and Watson (2012), examines the practices that people engage in; the competences, materials and meanings that they are comprised of; and the ways that practices emerge, evolve and spread. Practices persist even as practitioners come and go, so by mapping primary practices to specific role titles, we hope to highlight the principle purpose of the roles to encourage future clarification of unified terminologies.

Methodology

To better understand these roles, we gathered and analysed 37 job advertisements relating to the third space TEL roles in 13 Australian Universities. These job ads were published between 2012 and 2017 and were found through public web search by the authors. The advertisements analysed were spread across academic and professional roles with a range of seniority levels –

from Professional HEW 2 to 8 to Academic A to C, respectively (see Table 1 below). The roles are grouped by common titles.

Table 1: Roles analysed in the 37 job advertisements (Position Levels: HEW/Academic)

	Professional position titles	Academic position titles
Academic Developer	Senior Academic Developer x2 (8)	Academic Developer x2 (C,B)
Designer	Learning Designer x3 (6/7,7,7/8); Digital Education Designer x2 (7); Senior Educational Designer x2 (8); Educational Designer x4 (7,7,8,8); eLearning Designer (8)	Senior Lecturer (Course Enhancement)(C); Lecturer (Learning Futures)(B); Lecturer (Education Development)(B);
Technologist	Learning Technologist (5); Educational Technologist (6)	
Other: Coordinator	Coordinator Learning & Teaching Services (7); Senior Coordinator digital learning design (8); Online learning systems coordinator (7);	eLearning Coordinator (Technology) (B/C); Blended Learning Coordinator (B/C); eLearning Coordinator (B/C) Senior Academic Lead (C);
Other: Officer	Teaching support officer x2 (5,6); Online engagement officer (6), Digital learning projects officer (7), Blended learning officer (2);	eLearning Project Officer (B/C);
Other: Developer	Senior Educational Developer (8);	
Other: Advisor	eLearning Advisor (7)	eLearning Advisor (B/C);

Our analysis focused on the descriptions of practices third space TEL workers are expected to perform – commonly referred to as the duties statement. Drawing from content and thematic analysis (Vaismoradi, Turunen, & Bondas, 2013) we scrutinised the role title, academic/professional status, position description and duties statements. This resulted in identifying the seven key practices expected of the third space TEL workers: *train, research/evaluate, support/advise, design, develop, design/develop, and lead/manage*.

The number of times that a practice was connected to the position description was tallied to identify the primary practice/s of each position. Generic competencies such as communication and teamwork skills, though recognised as important to these roles (Ritzhaupt and Martin, 2014), are not included in our analysis as these practices do not offer distinctive attributes of the practices that specifically define third space TEL workers

Discussion – what is in a name?

The seven practices of the third space TEL workers

Across the 37 position descriptions that we examined, ***train*** was one of the most widely spread primary practices for third space TEL workers with 31/37 positions having training related duties. It was notably a primary practice across positions ranging from Academic Level C to Professional HEW2.

Support/advise equally appeared in 31/37 position duty statements and is clearly considered to be a vital component of third space TEL workers practice, across almost all positions. It connected third space TEL workers to a wide range of practices carried out by the people being supported/advised which ranged from pedagogically focused activities to more technological ones.

We considered the practice of ***research/evaluate*** to include not only the traditional association to academics of a scholarly approach to the creation of new knowledge, but also evaluation of technologies and teaching practices, linked more to professional staff. This was the second most common practice, appearing in the duty statements of 28/37 positions.

Design was represented as a stand-alone practice in 11/37 positions, as was ***develop***. However, 14/37 positions treated design and develop in a single sentence as part of the integrated inseparable practice. For this reason, we added ***design/develop*** as a separate practice. Given that 18/37 of the third space TEL worker position titles included variations on 'Designer' or 'Developer', this may be considered to be an important, and yet, ill-defined practice, or conversely, as Bird (2004) found in a review of the literature, "…the titles instructional, educational, design and development are used synonymously" (p.124). We see ***design*** and ***develop*** as both relating to curriculum, course design and learning resources (including online course building), with ***develop*** generally having more of a practical and technology-oriented focus than the more theoretical/pedagogical ***design***.

Lead/manage was represented as a practice in 8/37 positions. These tended to be more senior roles related to specific institutional TEL initiatives.

Academic Developer

The four Academic Developer positions all had ***training*** as a primary practice. Two of these positions were professional and two were academic. One academic and one professional position included ***design*** or ***develop*** practice related to curriculum or learning resources. Of all the positions, this was the most consistently defined and it aligns closely with the definitions found in the literature

– namely, one of curriculum development and building staff capacity around learning and teaching.

Designer

All 12 designer roles were professional positions. The role titles in our analysis included digital education designer, learning designer, educational designer (web developer) and eLearning designer, all specifying design in the title. Of the 12 positions however, only one actually had ***design*** as a primary practice. One other had ***design/develop*** as a primary practice. Five had ***support/advise*** as a primary practice. Two positions had the primary practice as ***research***; two others as ***develop***; and another as ***train***.

Technologist

The two Technologist positions analysed were both professional positions at HEW6. Their primary practices were ***support/advise*** and ***develop***. The advice and support practices were directly related to educational technology implementations. The titles for these roles were learning technologist and educational technologist, however there was no indication that they were substantively different.

Other role titles for third space roles (17) did not sit neatly within the above three role categories and lay across professional and academic positions. They included (but were not limited to) 'developer' roles outside of academic developer. In line with some of the perceptions identified in the literature, the academic positions had a more pedagogical focus while professional staff had a more technological focus.

Conclusion

Our thematic analysis of the selected 37 job advertisements within the third space confirmed what was indicated in the literature - significant overlap and/or disconnection between the current titles of third space TEL worker roles and their expected practices. The fact that 16/37 titles don't align with key role titles in literature suggests that these titles might not present great significance to HE institutions. The literature has identified challenges in providing meaning and value for these roles and gaining reputation with other stakeholders. Further research is therefore needed to further investigate: the nature of third space TEL worker practices - particularly the distinction between design and develop, the nuances across role definitions and the overlaps and distinctions between third space TEL roles compared to other academic and institutional stakeholder groups, and the tensions between institutional roles. Elements of Social Practice Theory may enable us to more accurately define third space TEL worker roles by aligning titles closely with their prevalent practices. Such future work is of high importance to ensure that increasingly in-demand, third space TEL workers are valued, supported and empowered to make significant contributions to and advocate for technology enhanced learning, and to ensure effective relationships and collaboration between third space TEL workers and other key stakeholders in HE.

References

Bath, D. & Smith, C. (2004). Academic developers: an academic tribe claiming their territory in higher education. *International Journal for Academic Development,* 9(1), 9-27.

Bradley, D., Noonan, P., Nugent, H., & Scales, B. (2008). Review of Australian higher education: final report [Bradley Review]. Retrieved from http://apo.org.au/research/review-australian-higher-education-final-report-0

Bird, J. (2004). Professional navel gazing: Flexible learning professionals into the future. In R. Atkinson, C. McBeath, D. Jonas-Dwyer & R. Phillips (Eds), Beyond the comfort zone: Proceedings of the 21st ASCILITE Conference (pp. 123-133). Perth, 5-8 December. Retrieved from http://www.ascilite.org.au/conferences/perth04/procs/bird.html

Davidson, J. (2003). A new role in facilitating school reform: The case of the educational technologist. *Teachers College Record,* 105(5), 729-752.

Fraser, K. & Ling, P. (2014). How academic is academic development? *International Journal for Academic Developmen*t, 19(3), 226-241.

Gornall, L. (1999). “New professionals”: Change and occupational roles in higher education. *Perspectives: Policy and Practice in Higher Education*, *3*(2), 44–49.

Oliver, M. (2002). What do Learning Technologists do? *Innovations in Education and Teaching International*, 39(4), 245–252.

Ritzhaupt, A., & Kumar, S. (2015). Knowledge and skills needed by instructional designers in higher education. *Performance Improvement Quarterly*, 28(3), 51–69.

Ritzhaupt, A., & Martin, F. (2014). Development and validation of the educational technologist multimedia competency survey. *Educational Technology Research and Development, 62,* 13-33.

Roberts, S. (2005). Multi-professional working and learning?: Teams or territorialism in the e-Learning age. *Continuing Professional Development-Preparing for New Roles in Libraries: A Voyage of Discovery Sixth World Conference on Continuing*

Professional Development and Workplace Learning for the Library and Information Professions, 2005.

Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice : everyday life and how it changes*. Los Angeles: SAGE, 2012.

Shurville, S., Browne, T., & Whitaker, M. (2009). Accommodating the newfound strategic importance of educational technologists within higher education. *Campus-Wide Information Systems*, 26(3), 201–231.

Soyoz, S. (2010, October). Identifying e-Learning technologists: Key roles, activities and values of an emerging group. *eLearn magazine*. Retrieved from http://elearnmag.acm.org/archive.cfm?aid=1872820

Torrisi, G., & Davis, G. (2000). Online Learning as a catalyst for reshaping practice – The experiences of some academics developing online learning materials. *International Journal for Academic Development*, 5(2), 166–176.

Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & health sciences, 15*(3), 398-405.

Whitchurch, C. (2008). Shifting Identities and Blurring Boundaries: the Emergence of Third Space Professionals in UK Higher Education. *Higher Education Quarterly*, 62(4), 377–396.

Willcox, K., Sarma, S., & Lippel, P. (2016). Online education: A catalyst for higher education reform. Cambridge: MIT Online Education Policy Initiative. Retrieved from https://professional.mit.edu/sites/default/files/MIT%20Online%20Education%20Policy%20Initiative%20April%202016.pdf

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Framing the digitally capable university: Digital literacies as shared scholarly and professional practice

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La Trobe University

The proliferation of "literacies" in educational discourse reflect a diverse array of interests, encompassing computer, information, technical, media literacies, and also forms like academic, financial, and health literacies. As digital literacies have become a concern for the higher education curriculum, there has been a tendency to define it as a practical type of operational know-how. This paper sets out a university-wide, holistic and critical approach that breaks from the legacy of institutional framings that narrow digital literacies to a set of skills or competencies.

In developing a Digital Literacies Framework, La Trobe University articulated a shared understanding of digital literacies as the capabilities and attitudes that are needed by staff and students 'in a digitally connected world'. This marks a shift from strategies that primarily deploy institutional curriculum mapping and measurement approaches; rather it argues for an institutional approach that requires collaboration and strategic engagement of students and academic and professional staff in order to meet goals related to building digital capability. The La Trobe Digital Literacies Framework takes a whole of university perspective that integrates policy and practice, providing a rationale for the critical importance of digital literacies in domains of life, work and learning, addressing an implicit 'Why?' question from staff and students. The University Library coordinated the Framework development. It was a scholarly undertaking that gathered evidence and reviewed international best practice. In this endeavour, the La Trobe University Library is a leader in the implementation of a university-wide strategy for digital literacies in Australia.

Introduction

In the current higher education environment, digital literacies underpin staff and student activity in all domains of knowledge and traverse boundaries around disciplinary and professional practice. Effective use of digital technology by university staff is vital to providing a compelling student experience, preparing graduates for the digital future and ensuring that universities can thrive as twenty-first century organisations. If students are to be better prepared to participate in tomorrow's digital workplaces and communities then it is essential that digital literacies are part of learning and research conversations today. At La Trobe University (La Trobe), a project to develop a digital literacies framework for the University was designed to increase conversations about digital issues and to establish a shared understanding of staff (academic and professional) and student digital literacies and their importance.

The development of the Digital Literacies Framework at La Trobe started in 2015 and resulted in the articulation of a shared understanding of digital literacies as the capabilities and attitudes that are needed by staff and students 'in a digitally connected world'. Most importantly, the project involved university staff in ongoing dialogue about key digital issues. The development and engagement process outlined in this paper is an example of the scale of engagement that can be achieved in a relatively short time with institutional support and commitment.

Defining digital literacies

In recent years, there have been a number of national projects that have explored understandings of digital literacies (Kenny et al 2016; Coldwell-Neilson, 2016). These projects draw together the multiplicity of definitions and key distinctions that emerge from the literature on digital literacies. For example, Lankshear & Knobel (2008) observe that while there is a tendency to refer to digital literacies as a practical type of "know-how" (p. 2), they distinguish "conceptual" from "operational" definitions, and refer to a broad understanding by

Bawden (2008) that digital literacy means "mastering ideas, not keystrokes" (p. 2).

The call for a less normative, more situated and critical perspective is a break with the legacy of institutional framings that narrow digital literacies to "know-how", as a set of skills or competencies. Studies of digital literacies in undergraduate students by Gourlay et al. (2014) note that students engage with the digital in complex ways, through digital devices, technologies, texts and work practices, in complex arrangements. A "situated" perspective emphases the "plurality" of digital literacies, and Lankshear & Knobel propose a socio-cultural perspective which views literacy as doing something with a "set of social organized practices" (2008, p. 4).

A practice-oriented and capabilities focus on digital literacies distinguishes social and critical understandings of literacies from "functional" ones. An understanding of digital literacies that extends curriculum to the digital futures of professional practice was scoped as an outcome of the Jisc projects, as "the capabilities required to thrive in and beyond education, in an age when digital forms of information and communication predominate." (Littlejohn, Beetham & McGill, 2012, p. 547).

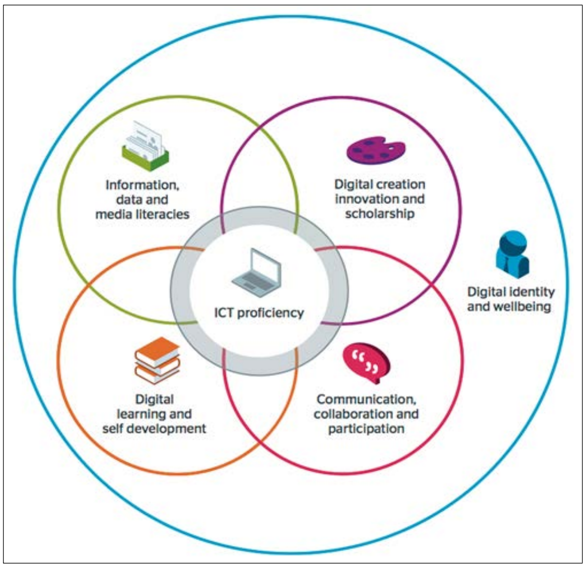

Figure 4: The six elements of digital capability. Beetham/Jisc 2015

The starting point for developing a digital literacies framework at La Trobe was the Jisc definition of digital literacies - "the capability that enables an individual to live, learn and work in a digital society" - and the Jisc capability model developed by Helen Beetham (Figure 1). The Jisc definition and model takes a pluralist approach to digital literacies; importantly the elements are not compartmentalized but interrelated and represent a wide range of social and cultural digital practices (Goodfellow, 2011). Adopting this robust existing definition of digital literacies enabled the La Trobe framework development project to focus on engagement, collaboration and strategic purpose.

Developing a digital literacies framework at La Trobe

The proposal for a digital literacies framework at La Trobe was the basis for a successful internal "Digital Learning Strategy innovation grant" by the University Library. The rationale for the digital literacies framework development project was to make visible connections between digital capabilities, attitudes and development. A framework approach reinforces the digital capabilities required in an academic environment and the broad fluency that evolves from developing these capabilities. This connection is important in a sector that demands ongoing digital transformation but where digital fluency is not necessarily second nature for students (Pope & Mutch, 2015) or staff. In addition, at La Trobe we wanted to develop a framework to emphasise digital literacies as a shared responsibility and a whole-of-institution priority. As part of the University digital innovation program the project was visible and the relevance of a digital literacies framework for the university and the University Digital Learning Strategy (La Trobe University, 2015) was affirmed.

a. Overview of process

The first step in developing the framework was to set up a reference group. Members of the reference group were vocal digital literacies champions. The reference group met fortnightly and included representatives from all major stakeholder groups e.g. La Trobe Learning and Teaching, Library, ICT, Colleges, College Education teams, etc. The reference group also included Helen Beetham, an external digital literacies expert and higher education consultant, who was essential to the success of the project.

One of the first tasks of the reference group was to conduct an audit of digital practices at La Trobe. The purpose of the audit was to directly inform the development of the framework and ensure that the framework was aligned with the university learning, teaching and research environment and university strategic directions. The audit tools had been used and refined previously by Helen with over 15 tertiary institutions in the UK (Littlejohn, Beetham & McGill, 2012), with La Trobe the first in Australia. The key stages of the project undertaken by the reference group included:

- Information gathering and reviewing existing evidence

  - Audit
  - Staff Survey
- Communications
  - University news, social media and email channels
- Engagement
  - Facilitation of focus groups, School meetings and individual meetings
- Drafting of framework documentation
- University-wide consultation on Draft framework
- Formal University endorsement – Education Committee and Academic Board.

b. Key characteristics of project

The institutional audit of the current state of digital practices at La Trobe generated enthusiastic discussion about digital literacies in the La Trobe community. This engagement process was an important characteristic of the project and it provided opportunities for people to talk, reflect and tell stories about digital literacies; either from a personal or professional perspective. At the heart of these conversations were two simple questions:

- Why are digital literacies important to you and/or La Trobe University?
- What does a digitally literate student or member of staff at LTU look like?

Engagement activities in meetings and focus groups addressed these questions and related sub-questions. This also allowed the relationship between staff and student digital literacies to be explored. In the staff survey, the key questions were expanded to explore the dimensions of digital habits, practices, aptitudes and identities in more detail. Because of their well-established liaison contacts and relationship in the Colleges, Library liaison staff played a key role in connecting academics to the project conversations at all campuses.

Engagement was the first important characteristic of the process; the second important characteristic of the project was that it was a strategic approach from the outset and was aligned with the university aspirations for digital learning, teaching and research. It addressed the institutional connection that needs to be made between digital learning, digital literacies and being a digitally capable organisation (Newland & Handley, 2016). While this connection is implicit in La Trobe strategy it had not previously been taken up across the university in an explicit and coordinated way.

c. Staff survey themes

A total of 422 staff responded to the survey that was part of the reference group's information gathering. This included 53% academic and 47% professional respondents. From the survey a number of themes emerged, that complemented other audit data collected and provided the reference group with the issues that needed to be addressed in the framework to promote a shared understanding of digital literacies. For example, themes and typical comments in these themes included:

- Digital thinking
  - *The technical know-how required currently is not complex, but staff and students won't embrace digital literacies unless they value them.*
  - Scholarly communication
  - *I am in the process of embracing digital technology and social media as it is part of the new norm in terms of learning, education, communication and marketing. These will be essential in the new economy*
- Students as active digital users
  - *Students have the invaluable "students' perspective" about how students like to learn online and what motivates/demotivates learning in an online/blended environment.*
- Issues in curriculum design
- Scholarly values and ethos
  - *The technical know-how required currently is not complex, but …no level of teaching me the 'how' will change my confidence and capability. I need to value the 'why' and then the rest is a piece of cake.*
- Communities of practice - academics - professional staff – students
  - *We should employ students to assist academics with digital literacy.*
  - *When I have an idea I need to be able to ask how can I do this, what's the best way to get this information, or what system exists that allows me to do ....*
- Time to explore
  - *The benefits are obvious, but how do I justify the time need to improve my digital literacy?*
  - *Time, time, and more time to get to grips with it.*
- Recognition and reward
  - *I want to improve my digital literacy: it aids teaching and external engagement. But if I'm to improve in this area, the workloads need to offer time and space to do this.*
  - *These are requirements for teaching in the modern world. They are an investment toward a teaching career.*

La Trobe digital literacies framework

It is no longer possible to function effectively as an academic, professional, scholar or educator without being engaged with the digital world. The completed Framework (La Trobe University, 2016) is about the intersection between digital attitudes, digital capabilities, community, technology and professional development of digital literacies. The goal is holistic: digital capability involves academic, research and professional staff and students. The Framework clearly articulates the attitudes and capabilities that university staff and students need in a "digitally capable organisation" and these are defined at two levels: proficient and expert, and distinguished for staff and students. The digital capabilities are articulated as teaching, collaboration, scholarship, digital identity, information literacy, data literacy, media literacy, and creativity.

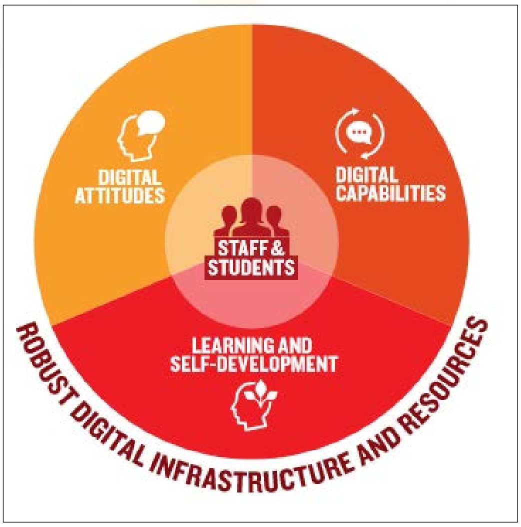

Figure 2: La Trobe University Digital Literacies framework

The Framework marks a shift away from previous notions of digital and information literacy that entailed skills development and technical proficiency. The capabilities articulated for students address "learning and work in a digital world", that is, the development of literacies for an unknown future. Thus, the Framework scopes not only the attitudes and capabilities of staff and students, but also the capacity of the university as an organisation to support this development.

Feedback on the Framework indicates that staff appreciate it as a tool that is well conceived and that can be used to get the digital literacies conversation started. Some staff have commented that it encourages thinking outside the square, rather than the sort of policy that forces a box ticking exercise. While it is generic it does provide indicators of examples of what digital literacies are and where they may apply to students and subjects.For these reasons, many academic staff have welcomed the Framework:

> *This framework to me appears excellent ... We have been encouraging digital literacy student projects in several of our subjects now for the last 3 years and it has been challenging but nevertheless terrific ... This framework will help support/develop our subjects further.*

Conclusion

The cohesive, whole university approach to digital capabilities distinguishes this framework from earlier developments of information and technological literacies. The development of the La Trobe Digital Literacies Framework involved a partnership between academic, research, professional staff and students, under the leadership and stewardship of the university library. The library's well-developed relationships across the university and its ongoing collaborative development of digital research and learning resources enabled a broad view across the learning, teaching and research needs of the university.

The Framework adopts a whole of university perspective and was developed by drawing on the Jisc model, La Trobe data, and international insights and experience. The project drew heavily on resources openly available from Jisc and in turn, the project reference group encouraged openness across Australian universities. The project was shared with other universities when in progress (including Adelaide, Melbourne, Deakin, New South Wales). Sharing work-in-progress with other universities considering an institution-wide approach to digital literacies is an important part of promoting the thinking and collaboration that is needed for a broader community of digital literacies.

The university-wide, holistic and critical approach to understanding digital literacies that was part of the framework development process was intentionally designed to break from the legacy of institutional framings that narrow digital literacies to a set of skills or competencies. The process adopted by La Trobe University to generate conversations and strategies around digital literacies could also be applied to other areas of shared practice, or at other institutions developing a digital literacies framework.

References

Bawden,D. (2008). Origins and Concepts of Digital Literacy. In: C. Lankshear, & M. Knobel, (Eds.), *Digital literacies: Concepts, policies and practices* (pp. 17-32). New York, NY: Peter Lang Publishing.

Beetham, H., McGill, L. & Littlejohn, A. (2009). Thriving in the 21st century: Learning literacies for the digital age (LLiDA project). http://www.academy.gcal.ac.uk/llida/LLiDAReportJune2009.pdf

Coldwell-Neilson, J. (2017). Decoding digital literacy. Australian Learning and Teaching Fellowship. Available at: http://www.decodingdigitalliteracy.org/fellowship.html

Gourlay, L., Hamilton, M. & Lea, M, (2014). Textual practices in the new media digital landscape: Messing with digital literacies. *Research in Learning Technology*, 17. Retrieved from: http://www.researchinlearningtechnology.net/index.php/rlt/article/view/21438.

Jisc (2015). Building digital capability: The six elements defined. Retrieved from: http://www.repository.jisc.ac.uk/6239/1/Digital_capabilities_six_elements.pdf

Kenny, A., Iacono, T., McKinstry, C., Hannon, J. & Knight, K., et al. (2016). *Capabilities for ehealth education: Developing undergraduate digital literacies for health professionals: Final report 2016*. Canberra, ACT: Office for Learning and Teaching. Retrieved from: http://www.olt.gov.au/project-capabilities-ehealth-education-developing-undergraduate-digital-literacies-health-profession

La Trobe University (2015). *Digital future: Digital learning strategy 2015–2017*. Retrieved from: http://www.latrobe.edu.au/__data/assets/pdf_file/0011/642998/Digital-Learning-Strategy-Brochure.pdf

La Trobe University (2016). *Skills for a digital world: Digital literacies framework*. Retrieved from: http://www.latrobe.edu.au/library/about-us/digital-literacies-framework

Lankshear, C. J. & Knobel, M. (2008). Introduction. In: C. Lankshear, & M. Knobel, (Eds.), *Digital literacies: Concepts, policies and practices* (pp. 1-16). New York, NY: Peter Lang Publishing.

Littlejohn, A., Beetham, H. & McGill, L. (2012). Learning at the digital frontier: A review of digital literacies in theory and practice. *Journal of Computer Assisted Learning*, 28, 547–556. doi: 10.1111/j.1365-2729.2011.00474.x

Newland, B. & Handley, F. (2016). Developing the digital literacies of academic staff: An institutional approach. *Research in Learning Technology, 24*, Research in Learning Technology, Retrieved from: http://dx.doi.org/10.3402/rlt.v24.31501

Pope, J. & Mutch, R. (2015), *How are young people faring in the transition from school to work?*, Foundations for Young Australians. Retrieved from: http://www.fya.org.au/wp-content/uploads/2015/11/ How-young-people-are-faring-report-card-2015-FINAL.pdf

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Using an e-authoring tool (H5P) to support blended learning: Librarians' experience

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With an increasing emphasis on blended learning at Victoria University (VU), all the units are to be redesigned and delivered in a blended approach by the end of 2020. This presentation will outline VU librarians' experience in the use of an open source e-authoring tool (H5P) to support the University's blended learning strategy. We will discuss using the H5P tool to enhance library instructional videos and create interactive learning objects to support a specific unit. By using these enhanced resources, students are actively engaged with the content and can easily revisit and review at any time and are able to complete self-assessment activities at their own pace and receive immediate feedback on their performance. Furthermore, this presentation will showcase various H5P learning objects created by librarians that are reusable and shared with all VU staff, who can access from the learning objects library in VU's learning management system (VU Collaborate). Instead of duplicating learning resources, teaching staff and other librarians are able to save time through reusing the learning objects/activities. In addition, we will outline the data that were accessible through VU Collaborate and feedback received from the teaching staff. The benefits of the tool outweighs the limitations and future plans are suggested to continue utilising this tool for the University's First Year Model.

Introduction

Advances in technology has steered academic librarians to create digital learning objects that focus on actively engaging students with the content rather than passively reading, watching or listening. Traditionally, librarians at Victoria University (VU) have been producing videos to support students with information literacy and library research needs in either the face-to-face environment or embedding these videos in the online guides. However, the videos did not give students the option to interact or engage with the content thus, encouraging passive learning. With the university's focus towards the blended learning approach, new learning objects are to be developed and existing digital learning objects need to be enhanced, so that students are able to actively engage with the content and reflect on their learning. This paper outlines the role of librarians in supporting a vital piece of learning for students in an academic environment. In particular, producing the APA referencing interactive videos and embedding into a core unit of the sport management course. This was achieved using an innovative approach, utilising specific technology to allow for flexible student access and active learning opportunities.

Background

VU is a dual sector university providing tertiary education for students in the West of Melbourne and beyond. There is an increasing emphasis on blended learning at VU where all the units are to be redesigned and delivered in a blended approach by the end of 2020 (Victoria University, 2017). Blended learning refers to learning that happens in face-to-face context as well as online and often involves the use of technology accommodating diverse learning needs of students (Alammary, Sheard, & Carbone, 2014). The purpose for introducing blended learning was to not only improve student engagement and success but also provide students with the flexibility of accessing course content and learning from anywhere and at any time.

Librarians at VU are accustomed to designing and delivering information literacy in the face-to-face mode. However, to support and promote the blended learning initiatives of the university and the library, librarians had to think of various ways of utilising the technologies to blend library tutorials.

Why we created interactive learning objects

Initially, a project was instigated to create online learning objects to support 'Introduction to Sport and Active Recreation' (SSM1101), a unit within the university's blended learning project. This unit is a core unit of the sport management course, which is a three-year undergraduate course. In first semester, all students commencing the sport management course are required to attend information literacy classes, integrated in the 'Introduction to Sport and Active Recreation' (SSM1101) unit. The information literacy class provides support to students with finding information, critically evaluating information sources and using information ethically for their assessment tasks including referencing skills. Previously, for this cohort, two information literacy classes were designed and delivered in a face-to-face mode in weeks two and seven. However, with the university's move towards blended learning and teaching, the SSM1101 unit was scheduled for blend development in semester 2, 2016 to be completed and delivered entirely in a blended approach in semester 1, 2017. The discipline librarian was invited to the unit's redesign meeting and this opened up a dialogue to redesign and blend the two library tutorials.

It was suggested to reduce two face-to-face library classes to one face-to-face class in week three. Instead of cutting out essential information literacy content altogether it was decided to adopt a flipped approach and create an online module. The flipped approach is a teaching strategy that reverses the traditional instruction where students gain exposure to the unit's teaching materials prior to attending the face-to-face class through recorded video lectures, audio, readings or other resources that are posted online (Arnold-Garza, 2014; Brooks, 2014). This included utilising existing content (quizzes, videos) and developing new interactive content to support student learning in a blended learning environment. In this context, the embedded online modules were created as pre-class activities (keyword searching activity, using the library activity, plagiarism quiz activity and APA referencing activities) for students to complete in their own time and at their own pace before coming to the face-to-face library tutorial. This resulted in reducing didactic instruction and facilitating more time for active learning opportunities during class time.

Using the H5P tool to create interactive learning objects

In addition to the existing videos and quizzes that were adapted and modified for students to complete pre-class, a suite of APA referencing videos were created using the tools GoAnimate, PowerPoint and Camtasia and hosted on the library's Vimeo channel. In creating these videos, librarians followed the library's digital learning object guidelines, ensuring that the videos were planned and designed following best practice. The guidelines were created based on the principles of Richard Mayer's Cognitive Theory of Multimedia Learning. For instance, in order to reduce content related load on student memory, a decision was made to divide the content into four separate videos. Presenting information or concepts in short sections or chunks assists learners to easily process the information and focus on each component at a time (Mayer, 2014; Oud, 2009; Stiwinter, 2013; Hess, 2013). Moreover Hess (2013), suggests learning objects/videos being made available through multiple access points to further enhance the findability of these learning objects (Bowles-Terry, Hensley & Hinchliffe, 2010). As a result, the videos were made accessible via the library's Vimeo channel and utilised to complement the referencing guides available through the library website. Developed using the Springshare LibGuides software, the text based online guides provide students with detailed instructional information for the referencing style. Embedding the videos into the APA online guides provides instructional information in a multimodal medium and supports the various learning styles of our students (Dewald, 1999; Dewan & Steeleworthy, 2013). Furthermore, the videos are supported by transcripts to ensure accessibility for all students (Hess, 2013).

The APA videos were produced and to make the learning interactive and more engaging, the H5P tool was utilised to further enhance the videos. H5P (HTML5 package) is an e-authoring tool to create rich interactive HTML5 e-learning content allowing it to be shared and reused (H5P, 2017). Various authors have highlighted the importance of incorporating interactive activities to promote meaningful and active learning (Dewald, 1999; Dewan & Steeleworthy, 2013; Mestre, 2012; Oud, 2009). The learning activities can take the form of quizzes, multiple-choice questions, drag and drop tasks or any self-assessments that allow the student to directly apply what they have learnt. Mestre (2012) found students performed better when they could apply what they were learning during the tutorial and Stiwinter (2013) pointed out that interactivity assists learners to stay focused and engaged with the content. Librarians decided to use the H5P tool, as it was a free and open source software integrated with the university's learning management system (LMS), VU Collaborate. Since the university supported the H5P tool, librarians were aware that the learning objects created using this tool would be easily embedded into a VU Collaborate unit space. Library learning objects when embedded within the LMS are more effective as the visibility of the resources is increased (Dewan & Steeleworthy, 2013; Snowball, 2014) and is placed at learners' point of need (Hess, 2013).

The H5P tool is easy to use and does not require any advanced technical skills. Support is available through online help guides and tutorials on the H5P website https://h5p.org/. The tool supports various content types such as quizzes, interactive videos, course presentation and timelines with an advantage of creating mobile friendly content. It does not require the end user to install any plugins or install any software. Additionally, the H5P tool is accessible via most devices as it uses the HTML5 to create the interactive content. This is unlike flash-based content, which can be problematic as it creates accessibility issues for people accessing the content on screen readers and mobile devices (Martin & Martin, 2015). However, as an author to create, publish and administer the content you need to install the H5P plugin in your LMS. This was not an issue for librarians as the systems administrators had already installed the plugin into VU Collaborate.

Outcome

A suite of APA referencing interactive videos was created using the H5P tool and introducing the fundamental rules of the APA style: APA referencing: the basics, APA referencing books & e-books; APA referencing: journal articles; APA referencing: web content. The interactive elements in the videos were a combination of drag & drop questions, multiple choice, single choice, statements, pop-up texts and links. Including the interactive elements in the video allows students to review and gauge their understanding of the APA referencing concepts presented. Studies confirm engaging learners with the content makes the learning process active rather than passive (Zhang, 2006; Dewald, 1999; Oud, 2009). Additionally, the interactive elements such as the multiple choice, single set questions and statement activity within the video provide students with immediate feedback on their performance. Providing immediate feedback to students is a great way of encouraging and motivating students to perform a task and reinforce their learning (Mayer, 2014; Oud, 2009; Stiwinter, 2013; Martin & Martin, 2015). The H5P tool also allows for multiple attempts where learners can retry a question. If the student provides an incorrect answer, comments and links can be inserted into the feedback to direct the student to further information and help them identify their knowledge gaps.

The four APA interactive videos (see figure 1) were embedded in the Introduction to Sport and Active Recreation (SSM1101) unit space as a pre-class learning activity for students to complete prior to attending the face-to-face library research class. Apart from the SSM1101 unit, these interactive videos are incorporated into four other first year units. As the librarians acquainted themselves with the H5P tool, additional interactive content was developed. For instance, the image hotspot activity was created for the students doing the Evidence and Health (HHB1105) unit, pointing out elements of an annotated bibliography (as a post class activity), a set of quizzes on plagiarism, and searching in SportDiscus database interactive video created for Growth Development and Ageing (SHE1002) and Exercise Psychology (AHE1106) cohorts.

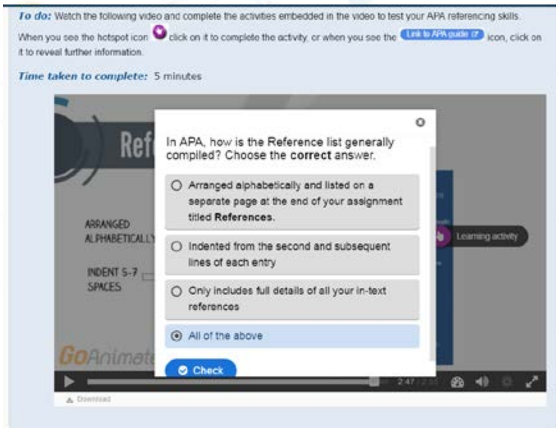

Figure 5: Pre-class activity: APA referencing (Part 1): multiple choice question

All the interactive digital learning objects including the APA referencing interactive videos created using the H5P tool enable learners to have control over their learning and provide greater flexibility. Therefore, learners can do activities at their own pace (ability to pause, review, and fast-forward the video) and in their own time (Mayer, 2014; Zhang, 2006; Oud, 2009; Martin & Martin, 2015). This also affords self-paced and self-directed learning. Considering that these H5P learning objects are embedded in the unit space in VU Collaborate, students are able to revisit these videos.

Furthermore, the H5P learning objects created by the librarians are reusable and shared with all staff, who can access from the learning objects library in VU Collaborate. Reusing activities saves time for the teaching staff and other librarians, which would otherwise duplicate learning resources, and at the same time, there is less content to update (Thornes, 2012). Teaching staff can reuse the content and adapt it to suit their learners' needs. For instance, any teaching staff can clone or copy the APA referencing interactive videos and modify the types of interactive content within the video or alter the questions to make it more meaningful for their learners.

Data

VU Collaborate also provided basic statistics of usage at an individual student level. These statistics presented an insightful picture of how many students watched the videos and attempted the inbuilt quizzes. For example, in the APA referencing tutorials (pre-class activity in week 3) only 46 students out of 141 (32%) completed the activity. It was anticipated students would require 20 minutes to complete the APA referencing tutorial. However, most students viewed the series of tutorials only once, spending an average of 6:43 minutes on the page. From the limited data available, it would be difficult to determine how many of the four tutorials students attempted and completed. Additionally, there is no data available that shows at what point the individual student played and stopped the videos.

As previously mentioned, students completed a series of other pre-class library activities including the keyword searching activity. However, teaching staff decided to use this five-minute keyword searching activity in-class during week 1. The following data shows that a greater percentage of students engaged with the content when required to complete it in-class. In this instance, 102 out of 141 (72%) students completed the activity. Of the students who completed the activities, 60% viewed the video multiple times and spent an average of 4:12 minutes on the page.

Challenges and future plans

A noted limitation of the H5P tool includes using the interactive videos outside of VU Collaborate. Consequently, the interactive videos cannot be embedded into the library referencing guides. For librarians, there are limitations with accessing more detailed data including results for students who had attempted the self-assessment activities. Therefore, it is difficult to identify what concepts students find challenging and where they require additional assistance. This will require further investigation with the VU Collaborate administrators and technical staff to enable librarians to access detailed statistics. It is important to plan future library tutorials to capture comprehensive statistics and collect feedback from students using survey tools. Collecting this information is vital to further improve future library tutorials and hopefully increase the number of students completing flipped classroom activities. Moreover, at the end of the semester, the librarian met with the SSM1101 unit coordinator and the tutor to get feedback about the flipped library session. Teaching staff were very optimistic and positive about the flipped library class and the way the pre-class activities were designed especially the interactive APA videos. However, the teaching staff had also observed that the students had not completed pre-class activities that they had assigned for students to complete in their flipped sessions. This highlights that student participation in flipped classroom activities was also an issue for the teaching staff.

Through the statistics in VU Collaborate, it was evident that a percentage of students were not viewing the APA videos pre-class or attempting the pre-class and post class activities. The next steps include working with unit coordinators to encourage students to utilise the interactive APA videos independently. Literature discusses the notion that grades are an important motivator for students so therefore, it is important that teaching staff also reinforce the importance of referencing for assessments (Stiwinter, 2013; Rosser & Willis, 2016; Loo et al., 2016). Furthermore, for librarians, when embedding interactive videos into VU Collaborate, it is important to highlight through instructions the relevance of the learning activities to the assessment task. Librarians will also continue to work with coordinators across units in the College of Sport and Exercise Sciences and College of Health and Biomedicine to embed the enhanced APA referencing videos into their online learning spaces and in flipped library classes. As the H5P tool offers a range of enhancement tools, there are opportunities to customise the interactive elements for specific units. Finally, the library is in the process of developing a suite of similar videos also enhanced with the H5P tools for other referencing styles used within the university. Having experienced using the H5P tool, librarians can support the university's blended learning projects by promoting the tool to teaching staff and provide assistance with creating enhanced digital learning objects for their own units.

Conclusion

This paper has summarised librarians' experience in developing interactive learning objects using the H5P tool to enhance information literacy tutorials in particular APA referencing. Aligned to the university's blended learning strategy, these tutorials were designed using a flipped approach to promote active and meaningful learning. Additionally, the use of embedded self-assessment activities allowed students to control the progress of their learning and reinforce key concepts and skills.

Reflecting on our experience and the challenges associated with transforming traditional face-to-face classes to a flipped approach will allow for further improvements to the re-designing of other blended library tutorials. With the increasing importance of the library's role in facilitating information literacy and digital literacy skills development, it is envisaged that the H5P tool or similar e-authoring tools will be further utilised by the librarians to create sharable and reusable interactive learning objects for blended library instruction.

References

Alammary, A., Sheard, J., & Carbone, A. (2014). Blended learning in higher education: Three different design approaches, *Australasian Journal of Educational Technology, 30*(4), 440-454.

Arnold-Garza, S. (2014). The flipped classroom teaching model and its use for information literacy instruction. *Communications in Information Literacy, 8*(1), 7-22.

Bowles-Terry, M., Hensley, M., & Hinchliffe, L. (2010). Best practices for online video tutorials in academic libraries: A study of student preferences and understanding. *Communications in Information Literacy, 4*(1), 17-28.

Brooks, A. W. (2014). Information literacy and the flipped classroom: Examining the impact of a one-shot flipped class on student learning and perceptions. *Communications in Information Literacy, 8*(2), 225-235.

Dewald, N. H. (1999). Transporting good library instruction practices into the web environment: An analysis of online tutorials. *Journal of Academic Librarianship, 25*(1), 26.

Dewan, P., & Steeleworthy, M. (2013). Incorporating online instruction in academic libraries: Getting ahead of the curve. *Journal of Library and Information Services in Distance Learning, 7*(3), 278-296. doi:10.1080/1533290X.2013.804020

H5P. (2017). H5P. Retrieved from https://h5p.org/

Hess, A. (2013) The MAGIC of web tutorials: How one library (Re) focused its delivery of online learning objects on users, *Journal of Library & Information Services in Distance Learning*, *74*, 331-348. doi:10.1080/1533290X.2013.839978

Loo, J. L., Eifler, D., Smith, E., Pendse, L., He, J., Sholinbeck, M., & Dupuis, E. A. (2016). Flipped instruction for information literacy: Five instructional cases of academic librarians. *Journal of Academic Librarianship, 42*(3), 273-280. doi:10.1016/j.acalib.2016.03.001

Martin, N. A., & Martin, R. (2015). Would you watch it? Creating effective and engaging video tutorials. *Journal of Library and Information Services in Distance Learning, 9*(1-2), 40-56. doi:10.1080/1533290X.2014.946345

Mayer, R. E. (2014). *The Cambridge handbook of multimedia learning*. New York: Cambridge University Press.

Mestre, L. S. (2012). Student preference for tutorial design: A usability study. *Reference Services Review, 40*(2), 258-276. doi: 10.1108/00907321211228318

Oud, J. (2009). Guidelines for effective online instruction using multimedia screencasts. *Reference Services Review, 37*(2), 164-177. doi:10.1108/00907320910957206

Rosser, C. M., & Willis, T. (2016). Flip over research instruction: Delivery, assessment, and feedback strategies for "Flipped" library. *Theological Librarianship, 9*(1), 22-27.

Snowball, J. (2014). Using interactive content and online activities to accommodate diversity in a large first year class. *Higher Education, 67*(6), 823-838. doi:10.1007/s10734-013-9708-7

Stiwinter, K. (2013). Using an interactive online tutorial to expand library instruction. *Internet Reference Services Quarterly, 18*(1), 15-41. doi:10.1080/10875301.2013.777010

Thornes, S. L. 2012. Creating an online tutorial to support information literacy and academic skills development. *Journal of Information Literacy, 6*(1), 82-95. Retrieved from http://ojs.lboro.ac.uk/ojs/index.php/JIL/article/view/LLC-V6-I1-2012-3

Victoria University (2017). Learning and teaching: Blended learning strategy. Retrieved from https://www.vu.edu.au/learning-teaching/blended-learning-strategy#goto-the-vu-blend-overall=1

Zhang, L. (2006). Effectively incorporating instructional media into web-based information literacy, *The Electronic Library, 24*(3), 294-306. doi:10.1108/02640470610671169

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Mobile learning and speech technology for language teachers' professional development: A design-based study

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This study aims to investigate the use of mobile learning to provide pronunciation training for lecturers of English as a Foreign Language (EFL) from Vietnamese provincial universities. Mobile learning offers a potential solution for the delivery of professional development to lecturers based outside major cities thanks to its capacity to enable learning anytime, anywhere. Mobile learning and speech technology are expected to facilitate lecturers' self-direct learning to fulfil their professional development needs using their own devices. This paper reports results from a pilot study which serves as the first phase of an on-going design-based research project. The pilot study was carried out to explore the feasibility of an online pronunciation course and identify potential problems for future course iterations in the context of participants living outside major cities in a developing country. The objectives of the project are to establish and test a set of fundamental principles for mobile learning to be an effective way of providing online professional development for lecturers based outside major cities and to shed light on the necessary adjustments in course design to make it a scalable model for future education planning. In this study, both qualitative and quantitative data were collected during two iterations of an online pronunciation professional development course for EFL lecturers from Vietnamese provincial universities.

Introduction

In 2008, the Vietnamese Ministry of Education and Training (MOET) initiated the National Foreign Language Project 2020, and invested approximately five billion USD in reforming language teaching methods, enhancing teachers' language competence, and purchasing learning resources (Hoang, 2011). However, there was widespread doubt about the successful achievement of the project (Parks, 2011). Critics argued that there were too few EFL teachers – about 80,000 for approximately 17.5 million students, and most were unqualified (Hoang, 2011). By the end of 2015, the percentage of teachers who met MOET's proficiency requirements increased from under 10% to 32% (Yen Anh, 2016a). However, the greatest challenge remains the improvement of teachers' oral skills, especially pronunciation (Quynh Trang, 2014).

For nearly 47,000 Vietnamese EFL teachers, improving their language competence to meet the language proficiency requirements set by Project 2020 is now a must (Yen Anh, 2016b). For those living outside major cities like, this means regular long distance travel to attend training. Sending teacher trainers to small towns to deliver on-site training, which MOET did between 2011 and 2015, has proved to be of limited efficacy, therefore alternative forms of providing English training are needed. At the end of 2016, MOET proposed to focus on online learning, and learning technologies for language learning for professional teacher training.

Mobile learning offers a potential solution to providing PD language training to EFL teachers for several reasons. Firstly, it reduces the traveling time for both educators and trainees to deliver or acquire training. Secondly, it is cost-effective since "technology can reduce training costs if there are a large number of learners, if the learners are geographically dispersed, and if the course will be repeated several times" (Welsh, Wanberg, Brown, & Simmering, 2003, p. 255). It can also enable teachers to sustain professional development using their own mobile devices.

Literature review

This study adopts the definition of professional development (PD) as "the development of a person in his or her professional role" proposed by Villegas-Reimers (2003, p. 11). However, it restricts the scope to EFL teachers, whose PD is "a lifelong process which begins with the initial preparation that teachers receive (whether at an institute of teacher education or actually on the job) and continues until retirement" (Villegas-Reimers, 2003, p. 8) in the context of Vietnam. Recent studies of Vietnamese tertiary EFL teachers' PD (Nguyen, Fehring, & Warren, 2015) indicates an increasing amount of attention in PD for teachers of English at higher education institutions. However, the limited number of studies is not sufficient to provide an overview of PD among EFL teachers in the country. Moreover, the current approaches to providing language PD for teachers of English in Vietnam have also been criticized for the inequitable selection of only experienced lecturers to attend external PD activities, especially overseas (Tran, 2016).

Mobile learning is defined as "both learning with portable technology, and also learning in an era characterized by mobility of people and knowledge" (Sharples, Taylor, & Vavoula, 2006). In this study, mobile learning involves the use of both mobile and stationary devices (i.e. desktops) that facilitate learning on the move, i.e. when learners use a hotel desktop to study while on a business trip. This conceptualization suits the context of EFL teachers from Vietnamese provincial universities, where long distances and low income may hinder their access to high-end devices or state-of-the-art technologies. In Vietnam, there have been few studies into the use of mobile learning for EFL teachers. A rare exception is the work of Murphy, Midgley, and Farley (2014) on mobile learning trends among 44 EFL teachers who took an MA in TESOL course held in Ho Chi Minh City. The findings revealed that all participants owned or had access to up to four mobile devices, with acceptable to moderate Internet quality. However, it may not be appropriate to generalize these findings for all Vietnamese teachers.

Computer-Assisted Pronunciation Training (CAPT) is defined as the employment of digitized speech for developing language pronunciation (Rostron & Kinsell, 1995). Of all the CAPT technologies, automatic speech recognition (ASR) was recognized as the most valuable for instantaneous, individualized feedback (Hansen, 2006). ASR is a technology which enables a computer or a hand-held device to transcribe words that are read aloud or spoken into any sound-recorder (Myers, 2000). ASR was found to help improve learners' pronunciation (Golonka, Bowles, Frank, Richardson, & Freynik, 2014), overall intelligibility, learners' confidence and autonomy (Geertsema & Campbell, 2014). However, it often fails to recognize accented speech, and is unable to provide meaningful pronunciation evaluation (Neri, Cucchiarini, & Strik, 2003). The concern was addressed by the development of ASR systems that can recognize non-native speech with acceptable performance. ELSA Speak and USpell, the apps adopted in this study, are such systems.

Pronunciation was not a popular research topic in Vietnam until the 21st century, when there was a strong emphasis on learning English. Research suggests that there is an observed lack of pronunciation pedagogical training for teachers (Tweedy, 2012). Although Vietnamese highly value native-like pronunciation (Cunningham, 2009), acquiring intelligible pronunciation is a real challenge for them (Vu, 2016). Fortunately, research shows that Vietnamese learners' pronunciation problems can be successfully addressed thanks to explicit training and practice (Ngo & Setter, 2011), and technology is a promising solution (Dang, 2011).

Research questions: The research questions of this study are:

1. What conditions need to be met for an online pronunciation course to be held for EFL lecturers from provincial universities in Vietnam?
2. What adjustments need to be done in course design and implementation to make such an online course feasible and scalable?

Methodology

Design-based research is adopted as the research paradigm of the study because its characteristics align well with those of mobile learning. Design-based research is defined as a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (Wang & Hannafin, 2005). This research paradigm is characterized by being (a) pragmatic, with the aim to solve real-world problems; (b) grounded, in both theory and real-world context; (c) interactive, with collaboration between researchers and practitioners, iterative, with theories and interventions continuously developed and refined from analysis to design then evaluation and redesign, and flexible, ongoing recursive; (d) integrative, with the utilization of a variety of research methods and approaches from both qualitative and quantitative research paradigms; and (e) contextual, connected with both the design process through which results are generated and the setting where the research is conducted (Wang & Hannafin, 2005).

In the study, three theoretical frameworks were used: The framework for analysing mobile learning proposed by Sharples et al (2005) reflects the dialectical relationship between technology and learning; the seamless language learning framework mediated by ubiquitous technology by Wong (2012) frames the course design and implementation for data collection; and the technical quality model by Sarab et al (2016) is employed for the selection of mobile technologies.

This pilot study was carried out between September and December 2016, with four participants completing the online pronunciation course and participating in the study. They were all female with between five and eleven years of teaching experience. Two work in mountainous areas in the North and Central Vietnam, the third one is based in a small town in the Mekong Delta in the South, and the fourth is from a coastal Central province. They all have laptops, one uses an iPhone, and the others have Android smartphones. Before the course started, the participants completed a questionnaire about their background, previous pronunciation training and training needs, then took a pre-test using automatic voice recognition technology. The participants recorded their own voice reading out loud a short paragraph (107 words) and sent their recordings to the researcher who used Dragon Dictation, a voice recognition app on her phone to transcribe the recordings into texts, then the transcription were compared against the original text to identify pronunciation mistakes. A training syllabus was built upon the questionnaire responses and the pre-test results.

The three-month online pronunciation course had two phases: In the first eight weeks (October to November 2016), the participants met with the researcher for two hours every week using online conference tools like Skype to discuss their learning problems and practice their pronunciation. There was no direct instruction since participants had been provided with learning videos. Outside class meeting times, participants practiced their pronunciation using pronunciation apps and mobile technologies on their own devices. The two apps used by participants were ELSA Speak, a voice recognition app focusing on problematic pronunciation features for Vietnamese speakers, and USpell, a pronunciation app with video lessons and practice session for each sound in English. Other technologies include Rachel's English, a well-known YouTube channel for pronunciation, and online text-to-speech tools such as Speechnotes or Dictation.io using Google voice recognition technology. The participants uploaded screenshots of their in-app practice, i.e. level completion reports to Edmodo, the learning management used in the course. They also provided consent for all the online meetings to be audio-recorded, and receive links to download these recordings. In the second phase of the course (December 2016), there were no weekly meetings, and participants self-directed their pronunciation practice.

After the course, the participants completed a post-test in the same way as the pre-test, using the same reading passage. The transcribed and original texts were compared, as were the pre and post test results. Three months after that, a questionnaire was sent to the participants to collection their feedback on the course and their pronunciation practice. During the course, the researcher also documented observations of technological issues and participants' behaviours.

Results and discussion

In terms of device ownership and accessibility, all the participants had no difficulty taking the course. They often used either a laptop, tablet or their phone to take part in the Skype meetings, and switched between them for more flexibility or convenience while on the move. They were asked to install Skype on all their devices so they can have backup devices in case of battery exhaustion. However, the compatibility of apps and websites seems to be challenging to address. Some apps, like Dragon Dictation, are only available on iOS. USpell, while works on both iOS and Android devices, is not available on Windows phones. Therefore, a participant borrowed an iPad from a family member to practice. The proposed solution was to use web-based dictation tools such as Speechnotes and Dictation.io to practice dictating English texts. Again, there was an issue: Most of the free online dictation websites employ Google voice recognition technology and therefore can only work on Chrome browser. One participant had problems with Chrome and did not know how to fix them. All the participants were busy lecturers, so an ideal tool for them must be not only compatible to as many operating systems and browsers as possible but also have different versions (i.e. web-based, mobile phone apps, etc.) to allow for flexibility and choice of devices. Towards the end of the course, a new solution was discovered: The Voice Typing function in Google Docs. This can be used on Chrome browser in a laptop or desktop, and have apps for iOS and Android. The availability of mobile apps is convenient for participants for their anywhere, anytime learning.

At the beginning of the course, participants struggled with the technological issues. At first, Adobe Connect was used to make an online video conference call between the researcher and four participants, but two participants could not join the call. Either the link did not work, or they could join and had no sounds and videos. And the participants also found the call interface not very user-friendly – they did not know what to do with the buttons and did not seem to read the pdf instructions sent to them before the meeting. The researcher then had to switch to Skype, and Zoom online conferencing tools to communicate with the participants. However, the video was often lagged, the audio was distorted and there were unwanted noises when there were four or five people in a real-time video call. When videos are turned off, the sound quality of the call improved, but occasionally a participant lost connection. After a few weeks, it was discovered that some participants were using unstable Wi-Fi or 3G connection, so they used a wired connection. It was also recognized that Zoom is far more effective than Skype in multi-participant calls, and it has a Mute-all button which is great for reducing or eliminating background noises. These suggest that in future iterations of the course, participants should use wired Internet connection, and the call group size should be small in online real-time meetings using conferencing tools. Moreover, video calls should be minimalized and replaced by audio calls when possible, and participants should be provided with initial technical training, probably in form of video tutorials before the course starts.

During the first phase of the course with regular weekly meetings with the researchers, all the participants showed a high level of commitment and engagement in both the class meetings and individual self-practice of pronunciation. During the online meetings, they proactively and eagerly took part in learning activities and were excited in addressing their pronunciation mistakes. For individual practice, they were asked to spend up to 15 minutes per day to complete one level or lesson in a pronunciation app, but only one of the participants strictly followed the instructions. All other participants spent between 30 minutes and an hour every day on pronunciation practice. They often practiced during breaks, at lunchtime or whenever they had some free time. Most of them uploaded screenshots of their in-app practice to Edmodo every day.

In the second self-directed learning phase of the course, in weeks 9 – 12, there were no longer weekly online meetings with the researcher, and the participants' level of commitment and engagement went downhill. They kept doing individual practice and uploaded their practice to Edmodo for one or two more weeks, then stopped asking questions and practicing although the researcher encouraged them to keep learning. When asked for the reasons, they admitted they were too busy, or lazy, and promised to go back to practice soon, but then did not.

There were some possible explanations for this sudden decrease in the participants' levels of commitment and engagement. Firstly, three months was a long time, and the participants lost their eagerness and excitement after two thirds of the duration. Secondly, the participants enjoyed having personal feedback and discussion during the online meetings in the first phase, and were motivated by the improvement in their pronunciation, but then felt lost and unsupported when there were no class meetings, while the apps and websites could not give them the personalized feedback they wanted. Thirdly, the participants might prefer guided learning to self-directed learning. Finally, the second phase of the course was in December, and with the semester-end examinations and the holiday season drawing closer, the participants were too busy and distracted to self-study, especially without the pressure of an upcoming meeting with the researcher. Therefore, it was proposed that in the next iterations, the course duration should be reduced to six weeks, and online meetings should be maintained during the whole duration.

The pre and post test results indicated that the participants' pronunciation accuracy improved significantly after the course. It seemed that the participants had better awareness of their pronunciation mistakes and made efforts to address them, especially in pronouncing vowels, ending sounds and consonant clusters. However, there was also an observed reluctance among participants to provide comments or suggestions or ask questions regarding the course syllabus and implementation. It seemed that most of the times, the participants just simply agreed with whatever suggested by the researcher. Therefore, when designing the next course iterations, participants' passive learning style and dependence on the researcher need to be taken into consideration.

Conclusion

This small-scaled pilot study serves as the first exploratory cycle of an ongoing design-based research project on the use of mobile learning for providing language PD for lecturers from Vietnamese provincial universities, and was followed by two iterations of course design, implementation and evaluation. Results from this study suggested that for mobile learning to be an effective method of PD provision in the context of remote participants in a developing country, special attention should be paid to initial technological training, Internet connection quality, and participants' learning style and culture. These will be incorporated into a new iterative cycle of the pronunciation course, and findings from these will be reported in future papers.

References

Cunningham, U. (2009). Models and targets for the pronunciation of English in Vietnam and Sweden. *Research in Language, 7*, 113-128. doi:10.2478/v10015-009-0008-3

Dang, N. T. (2011). *Exploring CALL options for teaching EFL in Vietnam.* (Master thesis), Minnesota State University, Mankato, Minnesota. Retrieved from http://search.proquest.com.ezproxy.library.uq.edu.au/docview/879631946#

Geertsema, M., & Campbell, C. (2014). Teachers using mobile devices to receive immediate feedback and improve learners' language learning. *Progressio, 36*(2), 38-52.

Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. *Computer Assisted Language Learning, 27*(1), 70-105. doi:10.1080/09588221.2012.700315

Hansen, T. K. (2006, 22-25 Nov). *Computer assisted pronunciation training: The four 'K's of feedback.* Paper presented at the m-ICTE2006 - Conference on Multimedia and Information and Communication Technologies in Education, Seville, Spain.

Hoang, V. V. (2011). The current situation and issues of the teaching of English in Vietnam. *Ritsumeikan Language and Culture Studies, 22*(1), 7-18.

Murphy, A., Midgley, W., & Farley, H. (2014, November 3-5). *Mobile learning trends among students in Vietnam.* Paper presented at the 13th World Conference on Mobile and Contextual Learning, mLearn 2014, Istanbul, Turkey.

Myers, M. J. (2000). Voice recognition software and a hand-held translation machine for second-language learning. *Computer-Assisted-Language-Learning, 13*(1), 29-41. doi:http://dx.doi.org/10.1076/0958-8221(200002)13:1;1-K;FT029

Neri, A., Cucchiarini, C., & Strik, W. (2003). *Automatic speech recognition for second language learning: How and why it actually works.* Paper presented at the Proc. ICPhS, Barcelona.

Ngo, A. P., & Setter, J. (2011, 17-21 August). *Evaluating the intonation perception ability of Vietnamese learners of English.* Paper presented at the 17th International Congress of Phonetic Sciences, Hong Kong

Nguyen, H. T., Fehring, H., & Warren, W. (2015). EFL teaching and learning at a Vietnamese university: What do teachers say? *English Language Teaching, 8*(1), 31-43. doi:10.5539/elt.v8n1p31

Parks, E. (2011, 8 Nov). Vietnam demands English language teaching "miracle". *The Guardian*. Retrieved from http://www.guardian.co.uk/education/2011/nov/08/vietnam-unrealistic-english-teaching-goals

Quynh Trang. (2014, 15 Oct). Students complain about teachers' pronunciation (Phat am sai, giao vien tieng Anh bi hoc tro phan nan). *VNExpress*. Retrieved from http://vnexpress.net/tin-tuc/giao-duc/phat-am-sai-giao-vien-tieng-anh-bi-hoc-tro-phan-nan-3093325.html

Rostron, A., & Kinsell, P. (1995). Learning pronunciation using CALL: Some experimental evidence. *ReCALL Newsletter, 5*(1).

Sharples, M., Taylor, J., & Vavoula, G. (2006). A theory of learning for the mobile age. In R. Andrews & C. Haythornthwaite (Eds.), *The Sage Handbook of Elearning Research* (pp. 221-247). London: Sage.

Tran, H. (2016). *Professional learning and development (PLD) in higher education: The experiences of teacher educators in Vietnam.* (PhD thesis), University of Wellington, Wellington, New Zealand.

Tweedy, L. (2012). *Discovering factors that influence English pronunciation of native Vietnamese speakers.* (Master thesis), Hamline University, Minnesota, USA.

Villegas-Reimers, E. (2003). *Teacher professional development: an international review of the literature*. Paris: UNESCO: International Institute for Educational Planning

Vu, H. Y. (2016). *Exploring English pronunciation teaching in Vietnam: Time for a new approach?* (MPhil thesis), Macquarie University.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational technology research and development, 53*(4), 5-23.

Welsh, E. T., Wanberg, C. R., Brown, K. G., & Simmering, M. J. (2003). E-learning: Emerging uses, empirical results and future directions. *International Journal of Training and Development, 7*(4), 245-258.

Yen Anh. (2016a, 28/01/2016). Hiem giao vien tieng Anh dat chuan (Few teachers of English met the proficiency requirements). *Nguoi lao dong (The labourer)*. Retrieved from http://nld.com.vn/giao-duc-khoa-hoc/hiem-giao-vien-tieng-anh-dat-chuan-20160128214338106.htm

Yen Anh. (2016b, 14 Apr 2016). Thieu tram trong giao vien tieng Anh (Serious shortage of teachers of English). *Nguoi lao dong (The labourer)*. Retrieved from http://nld.com.vn/giao-duc-khoa-hoc/thieu-tram-trong-giao-vien-tieng-anh-20160414221658642.htm

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The combined effects of physical and virtual models in learning cellular biology

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Physical models have long been used in science education for visualization of complex cellular structure and dynamics during face-to-face lecture (F2F). Recent advancement of technology has enabled us to create virtual models and to share knowledge remotely. This study aims to find out whether physical and virtual models work synergistically to enhance student engagement in learning an undergraduate Life Sciences module. Three independent experiments were conducted to assess learning effectiveness on three biology concepts through four learning approaches: video with virtual model only, video with integration of virtual and physical model demonstration, F2F lecture using virtual model only, F2F lecture using virtual and physical models. Participants were randomly assigned to different groups each with one learning approach. Data collected through pre- and post-tests revealed that significant improvement in learning scientific concepts occurred in one of three controlled experiments when the video contains both virtual and physical models, while no obvious difference found in the other two experiments. This data suggests that well-prepared digital media alone may convey scientific information well and additional physical models do not aid in information acquisition. However, feedback survey on student learning experience showed that all participants preferred to learn from physical models. In all three experiments, students consistently voted that the physical models attracted their attention and enhanced their interests. They made better mind maps and raised more questions. These hint that a combination of digital media with physical models might improve engagement and promote higher order thinking.

Background

The rapid development of technology has greatly transformed teaching and learning. Educators use video clips, animations and web-based learning to help visualizing challenging concepts and to cater for different learning needs (Brame, 2016, Yellepeddi & Roberson, 2016; Mayer, 2002). On the other hand, students have become more proactive in searching for these technological aids for deep learning. This is evident in the rise of educational content on video-sharing platforms such as YouTube, Vimeo and Dailymotion (Abdelouarit, Sbihi, & Aknin, 2015). The benefits of instructional video have been widely studied and recognised (Barford & Weston, 1997; Mayer, 2002; Girod, Bell, & Mishra, 2007; Targamadzė & Petrauskienė, 2010). Yellepeddi and Roberson (2016) reported that the implementation of educational videos in the classroom mitigated the complexity of pharmacological content and improved student's learning through the use of visual instructional aids. It also alleviates student's difficulty in understanding abstract and hard-to visualize concepts. These positive outcomes are often directly linked to cognitive load, student engagement and active learning (Brame, 2016).

Creation and selection of multimedia presentation are guided by a theoretical framework- Cognitive Theory of multimedia learning (CTML) (Day et al., 2006; Mayer, 2002). Most educational tools aim to decrease two cognitive loads, namely the intrinsic load which corresponds to the inherent difficulty of the topic and the extraneous load which are information that do not contribute to the learning outcome (Brame, 2016). There are nine ways to reduce cognitive load in multimedia learning and visual aid is an important tool for the purpose (Mayer & Moreno, 2003). Another central idea that revolves around the design of educational videos is the level of student engagement (Brame, 2016). Two working definitions are namely emotional and behavioral engagement. Emotional engagement reveals the affective reactions of the student with regards to the information that was presented. These feelings can be described as interest, anxiety, happiness and many more. Behavioral engagement on the other hand is defined as behaviors that reflect positive attitudes towards learning. Some of these behaviors include persistence, attention, questioning and effort, which are often indicators for the level of student engagement (Fredricks et al., 2004).

Physical models have long been used in science education and the advantages have been widely recognised (Harrison & Treagust, 1998; Azer and Azer, 2016; Bryce, et al. 2016; Krell & Krüger, 2016). However, there is rarely corroboration for the effectiveness of using a combination of video and physical models in both e-learning and face-to-face learning (Harris, 2009). Therefore, it is instrumental to find the values of physical models in the technology-enhanced learning environment, and hopefully the data generated from this research would enrich our technological pedagogical content knowledge (Koehler & Mishra, 2009).

Methods

Physical models, virtual models and video preparation

Three physical models: spindle apparatus, chromatin and mitochondrion were created and used to teach students in non-life science majors about three biology concepts: cell division (Expt 1), chromatin remodelling (Expt 2), and glucose metabolism (Expt 3), respectively. All models were designed to show dynamic process through their movable components and created using crafting materials. The building components were colour-coded to enhance their visual effects and attractiveness. Virtual models were created in PowerPoint (PPt) files with images to show the structures and animations to explain the dynamics. These PPt files were used for both video recordings and face-to-face (F2F) lectures. All instructional materials were designed for students with minimal prior biological background and aligned with learning objectives of a General Biology course (LSM1301).

Participants and experiments

Participants were mainly recruited via three platforms: a NUS internal website in Integrated Virtual Learning Environment (IVLE), a public website known as 1our.today and Facebook. The participants must not major in any biology-related field such as Life Sciences, Medicine, Nursing and Pharmacy and should not have taken any general biology module in order to minimize the bias in their biology background knowledge prior to experiments. They were from various faculties, such as engineering, computing science, arts and social sciences, business, etc.

Three independent experiments related to the three key biology concepts were conducted to investigate the effectiveness of combination effects of physical models and virtual models in both e-learning and F2F learning environments. In each experiment, participants were randomly assigned into 4 groups, receiving four different treatments (Table 1). In the E-learning environment, students watched the videos only. In the F2F learning environment, instructors gave live lectures using PPt file and physical models. The duration of presentation and scientific content were controlled to be the same for each treatment.

Table 1: Four groups in each experiment and their respective instructional materials and methods

	Instruction without Physical Model	Instruction with Physical Model
Video (E-Learning)	Recorded PPt presentation without using physical model (VO: Video Only)	Pre-recorded demonstration of physical model is embedded into the recorded PPt presentation (VM: Video + Model)
F2F presentation	Live PPt presentation without using the physical model (F2FO: F2F Only)	Live PPt presentation with the physical model (F2FM: F2F+Model)

Data collection and analysis

Data was collected through a pre and post-test followed by a survey using a 5-point Likert scale. Multiple choice questions in the pre and post-test were the same, but randomized to assess basic understanding of concepts. Questions in the survey were used to get their feedback on their learning experiences. Mind map drawing was only used in Expt 1 and 2, and questions raised by students were only collected and analysed in Expt 3. Student's preference on various components in educational tools was compared to evaluate its effectiveness. Data analysis was conducted via the two tailed student T-test at $\alpha = 0.05$.

Results and discussion

Structures and their dynamic changes during cellular processes are critical in understanding the mechanisms of life. However, it is notoriously difficult for students to understand geometric and topological changes of molecular complexity. Therefore, physical and virtual models are often used to help students visualize the structural and conformational changes. However, little research has been carried out to investigate relative benefits of traditional physical models versus computer-generated structures for student learning and comprehension. It is not known whether a synergistic effect can result from using both physical and virtual models in complementary ways in the classroom or in an e-learning environment. Nevertheless, a common theme from very limited research is that different types of structural models can be used to illustrate different concepts (Integrating Research and Education, n.d.). In order to gain technological pedagogical content knowledge (Harris et al, 2009) and improve students learning experiences in the blended learning mode, we built three different biology models, representing very different three concepts in Cell Biology (cell division, Expt 1), Epigenetics chromatin remodelling, Expt 2), and physiology (glucose breakdown, Expt 3). Virtual structures and dynamics were showed in PPt files using images and animations. The effectiveness was compared in both e-learning and F2F learning environments. Learning outcomes evaluated by pre-and post-tests showed clearly that all the instruction had improved students' understanding of the scientific concepts (Figure 1).

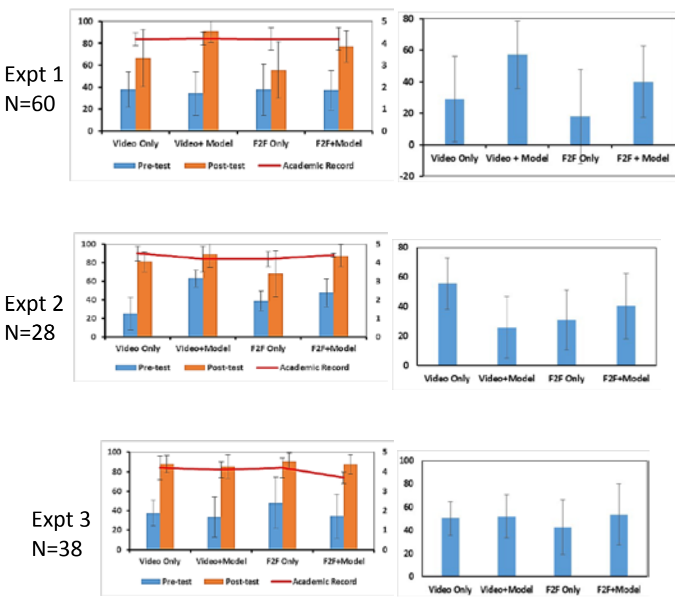

Figure 1: Comparison of learning outcomes using pre- and post-test scores

Three independent experiments were carried out to teach three biology concepts. In each experiment, participants in one of four groups were taught via one of four methods, namely video only, video with integration of demonstration of physical model (Video+Model), face-to-face lecturing without physical models (F2F only), and F2F lecturing with physical models (F2F+Model). Learning outcomes were evaluated with pre-and post-tests. The bars (mean ± S.D.) in the left column indicate percentage of pre-and post-test scores, the red line (mean ± S.D.) corresponding to the right Y axis indicates the average Cumulative Average Point (CAP) in the group. CAP is used to measure academic performance by grade points on a 5-point scale in NUS, being used as bench mark information of participants' academic capacity. The bars (mean ± S.D.) in the right column of the figure represents the net increase of test scores (post-test score minus pre-test score). The * indicates significant difference between test groups.

In Expt 1, participants (n=60) achieved the best post-test scores after learning through the combination of video and model (VM) among the four groups. It may suggest that the scientific concepts were best learnt through the integration of physical model demonstration into video file. The post-test score was significantly higher than the pre-test, and the mean net increase of test score was the highest among all tested groups. However, there was no significant difference in learning outcomes among all the four groups in Expt 2 (n=28) and 3 (n=38). Although the mean increase of test score after learning through video only (VO) was significantly higher than it after learning through VM in Expt 2, it is worth noting that the pre-test score in VO group is much higher. Therefore, the mean increase of test score may not be meaningful for comparison in the case.

It is complex to try to explain the variation of the learning outcomes among different experiments when a combination of virtual (images and animations) and physical models is used. One possible explanation based on participants' feedback is the seamless integration of the physical model into the presentation in Expt 1. Written feedback from students may partially explain the results. *"The 3D physical model and animations are most useful because they help me "see" what is happening. Static images in the PowerPoint are unable to do the same!" "'The model complemented the already well-done slides and yet did not seem redundant. I am not an auditory learner so speech does not capture much of my interest. However, when speech is synchronized with the animation and the model, it really helps digesting the information."* However, the learning outcome may also be theme related as mentioned above, and affected by other factors.

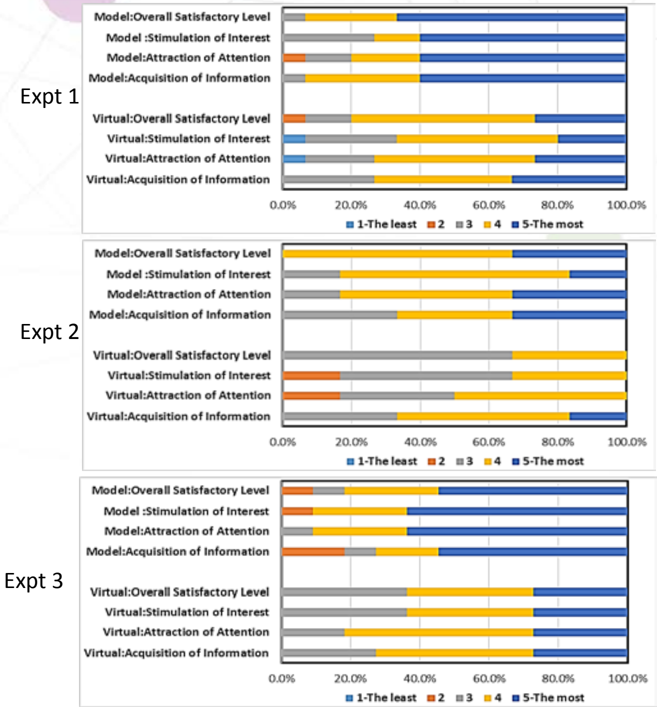

Figure 2: Survey on the virtual models and physical models using a 5-point Likert scale

Although the physical models did not always bring out significant improvement on learning scientific concept, survey on students' learning experiences and preferences were very consistent. Participants in the all experiments reported that the physical models were much better for stimulating interests, attracting attention, and acquiring information than the virtual models used in both video presentation and F2F presentation (Fig 2). The percentages of participants giving the highest rating for physical models were larger than the percentages for virtual models. This is an important finding because the ability to capture the students' interest and attention is an important criterion of an effective educational tool (Donnelly, Harvey, & O'Rourke, 2010).

Previous studies revealed that students prefer to use tactile tools to solve higher-level thinking questions instead of computer imageries. In addition, differences of student learning with a combination of hand-held models and computer imaging programs were not found in typical course assessments as compared with computer imagery alone, while differences can be identified by interviews and highly-challenging questions (Harris et al. 2009). This may suggest that our pre-and post-test may be unable to reveal all learning differences when virtual and physical models were used in different scenarios. We did note that the quality and completeness of mind maps created by students who had been taught with a combination of virtual and physical models were much better than those created by students who were taught with virtual models only in Expt 1 and 2. In Expt 3, we also noted that students asked more questions when the physical model was used as compared with virtual models alone (data not shown).

Taken together, our finding may hint that a combination of physical and virtual models may function better to attract students' attention and engage deep learning. In future, we may explore students learning efficiency when they are invited to create models and play with models

Acknowledgement

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References

Abdelouarit, K. A., Sbihi, B., & Aknin, N. (2015). Big-Learn: Towards a Tool Based on Big Data to Improve Research in an E-Learning Environment. *International Journal of Advanced Computer Science and Applications*, 6(10), 59-63.

Azer, S. A. & Azer, A. (2016). 3D Anatomy Models and Impact on Learning: A Review of the Quality of the Literature. Health Professions Education 2, 80–98.

Barford, J., & Weston, C. (1997). The use of video as a teaching resource in a new university. *British Journal of Educational Technology, 28*(1), 40-50.

Brame, C. J. (2016). Effective Educational Videos: Principles and Guidelines for Maximizing Student Learning from Video Content. *Cell Biology Education*, 15(4), es6-es6. http://doi.org/10.1187/cbe.16-03-0125

Bryce, C.M. et al. (2016). Exploring Models in the Biology Classroom. *The American Biology Teacher*, 78:1. doi: 10.1525/abt.2016.78.1.35

Day, J., Foley, J., & Catrambone, R. (2006). Investigating Multimedia Learning with Web Lectures, (June 2017). Retrieved from https://smartech.gatech.edu/bitstream/handle/1853/13141/06-25.pdf?sequence=1

Donnelly, R., Harvey, J., & O'Rourke, K. (2010). Critical design and effective tools for e-Learning in higher education: *Theory into Practice.* Hershey, PA: IGI Global.

Girod, M., Bell, J., & Mishra, P. (2007). Using Digital Video to Re-Think Teaching Practices. *Journal of Computing in Teacher Education, 24*(1), 23-29.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59–109. http://doi.org/10.3102/00346543074001059

Mayer, R.E. (2002). Multimedia learning. *Psychology of Learning and Motivation*, 41, 85–139. http://doi.org/10.1016/S0079-7421(02)80005-6

Harrison, A. G., & Treagust, D. F. (1998). Modelling in Science Lessons: Are There Better Ways to Learn With Models? *School Science and Mathematics*, 98 (8), 420-429.

Harris, M.A. et al. (2009). A Combination of hand-held models and computer imaging programs helps students answer oral questions about molecular structure and function: a controlled investigation of student learning. *CBE-Life Science Education* 8, 29–43.

Integrating Research and Education: crystallography: physical vs. virtual Models. (n.d.) http://serc.carleton.edu/research_education/crystallography/models.html

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60-70.

Krell, M., & Krüger, D. (2016). Testing models: a key aspect to promote teaching activities related to models and modelling in biology Lessons? *Journal of Biological Education*, 50(2), 160-173.

Yellepeddi, V. K., & Roberson, C. (2016). The use of animated videos to illustrate oral solid dosage form manufacturing in a pharmaceutics course. *American Journal of Pharmaceutical Education*, 80(8), 141. http://doi.org/10.5688/ajpe808141

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The pedagogy-technology nexus: Bridging the divide between academic and student perspectives on educational technologies

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This paper reports on the early findings of a research study into academic design practices when incorporating educational technology. As part of the overall project, students were questioned on their perceptions of the use of technologies in the course. The insights gained from the students are discussed within the parameters of three major themes that emerged from the data informing implications to practice in academic development and learning design.

Introduction

Critical proponents argue that students and their perspectives can often be overlooked in discussions on educational technology and pedagogical innovation (Conole, De Laat, Dillon, & Darby, 2008; Selwyn, 2014). At the 2012 ASCILITE conference in Wellington, we learned that in the Maori language they have a single word, ako, to represent teach and learn. It served as a powerful reminder that students and teachers have an equally important role to play in our educational environments. As we move towards more student-centred learning environments, it is important that those designing these environments understand how their students want to learn rather than directing how they should learn (Ellis & Goodyear, 2010). As such, it is vitally important that as an academic community we engage in research that brings us in direct contact with the student voice as major participants in the learning-teaching nexus, a position that is exemplified in this year's conference theme of *Me. Us and IT.*

Background

The use of technologies is integral to universities in their delivery of learning and teaching activities. Many argue that it has yet to completely transform educational practices largely because the introduction of technology alone cannot change people's practices (Flavin, 2012; King & Boyatt, 2015; Livingstone, 2012; Selwyn, 2014). For academics, a contributing factor to this may have been that academic development programs for technology adoption were largely based around the acquisition of technical skills rather than the pedagogical use of these technologies (Dondi, Mancinelli, & Moretti, 2006; Garrison & Akyol, 2009; Kirkwood & Price, 2006; McCarney, 2004). It has only been in the last decade that there has been a call to move academic professional development towards the pedagogical application of these tools (Cochrane, Black, Lee, Narayan, & Verswijvelen, 2013; Glover, Hepplestone, Parkin, Rodger, & Irwin, 2016; Macdonald & Poniatowska, 2011; Shephard, Mansvelt, Stein, Suddaby, Harris, & O'Hara, 2011).

Research now tends to concentrate on where pedagogy and technology connect as a way to drive innovation and an emerging area within this body of research is the investigation of academic design practices (Bennett, Agostinho, & Lockyer, 2016; Kali, Goodyear, & Markauskaite, 2011; McKenney, Kali, Markauskaite, & Voogt, 2015). However, the students' experience has not always been considered within these designs. This is highly problematic as Bennett, Agostinho, and Lockyer (2015) found that assumptions that teachers have about their students were the strongest influence on their design practices. Consequently, it is important that more research in the area of academic design practices is conducted to understand the student experience within technology-enhanced learning environments. The use of student voice within these design practices can shape and/or challenge these assumptions and align the learning-teaching nexus.

Methodology

The research presented in this paper is part of a larger explanatory case study investigating the issues surrounding the pedagogical challenges academics face when designing and delivering courses that incorporate technology. To date, research conducted in this area has relied on interview data, or self-reports from either staff or students, which do not provide a complete picture of "design and delivery practices" (Bennett, Thomas, Agostinho, Lockyer, Jones, & Harper, 2011, p. 165). As such, the larger project involves multiple sources of rich data collected from course documentation (course profiles and course sites) as an objective presentation of the design and delivery, as well as interviews with the academics and the students in the courses. In total, five academics were selected from an analysis of responses to an adapted TPACK survey that was sent to academics responsible for the design and delivery of courses at a large-scale Australian university. Each of the five academics was asked to nominate one course for the purpose of this in-depth investigation.

The data reported in this paper represents the student focus groups that were conducted to understand how the pedagogy-technology nexus is understood and experienced in the selected academics' courses. Focus groups were selected, as the best method in capturing a range of opinions from several groups (Krueger & Casey, 2000) in their own language and in how they understand the world (Kitzinger, 1994). Focus groups were conducted, through a voluntary invitation to participate, after the last tutorial or synchronous activity that occurred in the teaching schedule for that course. This allowed for general sampling to occur and, the timing at the end of semester, leveraged the sense of cohort that had been built throughout the course to create a "comfortable and permissive environment" (Krueger & Casey, 2000, p. 9) for participants to freely express their opinions.

As the overall project is still ongoing the data reported here represent sessions conducted within three different courses delivered in the 2016 academic year. Table 1 describes the attributes of the three courses in terms of topic, delivery mode, student enrolments, year level, and response rate to the focus group session.

Table 1: Attributes of the three courses in terms of topic, delivery mode, student enrolments, year level and response rate

Identifier	Course Topic	Delivery Mode	Number of Enrolled Students	Year Level Under graduate = UG	Response Rate
Course 1	Cell Biology	Mixed Mode	27	UG, 3rd	32%
Course 2	Language and Technology	Online	22	UG, 3rd	11%
Course 3	Exercise Science	In Person	188	UG, 3rd	1%

The student focus groups were between 20 to 42 minutes in length and had between three to seven participants in each. The sessions for Course 1 and Course 3 were run face-to-face and Course 2 was conducted in the synchronous online environment, Blackboard Collaborate, and involved students typing their answers to the interviewer's spoken questions. The focus group sessions were conducted as semi-structured interviews and students were asked to talk about *the technologies that were used in course, how effective these technologies were in supporting their learning*, and *how technologies may have hindered their learning*? These questions mirrored the questions that were used in the academic interviews.

Analysis of the transcriptions was conducted using a deductive approach through the application of a pre-defined codebook (Miles, Huberman, & Saldaña, 2014). Two theoretical educational frameworks were selected as they provide a way to talk about pedagogy in relation to technology in the design and delivery of educational experiences. These frameworks, which are represented in Figure 1 and Figure 2 respectively, are: Technological, Pedagogical and Content Knowledge (TPACK) model (Mishra & Koehler, 2006) and the Community of Inquiry (CoI) model (Garrison, Anderson, & Archer, 2000). The need to use two frameworks is due to the nature of their utility in the specific elements under investigation. TPACK (Mishra & Koehler, 2006) was selected because its research instruments focus on describing current usage of technologies rather than judging attitudes towards technologies (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009) and CoI was selected as it can be used to measure the development a community of inquiry within courses (Garrison, Anderson, & Archer, 2010) and determine student perceptions of this development (Swan, Day, Bogle, & Matthews, 2013).

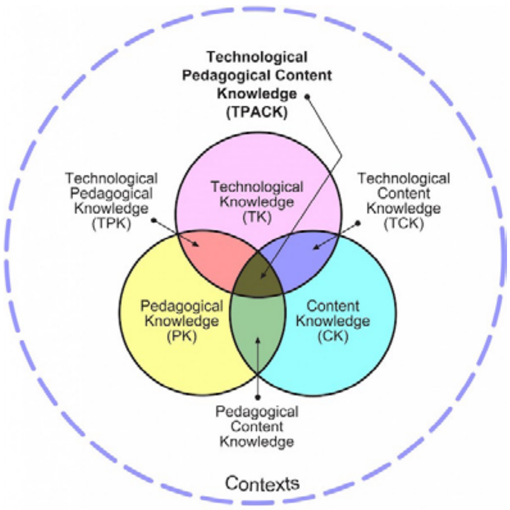

Figure 1: TPACK

Figure 2: CoI

The codebook was developed by adapting previous qualitative analytical codes used within the bodies of TPACK (Koh, Chai, & Tay, 2014) and CoI (Garrison et al., 2000; Rosenberg & Koehler, 2015) research.

Findings

The study has currently investigated three courses (with another two courses to be investigated in 2017) and has had a total of 14 students involved in the focus groups being reported in this paper. While this is a very limited sample size the data collected so far has offered some interesting insights into student perceptions in operating within their learning environments and how technologies are used to foster their engagement. These findings will be organised around three themes that emerged from the data that are indicative of components of both frameworks: sense of engagement, regulating learning, and technical knowledge. Alphanumeric codes have been used to simplify the presentation of results. For example, Course 2, Participant 5 is coded as C2P5.

Sense of Engagement

As learning and teaching activities move more online, academics struggle with building social presence with the absence of face-to-face interactions with students and are having to re-interpret what student engagement means in these environments (Roby, Ashe, Singh, & Clark, 2012). The following excerpt, where students talk about their classes within the synchronous online tool, Blackboard Collaborate, indicates that students potentially do not have the same struggles.

C2P5: *the chat window has been really helpful in getting all of us to participate*
Interviewer: *ok…so it's been a great participation tool?*
C2P7: *It has enabled me to virtually attend classes. There aren't too many things that you can do in a physical class that you can't do here.*
C2P2: *It was pretty much our lecture that you would normally have in a classroom but being online makes things a bit different. I know I for one have spoken more in this class than in any other class I've had*
C2P7: *true [#P2], I agree*

This exchange highlighted the importance of the chat feature to the students and their preference towards this medium over the use of the audio and video tools within the system. Students reported that it gave them the freedom to contribute more than in a traditional face-to-face teaching space. It also showed how the students did not perceive any diminished experience with learning online than learning in a face-to-face context.

The traditional lecture space and the nature of student engagement is also a highly contentious area within the research as academics perceive that the availability of recorded lectures is affecting student attendance at the live lectures (Green, Phillips, Gosper, McNeill, Woo, & Preston, 2007). In fact, it was found that the students who attended the lectures were most likely to watch the recordings (Green et al., 2007; Larkin, 2010; Leadbeater, Shuttleworth, Couperthwaite, & Nightingale, 2013). However, in their review of the literature, O'Callaghan, Neumann, Jones, and Creed (2017) found more often than not, students rely on lecture recordings to review key points or to fill gaps in their note-taking during the live lecture. This was evidenced in the data collected from Course 1 and 3 where comments were made on lecture capture used as "a *reinforcement* (C1P4)" but also revealed some student strategies to increase their cognitive engagement with the material presented in these lectures. One student in Course 3 reported *"the way I use lecture capture is, I get bored in lectures, so I speed it up. It actually engages my learning a heap more…..actually have it as like a hectic study session. I'll all the time daydream in class, but when I put it on two times speed, I can eliminate that* (C3P5)." By listening to the lectures back at double speed, this student could tell where the academic wanted maximum engagement as the student reported "*when you do it at fast speed, you actually get were there are emphasizing a heap better….you can see when they're actually wanting to skip over stuff. Chances are they don't really want you to know that* (C3P5)." This indicates that the student was not only exhibiting the review behaviors found in other studies but was using the features of the technology to increase their own cognitive engagement with the material.

Regulating learning

The data collected showed how students relied on multiple digital platforms and resources to help regulate their learning; within the designed structures provided by the academics, and for themselves. Studies into student behaviours with digital technologies reveals that students do rely on digital technologies to support their practice of "reviewing, replaying and revising" (Henderson, Selwyn, & Aston, 2017, p. 7).

One such way was the use of the Learning Management System (LMS) course sites to help them structure their studies and keep on track. In Course 1, which had a highly structured course site, a student referred to the LMS as their "*bible* (C1P4)" while another student agreed "*its just like the central hub for everything* (C1P2)" where they could go to "*see what we have to do this week, what's next week* (C1P4)". In Course 2, the students appreciated how the academic laid out the course site (again with a weekly structure with all the materials) and how effective the use of various tools they were exposed to that taught them new functions of the system. In Course 3, which had very little structure or content within the site, the students were slightly frustrated as the digital platforms felt like a "*puzzle piece* (C3P5)" with "*some stuff in the course profile, some stuff in announcements* (C3P5)" or they "*hide it in the lab book* (C3P3)". The students in this course felt that it could be made clearer. These findings indicate how important the structure of the LMS course site is to students, and while organisations may require certain information to be in other platforms (i.e., course or unit outlines), students expect this information to be replicated within the LMS in easy to follow structures.

Another way students rely on the digital platforms to regulate their learning is to use multiple forms of resources to address any gaps or any deficits in provision of content. This is evidenced in the following exchanges between the students in Course 1 who relied on the multiple resources (YouTube, Lecture Capture and lecture slides) provided by the academic to supplement deficits in the provided materials or to follow their own learning styles.

C1P2: *She tries really hard to make sure there's always lot of different-*
C1P4: *Lots of different options*
C1P2: *Lots of different options for you to take home learning, 'cause she obviously understands that people learn differently.*
C1P4: *Yeah, some courses just put up your lecture notes, then if the lecture records well, that's good, and that's it, some lecturers don't put effort into giving you extra resources or more available electronic……her slides are very comprehensive as well, the lecture slides that she uploads. So if you can't actually hear what she's saying on the Capture, you don't understand in the class, you can go back and read them and get all the information you need from her slides.*
Interviewer: *How do you think YouTube particularly helps you learn in this course?*
C1P2: *To pretty much clarify-*
C1P6: *To solidify what you've done.*
C1P3: *Maybe a little of extra detail, if you are really interested.*
C1P5: *'Cause it gives it from a different person's perspective, like if you don't like the way [teacher] actually lectures, then you hear it from someone else who lectures a different way.*

The students in this course were able to overcome the problems in the use of the lecture capture system for review purposes (because the audio was insufficient) by relying on the multiple visual resources provided to them. This aligns with other findings into student digital behaviours that found that students sought external video content to supplement their studies (Henderson, Selwyn, Finger, & Aston, 2015).

Technical knowledge

Technological competencies, of both the staff and the students, were another major theme that emerged from this data when students were asked how technologies hindered their learning. First, students in both Course 1 and 3 talked about the deficiencies with the use of lecture capture by the teachers. The following example shows how important the quality of lecture capture recordings is to the students using these as revision tools.

C1P2: *The lecturer doesn't really know how to use the microphones for things, so the Lecture Capture didn't work at all.*
C1P3: *Hmm, I still don't see that [teacher] ever used microphones.*
C1P4: *Or if you have one that doesn't know how to use them.*
C1P2: *Yeah. She doesn't use the clip on microphones, so when she walks close to the desk it always gets louder, and when she walks away-*
C1P2: *She relies on the in built microphone on the computer.*
C1P4: *Which is fine if you're attending in person. But if you have to rely on so much of the Lecture Capture, it's difficult, I guess.*
C1P 3: *So she'll walk back and the volume goes like, "WhooOOOOMM"*
C3P2: *I think that lecture capture should be a good revision tool. Not using the microphone because you want to wander around is not good enough at the end of the day. You're the teacher, and your students should be able to revise. I know that sounds really hard, but personally, I think it should be a thing.*

The following exchanges highlights how the quality of the lecture capture can also be affected by the other media and strategies that academics deploy during a lecture. In Course 3, it was the way the academic structured their slide presentation.

C3P3: *Yeah, lecture capture are pretty iffy sometimes.*
C3P2: *The slides are always super brief. If you miss anything, you have no idea what the point is of that particular slide like… like It's graph…what am I looking at?*
C3P4: *I might go back to the audio of the …*
C3P2: *Yeah. Then if audio's not up to standard, because like you said, there's no mic, you're left in the dark.*
C3P3: *You've got to try and interpret the graph. At the same time, I do like that method of teaching, because it actually gives a reason to go to a lecture and actually watch her explain the graph, rather than just going and watching some guy reading lecture slides for two hours, when you could have just sat there at home and read the lecture slides.*

In Course 1, it was the academic's use of the whiteboard, which is not captured through the lecture capture system, over using the provided digital overhead projector, which is captured.

C1P6: *Sometimes lecturers draw on boards, and do equations on boards, you can't see that. Sometimes it can really be the key thing that makes you understand it. You gotta be there to see it, or you're at home just listening to it to try and work out what she's doing on the whiteboard, or something like that.*
C1P5: *That's actually a really important point*
C1P2: *In this course, or-*
C1P6: *Well, every course.*
C1P2: *I think it would be better if it became like a compulsory thing for lecturers. 'Cause it's not just her. There's plenty of lecturers that do it.*
C1P6: *Oh, it's every lecturer.*
C1P2: *They should learn how to use the projector.*
C1P4: *That's right next to every computer.*

These examples indicate there is a divide between the academics understanding of how students use these lecture capture recordings to support their learning. The academics' technological knowledge and how this connects to their pedagogies, teaching in digitally-enabled spaces, may be limited and this is impinging on the preferred learning behaviours of the students.

Second, the students also talked about some of their own limitations within the digital learning environment. This theme arose around discussions of the LMS where they exhibited some confusion on how to use the system. A Course 1 student noted how they were "*never told…how to use the* [Blackboard] *site*. *You just have to work it out yourself* (C1S3)". In Course 2, a student stated they found the LMS "*really confusing* (C2P5)". Nevertheless, in both these courses these students also commented on how these particular academics used their sites made it easier for them to navigate the system. These two courses were the ones that had highly structured sites with a strong teaching presence identified throughout the sites at multiple points. As discussed in the previous section, Course 3 students felt their site was a "*puzzle piece* (C3P5)" as they were only provided the University-approved course outline and three lab book documents within their course site. This confirms observations elsewhere (Zanjani, Edwards, Nykvist, & Geva, 2017) of student difficulties with using the LMS and highlights the need to structure and orientate the students to these environments.

Implications for practice

This study aimed to understand the student experience of technology-enhanced learning designs as a mechanism to improve academic design practices. The three themes drawn from the current student data were *sense of engagement, regulating learning* and *technical knowledge*. Drawing on the analysis of these themes three arguments will be presented that could have implications for ongoing practice for academics, academic developers and university administrators.

First, there is a crucial story to illuminate that focuses on the importance of designing coursework to support the best of student behaviours rather than the worst. Students rely on the use of technologies, such as the LMS and other digital resources, to facilitate their on-going engagement with the content and teaching team outside of structured activities (Henderson et al., 2017; Henderson et al., 2015; Russell, Malfroy, Gosper, & McKenzie, 2014). It is in this realm of supporting students review practices that academics can use technologies effectively to support improved learning outcomes. For example, while attendance to lectures may be important and if producing a perfect recording may not be a priority, academics should aim to put things in place to support these review activities in different ways. If academics do not provide these mechanisms students have been found to turn to web resources, such as YouTube, to supplement their learning (Henderson et al., 2015).

Secondly, there is a need to start fostering a common understanding with academics on the meaning of engagement to improve the experience of both participant groups in these learning environments. This was evident in the use of Blackboard Collaborate where the findings highlight that the students do not seem to have the same feelings about the environment that academics do in relation to their engagement in the activity. In terms of the audio (academics) versus chat (students) reliance research reported by Brown, Schroeder, and Eaton (2016) has found that students do find it confusing to divide their attention between the discussions that are occurring on the audio and the chat. As such we can improve our professional development for these environments to support academics to design their Collaborate sessions to make full use of this schism.

Lastly, there may be a need for university administrations to reconsider their central support structures for students when it comes to the "digital campus". The findings in this study support those found by Selwyn (2016), that students are struggling to navigate our digital learning environments. There seems to be an over-reliance on the digital capabilities of our students even though research has found that there are more differences found within age groups than between when it comes to technical skills (Kennedy, Judd, Dalgarno, & Waycott, 2010). This over-reliance means that it seems to fall on individual academics (through their program and course designs) to embed these digital skills and inductions within course sites or learning designs (Russell, 2009; Russell et al., 2014). This can result in a fractured experience for students (Russell et al., 2014) who must then fend for themselves. It is important for administrators and central support structures to take note of this frustration of students and they should start planning more centralised student inductions into their universities' digital learning environments.

Future directions

The research project documented here has provided insight into how the use of student voice can be used to help bridge the divide between academic design practices and the student experience. As higher education institutions move towards more flexible and student-centred approaches to deliver quality learning and teaching it becomes increasingly important that both staff and student voices are heard. A fundamental shift in how these participants view the relationship between pedagogy and technology is needed (Garrison & Akyol, 2009; Garrison & Kanuka, 2004; Kirkup & Kirkwood, 2005; Livingstone, 2012). However, more research is required to understand how these participants understand and interact and inform each other in these technology-enhanced learning environments.

References

Bennett, S., Agostinho, S., & Lockyer, L. (2015). Technology tools to support learning design: Implications derived from an investigation of university teachers' design practices. *Computers & Education*, 81, 211-220.

Bennett, S., Agostinho, S., & Lockyer, L. (2016). The process of designing for learning: understanding university teachers' design work. *Educational Technology Research and Development*, 65(1), 125-145.

Bennett, S., Thomas, L., Agostinho, S., Lockyer, L., Jones, J., & Harper, B. (2011). Understanding the design context for Australian university teachers: Implications for the future of learning design. *Learning, Media and Technology*, 36(2), 151-167.

Brown, B., Schroeder, M., & Eaton, S. E. (2016). *Designing Synchronous Online Interactions and Discussions*. Paper presented at the IDEAS 2016: Designing for Innovation, Calgary, Canada.

Cochrane, T., Black, B., Lee, M., Narayan, V., & Verswijvelen, M. (2013). Rethinking e-learning support strategies. *International Journal for Academic Development,* 18(3), 276-293.

Conole, G., De Laat, M., Dillon, T., & Darby, J. (2008). 'Disruptive technologies','pedagogical innovation': What's new? Findings from an in-depth study of students' use and perception of technology. *Computers & Education*, 50(2), 511-524.

Dondi, C., Mancinelli, E., & Moretti, M. (2006). Adapting existing competence frameworks to higher education environments. In I. M. Labhrainn, C. M. Legg, D. Schneckenberg & J. Wildt (Eds.), *The Challenge of eCompetence in Academic Staff Development* (pp. 19-28). Galway: CELT.

Ellis, R. A., & Goodyear, P. (2010*). Students' experiences of e-learning in higher education: the ecology of sustainable innovation*. New York: Routledge.

Flavin, M. (2012). Disruptive technologies in higher education. *Research in Learning Technology*, 20, 102 - 111.

Garrison, D. R., & Akyol, Z. (2009). Role of instructional technology in the transformation of higher education. *Journal of Computing in Higher Education*, 21(1), 19 -30.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2), 87-105.

Garrison, D. R., Anderson, T., & Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, 13(1), 5-9.

Garrison, D. R., & Kanuka, H. (2004). Blended Learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, 7, 95-105.

Glover, I., Hepplestone, S., Parkin, H. J., Rodger, H., & Irwin, B. (2016). Pedagogy first: Realising technology enhanced learning by focusing on teaching practice. *British Journal of Educational Technology*, 47(5), 993-1002.

Green, D., Phillips, R., Gosper, M., McNeill, M., Woo, K., & Preston, G. (2007). *Green, D. J., Phillips, R., Gosper, M., McNeill, M., Woo, K., & Preston, G. (2007). Staff and student perspectives on web based lecture technologies: Insights into the great divide*. Paper presented at the ASCILITE ICT: Providing choices for learners and learning, Dec 2-5, Singapore.

Henderson, M., Selwyn, N., & Aston, R. (2017). What works and why? Student perceptions of 'useful' digital technology in university teaching and learning. *Studies in Higher Education*, 42(8), 1567-1579.

Henderson, M., Selwyn, N., Finger, G., & Aston, R. (2015). Students' everyday engagement with digital technology in university: exploring patterns of use and 'usefulness'. *Journal of Higher Education Policy and Management*, 37(3), 308-319.

Kali, Y., Goodyear, P., & Markauskaite, L. (2011). Researching design practices and design cognition: contexts, experiences and pedagogical knowledge-in-pieces. *Learning, Media and Technology*, 36(2), 129-149.

Kennedy, G., Judd, T., Dalgarno, B., & Waycott, J. (2010). Beyond natives and immigrants: exploring types of net generation students. *Journal of Computer Assisted Learning*, 26(5), 332-343.

King, E., & Boyatt, R. (2015). Exploring factors that influence adoption of e-learning within higher education. *British Journal of Educational Technology*, 46(6), 1272-1280.

Kirkup, G., & Kirkwood, A. (2005). Information and communications technologies (ICTs) in higher education - a tale of gradualism rather than revolution. *Learning, Media and Technology*, 30(2), 185-199.

Kirkwood, A., & Price, L. (2006). Adaptation for a changing environment: Developing learning and teaching with information and communication technologies. *The International Review of Research in Open and Distance Learning*, 7(2), 1-14.

Kitzinger, J. (1994). The methodology of focus groups: the importance of interaction between research participants. *Sociology of Health and Illness*, 16(1), 103-121.

Koh, J. H. L., Chai, C. S., & Tay, L. Y. (2014). TPACK-in-Action: Unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK*). Computers & Education*, 78, 20-29.

Krueger, R. A., & Casey, M. A. (2000). *Focus groups: A practical guide for applied research*. USA: Sage Publications.

Larkin, H. E. (2010). "But they won't come to lectures..." The impact of audio recorded lectures on student experience and attendance. *Australasian Journal of Educational Technology*, 26(2), 238-249.

Leadbeater, W., Shuttleworth, T., Couperthwaite, J., & Nightingale, K. P. (2013). Evaluating the use and impact of lecture recording in undergraduates: Evidence for distinct approaches by different groups of students. *Computers & Education*, 61, 185-192.

Livingstone, S. (2012). Critical Reflections on the benefits of ICT in Education. *Oxford Review of Education*, 38(1), 9-24.

Macdonald, J., & Poniatowska, B. (2011). Designing the professional development of staff for teaching online: an OU (UK) case study. *Distance Education*, 32(1), 119-134.

McCarney, J. (2004). Effective models of staff development in ICT. *European Journal of Teacher Education*, 27(1), 61-72.

McKenney, S., Kali, Y., Markauskaite, L., & Voogt, J. (2015). Teacher design knowledge for technology enhanced learning: an ecological framework for investigating assets and needs. *Instructional Science*, 43(2), 181-202.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). USA: SAGE Publications.

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record*, 108(6), 1017-1054.

O'Callaghan, F. V., Neumann, D. L., Jones, L., & Creed, P. A. (2017). The use of lecture recordings in higher education: A review of institutional, student, and lecturer issues. *Education and Information Technologies*, 22(1), 399-415.

Roby, T., Ashe, S., Singh, N., & Clark, C. (2012). Shaping the online experience: How administrators can influence student and instructor perceptions through policy and practice. *The Internet and Higher Education*, 17, 29-37.

Rosenberg, J. M., & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): a systematic review. *Journal of Research on Technology in Education*, 47(3), 186-210.

Russell, C. (2009). A systemic framework for managing e-learning adoption in campus universities: individual strategies in context. *Association for Learning Technology Journal*, 17(1), 3-19.

Russell, C., Malfroy, J., Gosper, M., & McKenzie, J. (2014). Using research to inform learning technology practice and policy: a qualitative analysis of student perspectives. *Australasian Journal of Educational Technology,* 30(1), 1-15.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education*, 42(2), 123-149.

Selwyn, N. (2014). *Digital Technology and the Contemporary University: Degrees of Digitization*. UK: Routledge.

Selwyn, N. (2016). Digital downsides: exploring university students' negative engagements with digital technology. *Teaching in Higher Education*, 21(8), 1006-1021.

Shephard, K., Mansvelt, J., Stein, S., Suddaby, G., Harris, I., & O'Hara, D. (2011). Professional development for e-learning: Researching a strategy for New Zealand's tertiary education sector. *International Journal on E-Learning*, 10(4), 461-481.

Swan, K., Day, S. L., Bogle, L. R., & Matthews, D. B. (2013). A collaborative, design-based approach to improving an online program. *The Internet and Higher Education*, 21, 74-81.

Zanjani, N., Edwards, S. L., Nykvist, S., & Geva, S. (2017). The important elements of LMS design that affect user engagement with e-learning tools within LMSs in the higher education sector. *Australasian Journal of Educational Technology*, 33(1), 19-31.

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Using the perceptions of online university students to improve the pedagogy and practice of distance educators: Them helping us to improve IT

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This paper reports on the findings of an investigation into the experiences of undergraduate and postgraduate distance education students from one higher education institution, Avondale College of Higher Education. All of the institution's current students who were enrolled in a distance course or who had previously completed a distance component of their course were surveyed using an online questionnaire. A subgroup of this population also contributed to focus group discussions. Findings from an analysis of the combined data gathered from the online questionnaire and the focus groups were used to inform the institution's professional development (PD) program that supports lecturers to design and teach online courses. Results of the study are outlined in terms of distance students' perceptions about the institution's distance education program, specifically in relation to course structure, interaction and communication, presentation of materials, use of media and design consistency. The paper concludes with recommendations for addressing the weaknesses of online learning programs including both curriculum design and PD strategies.

Introduction

The plight of distance students who typically enrol in online courses to complete their university studies has been reported at length over many years (for example, Cochran, Baker, Benson, & Rhea, 2016; Crampton & Ragusa, 2015; Gaskell & Mills, 2015; Smith, 2006). Similarly, the difficulties encountered by these students have been investigated and debated in varied contexts (for example, Davis, 2001; Niari, Manousou, & Lionarakis, 2016; Tyler-Smith, 2006). While the general benefits and limitations of online education continue to be topics of debate among educators across the higher education sector, the localised needs of distance education within specific higher education institutions are sometimes overlooked in favour of a more generalised set of recommendations. The purpose of the study reported in this paper was to determine the areas of strength and weakness within the distance education program at one specific institution, by giving the students an opportunity to voice their views about their past and current distance education experiences, with the view to modifying distance education courses in the future. In the past, the distance education courses had only been evaluated using the institution's generic end-of-semester evaluation survey and, to date, an in-depth evaluation of the students' experience of these distance courses across multiple programs and years had yet to be conducted. The study outlined in this paper reports on the first investigation at this institution which has specifically targeted distance students.

Background

Distance education courses provide a convenient way for busy people to learn. This premise has resulted in the number of distance programs being offered and, consequently, an increase in the number of students learning through distance education. In 2006, approximately 3.5 million students were enrolled in at least one online course, which was approximately a 10% increase from 2005 (Allen & Seaman, 2007). In contrast, in 2011, the number of students enrolled in an online course was 6.7 million students, almost doubling the number of students taking distance courses in 2006 (Allen & Seaman, 2013). In 2003, 28.3% of higher education institutions were offering online courses. More importantly, the number of distance programs had increased from 34.5% in 2002 to 62.4% in 2012. Simonson, Smaldino, Albright and Zvacek (2014) report that distance education has become an important part of many universities' long-term planning. An interesting trend appeared in the latest study by Allen and Seaman (2017), however. It was found that from 2012 to 2015, the number of students taking distance education courses has actually decreased 3.2%. Allen and Seaman (2017) note a changing situation in which colleges and universities will now be competing for fewer students. If this trends continues, it would make the issue of quality even more important as institutions of higher education try to maintain their distance programs.

When it comes to the quality of distance courses, the record has been mixed. Allen and Seaman (2013) reported that in 2003 "57.2 percent of academic leaders rated the learning outcomes in online education as the same or superior to those in face-to-face" (p. 5). In 2012, that number increased to 77 percent. In spite of the progress made in improving perceptions of online learning, a significant percent of academic leaders – in 2012, 23% - perceive online instruction to be inferior to face-to-face instruction. One of the specific concerns among academic leaders is the higher percentage of students who drop out of online programs compared with face-to-face programs (Bell & Federman, 2013; Patterson & McFadden, 2009; Tyler-Smith, 2006). The lower retention rates in distance programs add to the negative perceptions of distance learning. The academic leaders in the study by Allen and Seaman (2013) indicate that the high dropout rates are a significant barrier to the growth of distance education.

One of the reasons for dropping out may have to do with the impersonal nature of distance education caused by the lack of direct interaction with the lecturer (Perreault, Waldman, Alexander, & Zhao, 2002; Sunal, Sunal, Odell, & Sundberg, 2003). Bollet and Fallon (2002) report, "At this time, our challenge and inspiration is to include an essential human aspect in the further development of e-learning." (p. 44). As a result of the lack of direct interaction with lecturers, problems which are occurring may not be readily identified. These problems may fester and lead to frustration and ultimate disengagement from the lecturer and ultimately the program (Simonson et al., 2014). These problems will continue to haunt a distance education program unless addressed. It is therefore critical for administrators to listen to their students and determine their perceptions of the program.

If distance programs are to improve, it is also critical for administrators to focus upon quality indicators (Moore, Lockee, & Burton, 2002). In Smidt, Li, Bunk, Kochem and McAndrew (2017), the quality of online courses was defined by surveying students, faculty, and administrators who had experience in the online education environment. The open-ended question was asked of them: *How do you define quality in an online course?* The results were analysed using qualitative methods to identify themes. In their report, the researchers focus upon the top seven criteria: comparable rigour, clarity, interaction, meets objectives or outcomes, feedback, availability, and engagement. However, other criteria are also mentioned, such as multiple ways of learning, organisation, and real world application.

Generally, quantitative measures, such as surveys, have been the typical methods used to evaluate the quality of distance education programs. Focus groups have rarely been used (Cochran et al., 2016). In the study by Cochran, et al. (2016) three focus groups were used to evaluate the distance education program within a school of business at a large state university in a southern state in the United States. Eleven undergraduate students who had experience in online learning were asked to identify positive and negative aspects of their online experience at one university. The data were then coded to identify themes. The themes identified included the convenience of online learning, the need for consistency between classes, the need for a calendar to remind students about assignments, mixed feelings about discussion boards resulting from a dependency upon other students to post, the need for faculty to communicate the relevance of assignments to their future careers or lives, and the perception that some of the work was busy work and not important to the focus of the class. The participants' views were mixed when it came to the relative advantages and disadvantages of online versus face-to-face learning, liking the accountability of face-to-face classes, but also liking the anonymity and freedom associated with online learning (Cochran et al., 2016).

Methodology

The participants in the study reported in this paper were students enrolled in a private Christian tertiary institution in the Lake Macquarie district of New South Wales, Australia. Of the 1307 students enrolled at the institution, approximately 288 are currently completing at least one of their courses in distance mode or had previously completed a distance course.

This study employed a mixed methods research methodology (Creswell & Plano Clark, 2011). Quantitative data were collected using an online survey that was developed to measure quality indicators as identified by Smidt, Li, Bunk, Kochem and McAndrew (2017). To delve deeper into the responses from the survey, qualitative data were collected from participants during focus groups. The research processes used throughout the study were driven by the pursuit of answers to the following two research questions:

1. What are students' perceptions of distance learning at Avondale College of Higher Education?
2. What professional development is required to address the weaknesses of the distance learning program at Avondale College of Higher Education, as identified by the students' perceptions?

The whole cohort of distance students was invited to complete a survey online. The survey was designed to identify the areas of strength and weakness in the way distance education is currently being facilitated and has been administered at the institution in the past. In the sruvey, students were asked to indicate the percent of classes which fell into different categories, or the percent of classes which fitted various quality indicators

The online survey instrument was developed based upon two previous studies. A first draft of the instrument was created based upon the research by Muilenburg and Berge (2005) which looked at the barriers to online learning experienced by students. Since the focus of the study was upon program indicators, only program-related items were included. Items were expressed as positives. For example, if the barrier was that students were not able to interact with fellow students, the item would be expressed as the extent to which the courses within the program promoted interactions among students. Subsequently, the survey instrument was then revised to include program quality indicators, as derived from Smidt et al. (2017). Students were asked to rate the extent to which the program addressed those quality indicators.

The survey responses were entered into and analysed using the Statistical Package for the Social Sciences (SPSS). As part of the data analysis process each of the items' means and standard deviations were calculated. Because much of the data were skewed, the median was calculated as well. As directed by the distribution of the means or medians, the items were then ranked in order from lowest to highest. According to this ranking, strengths and weaknesses of the distance courses at this institution were evaluated.

Following the analysis of the responses collected from the surveys, focus groups were facilitated to which all of the 40 students who indicated their willingness to contribute to a focus group were invited. These focus groups, conducted in person and online through video conferencing, were centred around four main issues:

1. whether the participants perceived the strengths and weaknesses identified in the surveys to be valid;
2. whether the participants could provide examples of incidents that illustrated confirmed areas of strength or weakness in the distance program;
3. whether the participants were able to identify ways to address each of the identified areas of weakness; and
4. recommendations from the participants to maintain what they had confirmed to be the institution's areas of strength. The discussions that took place in relation to these questions were recorded and transcribed.

In general, the data analysis process used to analyse and code the focus group transcriptions followed many of the procedures used in Cochran, Baker, Benson and Rhea's (2016) study in which focus groups were facilitated to gain a rich understanding of student perspectives about their online learning experiences.

Initially, the qualitative data from the focus groups were analysed by identifying the major themes that emerged from the participants' comments. Also, the reported strengths and weaknesses about the institution's distance education program were grouped into sub-themes and analysed in relation to the study's research questions and aims. This grouping of the strengths and weaknesses of the institution's distance program formed the major categories under which the professional development recommendations were presented. The professional development recommendations themselves were also derived directly from the findings of the data analysis process. For example, one of the weaknesses identified in distance courses was the lack of clarity about the current week's course materials. The wording of identified weakness was thus reversed and converted to an instruction of what teachers *should do*, rather than what they *should not do*. As a result, the recommendation was worded as follows: "provide weekly context of where students are in the overall instructional process". Using the results of these data analyses, a set of recommendations for the professional development (PD) of course designers and online teachers was identified.

The PD recommendations outlined later in this paper are currently being embedded into the institution's PD program which comprises resources, activities and events. In each of these components of the PD program, the PD recommendations reported in this paper have been used to guide the practical development and design of the PD program components. For example, the recommendation that cites the importance of locating key assessment task information in an obvious location in an online course has become one of the outcomes of an assessment-related workshop. Furthermore, instructions and suggestions for how to ensure distance students do not feel like "second rate" students are being incorporated into one of the PD program's key online resources, known within the institution as *Moodle's Little Helper.*

Findings: students' perceptions of distance learning at Avondale College of Higher Education

Answers to the first research question of the study (What are students' perceptions of distance learning at Avondale College of Higher Education?) were sought through analysis of the quantitative data collected from the online survey and the qualitative data gathered during the focus groups. Firstly, the quantitative data from the online survey were analysed.

Initially, 288 students were surveyed. Out of 288 students, a total of 80 students responded to the online questionnaire. However, the responses of 14 respondents were eliminated because they reported that they had not taken a distance course, reducing the actual number of possible respondents to 274. In addition, the responses of ten respondents were eliminated who did not respond to at least 50% of the items on the questionnaire. A total of 56 respondents remained, representing a return rate of about 20% out of the population of 274 possible respondents. The larger majority, about 91% of the 56 viable survey respondents, indicated that they were currently enrolled in a distance course at Avondale and the large majority, 54%, had completed or almost completed six or more distance courses at Avondale, while 39% had completed or almost completed two to five courses. Overall, these response rates indicated that these student-participants were qualified to evaluate the program. While it was hoped for a higher response rate, it should be noted that studies "over the past decade have concluded that the response rate of the survey may not be as strongly associated with the quality or the representativeness of the survey as had been generally believed" (Johnson & Wislar, 2012, p. 1805). Other studies (Holbrook, Krosnick, & Pfent, 2007; Keeter, Kennedy, Dimock, Best, & Craighill, 2006; Visser, Krosnick, Marquette, & Curtin, 1996) have found little or no difference in the representativeness of surveys with differing response rates. Moreover, the response rate to the survey is moderated and validated by the use of the focus groups.

Initially, the online survey items required students to rate the quality of the courses by indicating the percent of the courses which fell into five categories: 1) excellent; 2) good; 3) fair; 4) poor; and 5) very poor. An overall score for quality was calculated by weighting these percentages, combining them, and dividing by the highest possible score. The categories were given a weighting of 4, 3, 2, 1, and 0, respectively. The average of these overall weighted scores was found to be 75.4%, a standard deviation of 20%, and a median of 77.1%, with the overall scores being negatively skewed.

Respondents were asked to indicate the percent of distance courses which met certain quality criteria. Those criteria can be found in *Table 1*, along with the mean, standard deviation, median, and the sample size upon which the statistics were based. The criteria are ordered by mean and median. Means, standard deviations, and medians are expressed as percentages.

Table 1: Mean, standard deviations, medians and sample size for ratings of quality criteria

Criteria	Mean	St. Dev.	Median	N
Assessments measure instructional objectives	73.9	22.2	80	52
Well organised	71.5	25.7	80	55
Same/higher rigour compared to face-to-face courses	69.3	28.4	80	49
Helped students to think critically	69.2	27.9	77	56
Helped students to apply knowledge to the real world	64.3	27.4	71	56
Actively engaged the student with the subject matter	62.3	31.3	70	56
Facilitated group interactions among the students	49.6	33.0	47.5	52
Accommodated different learning styles	47.9	30.8	50	56

Students were asked about the percent of the lecturers they found personable and accessible. On average, the percent of lecturers they found to be personable was 86.8% with a standard deviation of 19.0%. The median was 95%. With regards to accessibility, respondents reported an average of 79.1%, with a standard deviation of 22.4%. The median was 90%. Both responses were negatively skewed.

Only 73.2% of the students believed they had opportunities to collaborative with their fellow students during the units. Those students were asked to indicate the percent of the interactions that were excellent, good, fair, poor, and very poor. These percentages were again weighted, combined, and divided by the maximum possible score. The average of these overall weighted scores was found to be 63.3%, with a standard deviation of 25.0%. The median score was 65.0%. Again, the data were negatively skewed.

The majority of the respondents, 53.6% did not feel close at all to their fellow students; 19.6% and 16.1% reported feeling a bit close or somewhat close.

Respondents were asked in what percent of distance courses at Avondale was the amount of work required too much, too little or just right. Respondents stated that they felt an average of 30.6% of the courses required too much work, an average of 6.2% of the courses required too little work, and an average of 63.2% of the courses required just the right amount of work.

Students were also asked about the Learning Management System (LMS), Moodle, as well as the dependability of the technology that they used in their distance courses. Sixty percent found Moodle to be user-friendly or very user-friendly, while 40% found it not user-friendly. 82% found the technology to be dependable or very dependable.

Students were asked about the quality of the instructional materials used by lecturers in the distance courses. Students were asked to determine the percent of the materials that fell into the categories excellent, good, fair, poor, and very poor. An overall score was calculated by multiplying each percentage by its respective weight, adding them together, and dividing by the maximum possible score, as was done previously. The mean of these overall weighted scores was found to be 77.2%, with a standard deviation of 20.2%. The median was 80.8%.

Students were asked how helpful the assistance provided by the distance lecturer(s) was when they had a question. Overall, an average of 87.9% of the respondents found the assistance to be very helpful or helpful. The medians were 70% and 20% respectively. Students were also asked about their perception of the quality of the feedback provided by lecturers to the work they submitted to distance courses at Avondale. They were asked to indicate what percent of time the quality of the feedback was excellent, good, fair, or poor. On average, 82.3% of respondents found the feedback to be excellent or good. However, on average, 11.5% of the respondents found it fair, and 6.1% found it to be poor.

Students were asked about their perception of the timeliness of the feedback provided by lecturers on work completed in distance courses. On average, 55.4% of the time the feedback was timely, 29.6% it was somewhat timely, and 15.0% of the time is was not timely at all.

As well as analysing the quantitative data, gained from the online questionnaire, students also offered views about their distance learning experiences by contributing by focus groups. The questions in the focus group discussions were developed by analysing the quantitative data gathered from the students' responses to the online surveys. Furthermore, following the lead of Cochran et al. (2016), students were specifically asked about the positive and negative aspects of their experiences as distance learners. In total, seven focus groups (including three on-campus and four online focus groups) were facilitated including a total of 16 students who had been enrolled for between one and nine years. Some of the students had been enrolled in undergraduate courses and some had been enrolled in postgraduate distance programs. Each focus group lasted from 30 to 60 minutes. To ensure that the participants' facial expressions and gestures were visible, the online focus groups were conducted using a video-conferencing program, Skype for Business. An initial analysis of the transcriptions of the focus group data generated a set of major themes that reflected the distance students' perceptions of learning online (Figure 6).

Figure 6: Word cloud of major themes from focus groups

During the focus group, many of the students commented on the need for more consistency across different courses:

> "I feel like there's not much consistency across the board between teachers. There's not a lot of consistency between what is posted online. Some just post audio, some just post websites, some post videos of themselves talking, some post just their slides."

Interestingly, many of the students recognised the lecturer's plight in terms of workload and difficulty in meeting the many different learning needs of their students, as well as juggling conflicting requirements of students, the institution and their own personal life. Comments such as the following reflected their awareness of these issues:

> "You've also got to think of the lecturer's time. It would be so difficult to be a lecturer and accommodate everyone's needs".

> "Obviously there's been a lot of work put in from the lecturer's side of it."

Despite their ability to view multiple perspectives of the stakeholders in distance education, the distance students who participated in the focus groups were quite firm in their resolve not to be seen as "second class students", "second rate" or "invisible" due to their choice to study by distance and, consequently, through online means. They appeared very aware of the differences between the online courses and the on-campus courses, some of which they saw as necessary in order to meet the needs of the students who studied in these two different modes.

Once the major themes were identified in the focus group data, further analysis was conducted to determine the students' perceived strengths and weaknesses of the distance courses in which they had been or were currently enrolled. Two samples of the positive-negative matrix created from each focus group, based on the methodology used by Cochran, et al. (2016), is illustrated below (Figure 7). This method was applied to each of the seven focus groups.

FOCUS GROUP NO. 1	
Positives	**Negatives**
Availability of online forums	Felt alone and isolated
Hearing the lecturer's voice (audio or video)	Lack of communication from lecturer
Weekly checklists are helpful	Over assessed
Early availability of course materials	Lack of consistency across subjects
Audio feedback regarding assignments	Challenging and frustrating
Synchronous sessions with lecturer/ students	Lack of contact with other students
Chunking of tasks	Difficulties in setting up groupwork schedule

FOCUS GROUP NO. 2	
Positives	**Negatives**
Flexibility	Lack of accountability of other students
Active learning encouraged	Piecemeal structure of some courses
Use of reflective learning activities	Quality of audio files need improvement
Support service staff helpful (IT, Library, Tutoring)	Too much reading material (little media)
Learning Management System worked well	Lack of communication from other students
Sequenced flow of activities and materials	Not made aware of wider services

Figure 7: Samples of positive-negative analysis matrix from two focus groups

When the transcription data from all seven focus groups were analysed, the three most frequently mentioned positive features of Avondale's online distance program included the flexibility offered by distance learning, the welcoming and approachable ways in which teaching staff fielded students' inquiries and the engaging, relevant, applicable nature of the course materials. These themes were illustrated through the students' comments such as the following:

> "I've just found everyone in all the subjects are all great."
>
> "Contact with the lecturers has been very good. They respond promptly. Like, I sent an email on Sunday and didn't anticipate that I'd get a response but I did. Like, 15 minutes later, I was very impressed!"
>
> "It's important to make the distance students feel part of the Avondale community which, in general, I feel that I have been included."
>
> "I would never have been able to do this if it wasn't online."
>
> "I felt very engaged with all my subjects."

While many of the students described their distance learning experiences as positive overall ("Overall, a positive experience" and "Generally, very good"), there were a number of areas that required improvement, such as the need for the use of more audio and visual media to highlight the teacher's presence, greater use of online communication tools to facilitate interaction and the need for some form of consistency in course structure across subjects. These themes were illustrated by comments from the students, such as the following:

> "It would be nice to see a bit more consistency in the look of the different Moodle sites for each subject. It seems like you are aiming towards more consistency. Some of the sites that I've accessed this semester have got a little tool bar at the top … there are different links that you can click on to access different materials."
>
> "I learn in chunks. For me, if it's broken down into smaller lectures or a lecture and a reading, I manage better. I learn better that way."

Interestingly many of the students appeared to conceive of online teaching as the provision of online lectures and, conversely, online learning as the viewing or consuming of online lectures. Although there was an awareness of the value of engaging in learning activities and meaningful tasks, their conceptions of learning and teaching were still largely focused on a traditional model of pedagogy.

After the students' perceptions of distance learning were identified, these were used to identify answers to the study's second research question (What professional development is required to address the weaknesses of the distance learning program at Avondale College of Higher Education, as identified by the students' perceptions?). This research question is now answered.

Findings: Professional development recommendations

Emerging from analyses of the quantitative and quantitative data, and the triangulation of these two sources of data, a set of professional development (PD) recommendations were developed. To ensure these PD recommendations were closely linked to the current PD program which is in operation in the institution, these recommendations have been categorised according to previously identified PD recommendations related to another online teaching research project which has been operation at the institution since 2010. The previous PD-focused research project focused on the identification of threshold concepts of online teachers (Northcote, Gosselin, Reynaud, Kilgour, & Anderson, 2015; Northcote et al., 2017; Northcote, Reynaud, Beamish, Martin, & Gosselin, 2011). Consequently, the PD recommendations developed from this project were classified into the following three classifications: 1) preparation and course design; 2) online presence; and 3) interaction and relationships. To ensure that the recommendations that were yielded from this recent research project were embedded into the PD program already in operation, it was decided to categorise the recently identified PD guidelines into these three categories, as outlined in Table 2.

The more detailed sub-themes, often represented by participants as commentary about what *should* be done and what *should not* be done in a semester of teaching and learning, were used to develop the actual PD recommendations within the three PD categories. These practical recommendations have been designed to meet the specific needs of the current academic teaching staff, especially in relation to designing and teaching online distance students at the institution from which the data were gathered.

Although some of the PD recommendations outlined in Table 2 have been reported elsewhere in online education literature, these recommendations have been derived directly from practising online teachers and currently enrolled higher education students. Whereas many other published sets of PD recommendations for online teaching and course design represent the views of experts or experienced online educators, the recommendations outlined here represent students' *and* teachers' views from within the same institution. Furthermore, when viewed as a set of recommendations and in light of the bulk of recommendations related to preparation and course design, they confirm the value of the work completed by online educators during the preparation time before a typical semester begins.

Table 2: Professional development recommendations for distance education lecturers

PD category	PD recommendations
Preparation and course design	When assisting lecturers to developing materials, the allocation of reading material should be interspersed with the presentation of audio or video materials. PD programs should include instruction to lecturers about how to: • "chunk" learning materials into manageable sections; • where to locate key assessment task information in an online course; • consider students' views about difficulties they encounter when new material is added to the course without notification; • use signposts to highlight the current week of the course; • provide weekly context of where students are in the overall instructional process; • ensure learning materials are aligned with assessment tasks; • coordinate due dates of assessment tasks across and within courses; • promote self-determined learning strategies (e.g., self-paced checklists); • ensure students feel they are accountable to complete learning activities *and* assessment tasks; and • implement strategies that enable immediate or quick feedback.
Online presence	Lecturers need to be taught techniques for promoting online presence of themselves (Garrison & Cleveland-Innes, 2005) as well as online presence of other students. If forums are recommended for use in online distance courses, course designers and lecturers require PD in how to promote higher level thinking and develop a sense of community by using forums.
Interaction and relationships	PD programs should include instruction to lecturers about how to: • promote social student-student and student-lecturer interactions; • develop meaningful group work activities and/or assessment tasks; • ensure distance students do not feel like "second rate" students; and • convey interest in distance students and their learning.

Discussion

Although used as one of the data collection methods in this study, the use of questionnaires is not fully sufficient to comprehensively investigate the “state of play” of an institution’s distance learning program. As with the work of Cochran et al. (2016), this study also used focus groups to gather data purposely to evaluate online distance programs; this approach has not yet been used extensively for this purpose. Furthermore, this study adopted a mixed methods design, as advocated by Bozkurt et al. (2015) when researching distance education, and also targeted a mix of both undergraduate and postgraduate students.

While the findings of this study reinforced some of the results of previous studies, there were also differences. While some of the participants in the study by Cochran et al. (2016) reported viewing the requirement to contribute to online forums as “busy work”, not related in a meaningful way to the overall course intentions, the participants in the study reported in this paper offered more varied perceptions of the purpose of forum activities. While they did acknowledge some of the challenges associated with forums, they recognised their value in providing opportunities for student interaction. They also noted that forums presented opportunities to develop critical thinking skills by reacting to other students’ thought processes. The participants acknowledged that student interactions within forums could assist in the development of a learning community and could also develop social presence, as identified by Akyol and Garrison (2008). As such, this study provides evidence of students recognising the link between interaction and critical thinking, the value of which has previously been reported from distance educators’ points of view (Bullen, 2007).

Although many previously reported studies have suggested that online or distance learning has been perceived as negative (Allen & Seaman, 2013; Parker, 2008), the students in this study have largely reported a positive experience, even in relation to some issues which have sometimes been reported negatively in previous research. In comparison to previously reported studies on the value of interaction in online courses (for example, Dawson, 2006; Salmon, 2013), the students in this study recognised the usefulness of interacting online with others for learning purposes. In addition, they acknowledged the role of interactive online communication with both lecturers and other students, even expressing acknowledgement about the value of group work tasks especially when they incorporated collaborative strategies that promoted learning.

Interestingly, although most of the students in the study reported on their perceived recognition of the value of interaction, communication, authentic learning and relevant materials, the lens through which they viewed teaching and learning was still very much tinged by an underlying dual understanding of *teaching as lecturing* and *learning as absorbing lectures*. According to those who have previously categorised conceptions of teaching and learning (Gow & Kember, 1993; Marton, Dall'Alba, & Beaty, 1993) from remembering information through to changing as a person, this lens represents quite an underdeveloped view of teaching and learning. From a PD perspective, this finding suggests that, like on-campus educators, distance educators have a responsibility to convey more sophisticated models of education to students, beyond the traditional views of delivering and receiving information.

While the use of focus groups can be useful in elaborating upon quantitative research results, as has been done in this paper, a note of caution needs to be introduced. In the context of the current study, focus groups were used to understand our students’ experiences in their education. While this information is important, it should not be used as the only determinant of the content and methods of our educational practices. Because students are viewing education from their limited perspective, they do not always see the big picture. Our educational practices should be driven by an overarching conceptual model which considers the needs and input of students. Thus, the results of focus groups research need to be interpreted within the contexts of that conceptual model. Focus groups should be used to determine if the conceptual model is being used or implemented appropriately. For example, the students’ need for structure might be balanced with the benefit of accepting a degree of uncertainty which can promote higher-level thinking (Cochran et al., 2016).

Conclusion

The study reported in this paper investigated distance students’ perceptions of their previous or current courses, especially in terms of strategies that they viewed as being negative or positive. An online survey and focus groups were used to gather rich and important sources of information about one institution’s distance education programs. Together, the data gathered from these two sources provided evidence-based insights into students’ perceptions of their distance learning experiences. These perceptions were further interpreted to develop PD recommendations to assist lecturers become effective course designers and teachers of online courses. The PD recommendations offered in this paper should not be interpreted as generalisations, rather, faculty members need to interpret these PD recommendations and decide whether or not to apply them to their own context.

As reported in the data gathered throughout this project, students valued media-rich materials that address multiple learning styles. Video and audio materials, and the use of social media can also be utilised to promote a sense of lecturer presence and student presence, and can as such serve to personalise the learning materials of the course. Lastly, online learning cannot simply be the process of impersonally conveying information. The relationship between the student and the online/ distance lecturer still plays a critical role in the success of online education programs.

During the next few months, the researchers plan to replicate this study within the context of a public university in the US, West Chester University of Pennsylvania. The results of the data gathered from the two institutions will then be compared and used to develop and share common PD resources with the aim of supporting the development of online teachers in both institutions. The authors welcome other educators to trial and implement the methodology outlined in this paper to determine the needs of distance learners in their own higher education institutions.

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References

Akyol, Z., & Garrison, D. R. (2008). The development of a community of inquiry over time in an online course: Understanding the progression and integration of social, cognitive and teaching presence. *Journal of Asynchronous Learning Networks, 12*(3-4), 3-22.

Allen, I. E., & Seaman, J. (2007). Online nation: Five years of growth. Needham, MA: The Sloan Consortium.

Allen, I. E., & Seaman, J. (2013). *Changing Course: Ten Years of Tracking Online Education in the United States*. Needham, MA: Sloan-C.

Allen, I. E., & Seaman, J. (2017). Digital learning compass: Distance education enrollment report 2017. Babson Park, MA: Babson Survey Research Group, e-Literate, and WCET.

Bell, B. S., & Federman, J. E. (2013). E-learning in postsecondary education. *The Future of Children, 23*(1), 165-185.

Bollet, R. M., & Fallon, S. (2002). Personalizing e-learning. *Educational Media International, 39*(1), 39-45.

Bozkurt, A., Akgun-Ozbek, E., Yilmazel, S., Erdogdu, E., Ucar, H., Guler, E., Goksel-Canbek, N. (2015). Trends in distance education research: A content analysis of journals 2009-2013. *The International Review of Research in Open and Distributed Learning, 16*(1).

Bullen, M. (2007). Participation and critical thinking in online university distance education. *International Journal of E-Learning & Distance Education, 13*(2), 1-32.

Cochran, J. D., Baker, H. M., Benson, D., & Rhea, W. (2016). Business student perceptions of online learning: Using focus groups for richer understanding of student perspectives. *Organization Management Journal, 13*(3), 149-166.

Crampton, A., & Ragusa, A. T. (2015). Exploring the role of technology in fostering sense of belonging in students studying by distance. Sydney: Office for Learning and Teaching, Department of Education and Training.

Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage.

Davis, A. (2001). Athabasca University: Conversion from traditional distance education to online courses, programs and services. *International Review of Research in Open and Distance Learning, 1*(2), 1-16.

Dawson, S. (2006). A study of the relationship between student communication interaction and sense of community. *The Internet and Higher Education, 9*(3), 153-162. doi: 10.1016/j.iheduc.2006.06.007

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education, 19*(3), 133-148.

Gaskell, A., & Mills, R. (2015). The quality and reputation of open, distance and e-learning: What are the challenges? *Open Learning: The Journal of Open, Distance and e-Learning*, 1-16. doi: 10.1080/02680513.2014.993603

Gow, L., & Kember, D. (1993). Conceptions of teaching and their relationship to student learning. *The British Journal of Educational Psychology, 63*, 20-33.

Holbrook, A., Krosnick, J. A., & Pfent, A. (2007). The causes and consequences of response rates in surveys by the news media and government contractor survey research firms. *Advances in telephone survey methodology*, 499-528.

Johnson, T. P., & Wislar, J. S. (2012). Response rates and nonresponse errors in surveys. *Jama, 307*(17), 1805-1806.

Keeter, S., Kennedy, C., Dimock, M., Best, J., & Craighill, P. (2006). Gauging the impact of growing nonresponse on estimates from a national RDD telephone survey. *Public Opinion Quarterly*, 759-779.

Marton, F., Dall'Alba, G., & Beaty, E. (1993). Conceptions of learning. *International Journal of Educational Research, 19*, 277-300.

Moore, M., Lockee, B., & Burton, J. (2002). Measuring success: evaluation strategies for distance education. *Educause Quarterly, 25*(1), 20-26.

Muilenburg, L. Y., & Berge, Z. L. (2005). Student barriers to online learning: A factor analytic study. *Distance Education, 26*(1), 29-48.

Niari, M., Manousou, E., & Lionarakis, A. (2016). The pygmalion effect in distance learning: A case study at the Hellenic Open University. *European Journal of Open, Distance and E-learning, 19*(1), 36-52.

Northcote, M., Gosselin, K. P., Reynaud, D., Kilgour, P., & Anderson, M. (2015). Navigating learning journeys of online teachers: Threshold concepts and self-efficacy. *Issues in Educational Research, 25*(3), 319-344.

Northcote, M., Gosselin, K. P., Reynaud, D., Kilgour, P., Anderson, M., & Boddey, C. (2017). Reversing the tyranny of distance education: using research about threshold concepts to humanise online course design. In M. Northcote & K. P. Gosselin (Eds.), *Handbook of research on humanizing the distance learning experience* (pp. 232-255). Hershey, PA: IGI Global.

Northcote, M., Reynaud, D., Beamish, P., Martin, T., & Gosselin, K. P. (2011). Bumpy moments and joyful breakthroughs: The place of threshold concepts in academic staff development programs about online learning and teaching. *ACCESS: Critical Perspectives on Communication, Cultural & Policy Studies, 30*(2), 75-90.

Parker, N. K. (2008). The quality dilemma in online education revisited. In T. Anderson (Ed.), *The theory and practice of online learning* (2nd ed., pp. 305-332). Athabasca University, Edmonton, AB: AU Press.

Patterson, B., & McFadden, C. (2009). Attrition in online and campus degree programs. *Online Journal of Distance Learning Administration, 12*(2), n2.

Perreault, H., Waldman, L., Alexander, M., & Zhao, J. (2002). Overcoming barriers to successful delivery of distance-learning courses. *Journal of Education for Business, 77*(6), 313-318.

Salmon, G. (2013). *E-tivities: The key to active online learning* (2nd ed.). London and New York: Routledge.

Simonson, M., Smaldino, S., Albright, M., & Zvacek, S. (2014). *Teaching and learning at a distance*. Charlotte, NC: Information Age Publications.

Smidt, E., Li, R., Bunk, J., Kochem, T., & McAndrew, A. (2017). The meaning of quality in an online course to administrators, faculty, and students. *Journal of Interactive Learning Research, 28*(1), 65-86.

Smith, L. M. (2006). Best practices in distance education. *Distance Learning, 3*(3), 59-66.

Sunal, D. W., Sunal, C. S., Odell, M. R., & Sundberg, C. A. (2003). Research-supported best practices for developing online learning. *The journal of interactive online learning, 2*(1), 1-40.

Tyler-Smith, K. (2006). Early attrition among first time eLearners: A review of factors that contribute to drop-out, withdrawal and non-completion rates of adult learners undertaking eLearning programmes. *Journal of Online Learning and Teaching, 2*(2), 73-85.

Visser, P. S., Krosnick, J. A., Marquette, J., & Curtin, M. (1996). Mail surveys for election forecasting? An evaluation of the Columbus Dispatch poll. *Public Opinion Quarterly, 60*(2), 181-227.

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Competence-based assessment and digital badging as guidance in vocational teacher education

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Digital pedagogy means applying new technologies to teaching and learning in online, hybrid and face-to-face learning environments. Digital open badges, a set of micro-credentials, support equal and egalitarian competence-based assessment models. Criterion-based digital badging combined with gamification promise learning solutions that have the potential to improve learning outcomes substantially. The aim of this study is to investigate how a competence-based assessment process in an open badge management system enhances learning and guides students to improved learning outcomes. The theoretical framework is focused on concepts of gamification and instructional badging.

Data were collected in 2016 from group interviews (n=6) of trained Finnish professional teachers (n=17) along with students in vocational teacher education (n=12) who earned 645 badges over one year in the Professional Development (PD) program, Learning Online.

Inductive thematic analysis revealed several significant features of competence-based assessment and badge management, which reflected the students' individual experiences of the optimal form and frequency of assessments, feedback, guidance and advice. The preliminary results of this study emphasise the importance of open study groups and the option of joining and leaving the learning network freely. Shared expertise and shared learning experiences increase cohesion within freely formed study groups. The results of this study show the challenges and opportunities involved in badge management from the perspective of digital guidance and gamification, providing additional insight into the design and development of badge-driven learning in the future. This paper suggests that researchers should consider using a badge management application as an environment to guide badge-driven learning.

Introduction

Evaluation is often seen as a final (or repeating) stage of the learning process. Competence-based assessment has previously been simplistic; the evidence is evaluated to determine whether the relevant knowledge is possessed, or not (Gonczi, Hager & Athanasou, 1993). Institution-centred assessment management platforms support formative and summative assessment, storing qualitative and quantitative data concerning students' performance (Barrett, 2004). Today, evaluation has increasingly shifted to open online environments; instead of final evaluation, competence-based assessment represents a rather complex learning process. Assessments can include a student's self-assessment, peer assessments, peer group assessments and teachers' assessments of the path towards competencies, in both face-to-face and online learning.

Teachers need skills in digital pedagogy along with discipline-specific digital competencies that enhance innovative teaching and the use of technology (European Commission, 2017). A teacher's role shifts from teaching to planning, guiding, orchestrating and supporting the learning process of students. Evaluation criteria help teachers to specify the knowledge and skills needed for specific grades (Sadler, 2005). Comprehensible criteria and standards of assessment help students to understand their existing competencies and how to deepen them. Digital open badges, as an emerging concept, refer the learner's completion of a certificate, participation in educational process or achievement of a specific competence (Abramovich, Schunn & Higashi, 2013). Digital badges (e.g. Mozilla Open Badges) allow the recognition of excellence in small fractions (Davies, Randall, & West, 2015) and motivate students to continue learning new things (Brauer, Siklander & Ruhalahti, 2017). Digital open badge management platforms, such as Open

Badge Factory (OBF), provide the infrastructure required to create and issue badges. Additionally, badges may be granted based on an application and students will be assessed in relation to the badge criteria and a demonstration or evidence of the competence in question. OBF was not designed to provide a learning environment; however, the integration of badges into an active learning process allows a comprehensive system of assessment supporting learning. In the near future, digital badges may offer criterion-based learning solutions that combine different learning communities and empower alternative ways to acquire knowledge and skills (Knight & Casilli, 2012). Therefore, the aim of this study is to examine and describe how to structure competence-based assessment processes in an open badge management system to guide students to successful learning outcomes.

Theoretical Framework

This paper follows a digital open badge-driven learning process along with an implementation of competence-based assessment that the authors have experienced and observed. The theoretical framework is focused on the concepts of gamification (Deterding, 2015; 2012) and instructional badging (Gamrat, Bixler & Raish, 2016; Reid, Paster & Abramovich, 2015; Ahn, Pellicone & Butler, 2014).

Gamification

Digital pedagogy combines theory with practice, and making with thinking, aiming to foster creativity, play and problem solving among learners (Spiro, 2013). The essential goal of this approach is to encourage participation, collaboration and public engagement, while increasing critical understanding of digital environments.

Gamification as a term originates from the digital media industry (Deterding, Khaled, Nacke & Dixon, 2011). The idea of gamification is to use game elements and techniques in a new context, to motivate users towards desired behaviours, and arousing enthusiasm about online learning similar to the excitement and enjoyment experienced while playing games (Deterding, 2012; 2015). Reid et al. (2015) found that badges are often used to recognise learning and to motivate the learner, as a ‘game-like encouragement’ in non-game and educational contexts. Gamification is based on simple game design elements instead of ludic qualities – the ‘gamefulness’ of gameful design (Deterding, 2015). The reduced complexity of a gamified learning application retains only the simplest components of gamification, e.g. badges, levels, points, and a leaderboard (Deterding, 2012). Developing technologies promote novel possibilities, raising the question of how to combine gamification to digital badging in non-game platforms and contexts.

Instructional Badging

Instructional badges are designed to prompt a learner to demonstrate required competencies; the design of badges, and of families of connected badges, relates to the behaviours instructional designers want to reward and encourage (Reid et al., 2015; Gamrat et al., 2016). However, appropriate pedagogical models and sound instructional design are required to create quality badges. Further, the design processes should be complex and multifaceted to engage the full potential of badges that provide promising solutions in pursuit of a variety of goals. It is useful for learners to understand the constellation of instructional badges and metabadges as a personalised digital pathway of learning to structure their studies (Gamrat et al., 2016; Davies et al., 2015; Ahn et al., 2014). Clear and consistent design of meta-badges supports the visualisation of learning and summarises accomplished learner’s achievements. Gamrat et al. (2016) suggest that badge designers should consider whether learners could personalise their learning pathways using badges from different badge families. The concept of a "choose-your-own-adventure online course" (McDaniel, Lindgren & Friskics, 2012) describes the scale of customisation required for such a learning process and evokes the role of badges in the connected learning ecology, “acting as a bridge between contexts, making these alternative learning channels and types of learning more viable, portable, and impactful” (Knight & Casilli, 2012).

Badge-driven learning on a customised study path consists of instructional modules, badge application process and assessment, which requires a demonstration of competence or other evidence provided by the student (Reid et al., 2015; Brauer et al., 2017). The aim of scalable badges and badge families is similar to gamified constellations, allowing students to reflect on their accomplishments and strengthen their sense of competence and progress (Deterding, 2012). Hierarchical badges provide students with progressively deeper and more complex challenges, similar to progressive obstacles in games. Gamrat, Zimmerman, Dudek and Peck (2014) describe a dual model, with badges and stamps equalling respectively more or less effort. Gamrat et al. (2016) call for a badge design that would offer both granularity and flexibility, to expand the evaluation of the degree of mastery or levels of credentials beyond the most basic level.

The techniques of peer review and automated response have been pursued to solve the large workload of teachers and tutors in badge evaluation (Gamrat et al., 2016). However, experienced peer-reviewers and automatic solutions are both elusive, especially in cases where the desired process for badge applications should include unique claims and evidence (Hickey, Willis & Quick, 2015). It is essential that students receive prompt and precise feedback; meanwhile, automated responses are valued differently than peer-review or professional evaluations (Gamrat et al., 2016). As an answer for rejected badge applications Gamrat et al. (2016) suggest providing feedback or remediation to guide learners towards a second submission. The guidance process in relation to digital open badge-driven learning is a new interest for practitioners and researchers.

Methodology

Research question

The aim of this study is to investigate how to structure a competence-based assessment process in an open badge management system to guide students to enhanced learning outcomes. The research question is, how assessment management on an open badge platform supports pedagogical guidance through gamification? The context of the study is the competence-development continuum of vocational teachers, in particular the identification and recognition process of digital pedagogical competencies.

Context and participants

The context of the study is a competence-based vocational teacher education. Participants were Finnish professional teachers (n=17) and students (n=12) of vocational teacher education, both men and women. They were asked to form groups for the interviews (n=6) based on their achievements in the Learning Online PD program. The investigated Learning Online program offers in-service and pre-service ICT-training for teachers, based on national guidelines and the UNESCO ICT competence framework for teachers. Participants were known to be highly functional online, representing badge earners on every level of the requisite skill set. Learning Online badges visualise the digital pedagogical expertise achieved and help participants to plan and customise their personal development to meet the individual requirements and the needs of working life. Instructional guidance is always related to rejection of badge application to direct the guidance to those who need it the most.

Data

Data were collected in the spring of 2016. Online group interviews (n=6) with in-service teachers (n=17) and student teachers (n=12) provided interview transcripts 439 minutes or 141 pages in length. The interview groups consisted of 3-8 people. A guided group interview gave participants the opportunity to share their own thoughts and reflect on their experiences. Meanwhile, an interviewee chooses the point of view of the story itself, what and in what way he or she tells it. The role of the interviewer is to sustain the debate and encourage the story to be told by presenting additional questions. The interviewer was prepared to ask questions about criterion- and competence-based assessment, learning motivation, and digital open badge-driven learning experience. During each interview, it was verified that all these topics had been discussed in each group. The researcher did not raise questions where the group had already discussed the subject on its own initiative.

Analysis

Research was conducted via data-driven content analysis (Schreier, 2012) using NVivo 11.3.2 software. The unit of analysis was a short expression of words that captured the meaning of an aspect related to learning phenomena. Hierarchically inclusive relationships were analysed in an ongoing comparison, to examine the structure and components of competence-based assessment process in an open badge management system.

Table 1: Coded data compared by sorted data on resulting guidance

Coded data		Result data	
Expressions Total	1224	Nodes Total	291
Cases Total	57	Cases Total	12

The saturation of the data within the coding process reveals what students consider important in the badge-driven learning process from the point of view of guidance. Students' experiences describe how guidance and assessment are related to badge-driven learning, and what kind of online solutions may enhance learning, in addition to guidance of the studies.

As the final outcome the results allow to draft the guidance process related to competence-based assessment within digital open badge-driven learning.

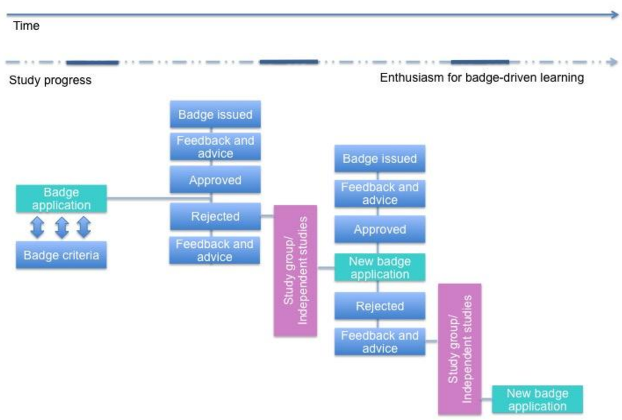

Figure 1: Structure and components of a digital open badge-driven learning process: competence-based assessment and badge management related to guidance

This visual description related to the research question, was revised in a triangulation process to increase the validity of findings.

Preliminary findings

Inductive thematic analysis revealed significant aspects of competence-based assessment and badge management, suggesting how to structure a competence-based assessment process in a digital open badge management system to guide students towards successful learning outcomes. These findings reflect students' personal understandings of the optimal form and frequency of assessment, feedback, guidance and advice. Clear badge criteria are crucial for independent self-evaluation of competencies; guiding learners in how to proceed with respect to demonstrating achieved competencies. In the PD program, Learning Online, trainers provide brief feedback to students who have succeeded in the assignment; guidance resources are allocated mostly to students who do not meet the badge criteria on the first attempt. Nevertheless, students felt that feedback about success was very important. The short personal message was significant, and reminded in-service teachers how good it feels to receive positive feedback.

> How nice it is to get feedback and sense that someone really reads and looks at (one's badge application). You get so much, if there is a comment or a funny line; if there's more than just an automatic response. I do not expect written novels, it would be really horrible, really time consuming, but a precise comment, it's so nice to get it.
>
> *Pre-service teacher on skills set Novice-level I*

> I decided to start giving more personalised feedback for students, as I remembered how good it feels to get feedback.
>
> *In-service teacher on skills set Developer-level III*

Students who failed in the assessment receive more extensive feedback, so they can learn more and further develop the evidence needed to meet the requirements defined in the badge criteria. Students were promised that they would receive the assessment no later than two weeks after their badge application. Students found a maximum of two weeks to be a reasonable time to wait for the evaluation. However, the faster the assessment is completed, the more it supports and inspires learning.

> If it takes two weeks, then it's probably too long. However, the assessment is a sign that the badge has been issued and the competence has been approved. Then you can move forward, since you know that the previous ones have been approved. Like - what's next?
>
> *In-service teacher on skills set Developer-level III*

The feedback received inspires additional study; students intensify their studying following the waves of assessment. Badge earners appreciate this expert guidance and find it important that the evaluators are professional teacher trainers and experts on the subject instead of peers.

> I do not support it (peer review) yet. Yes, I feel that the feedback from the teacher or the tutor was good. I do not rule out peer feedback as an opportunity. But how is it then? You'll have to try. I was grateful that the feedback came from the tutor.
>
> I noticed that the auditor was really accurate that any blog did not do; that was supposed to consist of the things required. And that's good. Reliance on this system increased greatly.
>
> *Pre-service teachers on skills set Novice-level I*

Badge-driven learning enhances progress on customised study paths; guidance is most needed for students who fail the task for the first time. Based on the rejected badge application and the feedback and guidance received, the student continues to learn and continues to develop evidence of their mastery. The feedback provided with the rejected badge application shows the direction of necessary studies, but students must search for the needed information themselves, either in professional development materials or within the study group on Facebook. The results of this study emphasise the importance of an open study group, with the option to join and leave the network freely. Shared expertise and shared learning experiences increase cohesion within freely formed groups of students. The study group provided students with significant new networks beyond institutional boundaries.

Discussion

The aim of this study was to investigate how to structure a competence-based assessment process in an open badge management system to guide students towards improved learning outcomes. The main result is that structured competence-based assessment and badge-driven learning seem to support student guidance and gamification. On the basis of these preliminary findings we now raise the following issues to discuss further.

First, the authors conclude the competence-based assessment and digital badging in an open badge management system as a multifaceted process consisting of the badge-criteria, the badge application and pedagogical guidance. The badge application and assessment process require a demonstration of competence or other evidence provided by the student. The badge-criterion is aimed for the student to provide required information to identify competencies, to self-evaluate the mastery and to support procedures of badge application.

Second, the results of this study have identified that the best opportunity to give appropriate feedback relating to badge rejection, confirming the suggestion of Gamrat et al. (2016) to provide feedback or remediation as guidance for a second submission. This feedback encourages waves of enthusiasm towards learning. It is necessary to look further, to investigate how new, affordable solutions for individual, professional assessment will work. Automated answers are adequate for situations where the student has been successful, but do not provide enough for those needing to resubmit after a rejected application. In light of these preliminary results, peer review seems not to be an option, because students desire experienced professional reviewers.

According to Gamrat et al. (2016), recommended learning pathways “require collaboration between various badge stakeholders”. Self-education and learning by doing should be considered the predominant ways to acquire expertise in the digital age; however, students also appreciate the option of collaborating with their peers in problem solving and learning in general (Lewis, Spiro, Wang & Cawthorne, 2015). We will continue to complement these preliminary results, deepening the theoretical framework of inspiring gamification, because badges seem to work better when the learning is social and networked (Hickey et al., 2015). This also calls for an in-depth review of such concepts as co-regulation, self-regulation and socially shared regulation of learning (Järvelä, Kirschner & Hadwin, 2016); and the game models including achievement goals intended to encourage collaborative rather than individual work (Deterding, 2012).

This paper suggests that future researchers should consider a badge management platform as a guidance environment of badge-driven learning. However, additional research is needed to optimise the assessment process on the badge management platform for student guidance and improvement of learning outcomes.

References

Abramovich, S., Schunn, C., & Higashi, R. M. (2013). Are badges useful in education?: it depends upon the type of badge and expertise of learner. *Educational Technology Research and Development*,61, 2, 217–232. doi: 10.1007/s11423-013-9289-2.

Ahn, J., Pellicone, A., & Butler, B. (2014). Open badges for education: what are the implications at the intersection of open systems and badging? *Research In Learning Technology, 22*. doi: http://dx.doi.org/10.3402/rlt.v22.23563

Barrett, H. (2004). Differentiating electronic portfolios and online assessment management systems. In *Proceedings of the 2004 Annual Conference of the Society for Information Technology in Teacher Education*.

Brauer, S., Siklander, P. & Ruhalahti, S. (in-press). Motivation in Digital Open Badge-Driven Learning in Vocational Teacher Education.

Davies, R., Randall, D. & West, R. E. (2015). Using Open Badges to Certify Practicing Evaluators *American Journal of Evaluation* June 2015 36, 151-163.

Deterding, S. (2012). Gamification: designing for motivation. *interactions*, *19*(4), 14–17.

Deterding, S. (2015). The Lens of Intrinsic Skill Atoms: A Method for Gameful Design. *Human - Computer Interaction 30* (3–4), 294–335. doi.org/10.1080/07370024.2014.993471

Deterding, S., Khaled, R., Nacke, L., Dixon, D. (2011) Gamification: Toward a Definition, *CHI 2011 Gamification Workshop Proceedings*, Vancouver, BC, Canada.

European Commission (2017). Transforming Higher Education: how we teach in the digital age. Teaching in the Digital Age. The ET2020 Working Groups on the Modernisation of Higher Education and Digital Skills and Competences. Retrieved 18.5.2017 https://ec.europa.eu/education/sites/.../files/2016-pla-digital-higher-education_en.pdf

Gamrat, C., Bixler, B. & Raish, V. (2016). Instructional Design Considerations for Digital Badges. Digital Badges in Education: Trends, Issues, and Cases, 71-81.

Gamrat, C., Zimmerman, H.T., Dudek,J. & Peck, K. (2014) Personalized workplace learning: An exploratory study on digital badging within a teacher professional development program. *British journal of educational technology* 45 (6), 1136-1148.

Gonczi, A, Hager, P & Athanasou, J. (1993). *The development of competency-based assessment strategies for the professions*, Research paper (National Office of Overseas Skills Recognition) no. 8, Australian Government Publishing Service, Canberra. Retrieved 30.3.2017 http://hdl.voced.edu.au/10707/104071

Hickey, D., Willis III, J. E. & Quick, J. (2015). "Where Badges Work Better," ELI brief EDUCAUSE: Louisville, CO: June 2015: 2.

Järvelä, S., Kirschner, P.A., Hadwin, A. et al. Intern. J. Comput.-Support. Collab. Learn (2016) 11: 263. doi:10.1007/s11412-016-9238-2

Knight, E. & Casilli, C. (2012). Mozilla Open Badges. In *Game Changers. Education and information technologies*. EDUCAUSE, 279-284. Retrieved 18.5.2017 https://net.educause.edu/ir/library/pdf/pub7203cs6.pdf

Lewis, V., Spiro, L., Wang, X., Cawthorne, J.E. (2015). Building Expertise to Support Digital Scholarship: A Global Perspective. Council on Library and Information Resources Retrieved 18.5.2017 http://files.eric.ed.gov/fulltext/ED560963.pdf

McDaniel, R., Lindgren, R., & Friskics, J. (2012). Using badges for shaping interactions in online learning environments. In *2012 IEEE International Professional Communication Conference, IPCC 2012* [6408619] DOI: 10.1109/IPCC.2012.6408619

Mozilla Open Badges. Retrieved 30.3.2017 http://openbadges.org/

Reid, A. J., Paster, D., & Abramovich, S. (2015). Digital badges in undergraduate composition courses: effects on intrinsic motivation. *Journal of Computers in Education*, *2*(4), 377–398.

Sadler, D. R. (2005). Interpretations of criteria-based assessment and grading in higher education. *Assessment & Evaluation in Higher Education*, *30*(2), 175-194.

Schreier, M. (2012). Qualitative Content Analysis in practice. London: SAGE Publications Ltd.

Spiro, L. (2013). Defining Digital Pedagogy. Presentation. Retrieved 18.5.2017 https://digitalscholarship.files.wordpress.com/2013/03/gettysburgintrodigitalpedagogyfinal.pdf

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Generating learning through the crowd: The role of social media practices in supporting students as producers at scale

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Social media and higher education pedagogy have enjoyed a chequered relationship with significant debates about the efficacy of social media as a site of student centred learning, the manager/host of an individual's learning trajectory and as a tool of facilitating collaborative learning at scale. This paper presents the findings from the evaluation of Constitution UK, an innovative civic engagement and open learning project run by the London School of Economics and Political Science (UK). This was the lead initiative in an institution-wide shift in pedagogical approach, designed to transform the learning experience through supporting students to be co-producers of knowledge. We argue that some of the behaviours inherent in social media learning (centred on fleeting connections, digital identity and discontinuous engagement) can create the conditions for effective learning through experience and practice, both at scale in open, online modes as well in the face-to-face delivery environment. Challenging the dominant pedagogical approaches of other massive online programmes, Constitution UK brought together a civil community of people engaging in the process of digital citizenship that produced a crowdsourced constitution for the United Kingdom. The learning design of the project successfully engineered both learning and problem solving at scale. The key aspects of the project arising from how social media can facilitate critical thinking, engagement, peer and crowd learning have informed pedagogical change within the mainstream provision of the School for initiatives such as Students as Producers, civic engagement over Brexit and games-based learning.

Introduction

Technology and the practices facilitated through it have changed the dynamics of participation and access to higher education, managing and enhancing learning in open spaces whilst creating increasingly fragmented institutional environments (Altbach, Reisberg, & Rumbley, 2009; B. Davis & Sumara, 2009; Ferguson & Sharples, 2014). These changes have been received in higher education institutions with varying degrees of rapture, disruption, acceptance, fear and resistance, at all levels of the organisation (Flavin, 2016; Watty, McKay, & Ngo, 2016). The patterns and responses of resistance to change often make the people who engage in teaching and learning practices that 'stray from the norm' have to justify why they have chosen to innovate their practice (Blin & Munro, 2008; Bryant, Coombs, & Pazio, 2014). The result is often polarised debates about the potentials of technology, the surfacing of tensions around techno-determinism and the fears of staff about replacement and redundancy (Losh, 2014; O'Callaghan, Neumann, Jones, & Creed, 2017; Waltz, 2003). Challenges to the efficacy of implementing strategic pedagogical change through technology have created binary positions and oppositional politics, where technology has been labelled as the enemy of good teaching and the antidote to bad (see e.g. Aagaard, 2015; Bugeja, 2007; Gupta & Irwin, 2016; Mueller & Oppenheimer, 2014; Roberts & Rees, 2014; Rosen, Carrier, & Cheever, 2013; Taneja, Fiore, & Fischer, 2015). Successfully integrating technology and the practices arising from social media into teaching and learning can offer transformative possibilities for programmes, disciplines and institutions (Manca & Ranieri, 2016). Integrating social media practices, for example, into curriculum design and delivery has offered some potential solutions to these challenges, providing opportunities for communication, student co-production, collaboration, engagement and new forms of learning outside of 'traditional' learning platforms (Selwyn, 2012), whilst presenting challenges for educators, exposing issues of learner support, interaction, privacy, identity, feedback and engagement (J. S. Davis, 2016; Dennen & Burner, 2017). Alternately, social media can be used to replicate existing broadcast pedagogies, delivering content in more convenient but less interactive ways (Barnes & Tynan, 2007; Kirkup & Kirkwood, 2005) which can often force students into engaging with social media outside the university ecosystem (Liote & Axe, 2016). What happens when the mode of learning demands more active engagement, where the learner is required to learn through making, to be able to critique and comment on the making of others, to participate within a democratic environment and to share and disseminate their production of knowledge?

Engaging learners in their own learning through social media

In a post-digital world, where the impacts and influences of technology are increasingly normalised, the concept of learning through experience has been transformed (Greenhow, Sonnevend, & Agur, 2016; Kaplan & Haenlein, 2016). Social media, collaboration, knowledge acquisition have changed work, play and life, and those changes are not simply potential or cutting edge, they are impacting on the critical processes of higher education from design through to delivery and assessment. Social media has facilitated a complex, co-created and immediate form of learning, where shared content and openness can challenge the closed, structured nature of modern higher education (Dabbagh & Kitsantas, 2012; McLoughlin & Lee, 2010). More than Facebook and Twitter, social media represents a complex set of interactive, participatory tools and platforms, emerging initially from the notions of web 2.0 (O'Reilly, 2006). Boyd (2014) defines social media essentially as platforms and sites where users can produce and share content. Fuchs (2017) asserts that social media is located and defined by what it means be social and more importantly, what it means to act social.

Social media have afforded the opportunity to embed experiential approaches that support the student to participate actively in their own learning by co-producing content, curriculum, learning and knowledge (Cook-Sather, Bovill, & Felten, 2014; Lee & McLoughlin, 2007; Neary & Winn, 2009). Social media can support more than user interactivity, they support the development and application of user-generated content, collaborative learning, network formation, critical inquiry, relationship building, information literacy, dynamic searching and reflection (Fischer, 2009; Hong, Caldwell, Ashley, & Alpert, 2008; Tapscott & Williams, 2010). Social media spaces are by their nature less structured (or indeed unstructured) and frequently not under the control of a central designer (Chen & Bryer, 2012). They can be democratic, personalised and are capable of facilitating a form of knowledge construction that is organic and collaborative (Hemmi, Bayne, & Land, 2009). They support serendipitous and sometimes fleeting encounters with information (Dantonio, Makri, & Blandford, 2012) where the discovery and identification of knowledge can be instantaneous and distracting. Where learning happens within these spaces, it takes on the attributes of the media itself; autonomous, collective, collaborative, critical and flexible (Tapscott & Williams, 2010). Critically, there is a sense (real or imagined) that the media is owned by the crowd and can be consumed and used in ways that support personal and individual development (Berthon, Pitt, Plangger, & Shapiro, 2012; Piller, Vossen, & Ihl, 2012). Learning through experience is facilitated by virtual communications, immediate responses, agile access to information and a community of people willing to provide crowd sourced opinions, answers and support (Green & Hannon, 2007; Jenkins, 2009; Kukulska-Hulme, 2010). Social media has had significant impacts on the way learners connect with people and with the knowledge they require in order to learn across a variety of contexts (Chen & Bryer, 2012; Ravenscroft, Schmidt, Cook, & Bradley, 2012).

There has been a reaction amongst educators to these challenging behaviours arguing for ways to 'protect' learners from danger, teach them the risks involved with social media use and to regulate how social media can be used by both staff and students in order to be a safe space for teaching (Junco & Chickering, 2010; Peck, 2014; Tennant, Demaray, Coyle, & Malecki, 2015). These behaviours and some of the 'myths' and (mal) practices explain, in part at least, the variable and contentious uptake and use of social media within higher education, with academic professional identity and research dissemination uses outstripping the embedding of social media learning at a curricular level (Chen & Bryer, 2012; Gruzd, Staves, & Wilk, 2012; Veletsianos, 2013). There has been an increasingly polarised debate about the efficacy of social media in teaching at scale, especially in the use of social media that are considered with the personal domain of learners. Perceptions such as the 'creepy treehouse' where students resist academic invasion of the personalised peer space on social media platforms like Facebook (Stein, 2008) and the encroachment of structured learning platforms like the Virtual Learning Environment into social media (Siemens & Weller, 2011) pervade the analysis of practice and challenge the wider acceptance of social media for teaching at scale.

Crowdsourcing the UK Constitution project

In 2015, the LSE launched an innovative civic engagement and open education project that was to become a critical part of the Schools approach to engaging students in their own learning through social media. One of the key intentions of Constitution UK was to leverage and magnify the power of the community and the crowd, to empower learners to engage in civic debate, co-produce learning content and come to a common agreement about the need for and the content of a UK Constitution.

The project ran for fourteen weeks from January 2015 and involved over 1500 community members and groups, who debated the relative merits of competing clauses and then refined them to a manageable number, leading to the writing and voting on an 8000-word constitution from over a million words of debate. Run by the Institute for Public Affairs and the Learning Technology and Innovation team at the LSE, the number of active participants increased through the duration of the project, engaging with individuals and special interest groups on social media and through three Town Hall style events held across the UK. Led by Professor Conor Gearty, the academic component of the project engaged twenty LSE students as moderators, leading ten challenge tasks aligned with key aspects of a constitution (Human Rights, the Monarchy, Powers of Parliament, etc.). Figure 1 shows the interactive components of the platform including the leader board (a gamified way of encouraging and rewarding participation), content about the project for those seeking guidance or context (such as videos), the latest clauses that had been commented on or proposed and a blog for more asynchronous conversations.

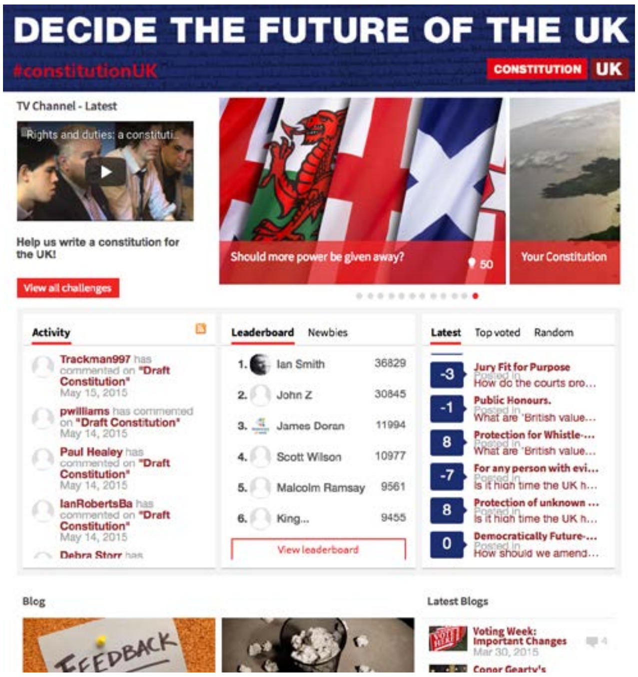

Figure 1: Screenshot of the front page of the Constitution UK platform

The project used a social media platform (Crowdicity) to support effective community-led ideation and learning. It also drew on other social media platforms to recruit community members (blogs, Facebook and Twitter) and to summarise the ever-increasing scope of the debates for new entrants to the project (Storify). The Constitution UK project was designed to facilitate a democratic approach to participation and learning, where knowledge was not broadcast from a 'sage on the stage' but instead, emerged from a community participating in open debate, ideating and solving problems collectively and democratically. It was critical for the project that participants felt safe within the social media space where the project ran, particularly as there would be debates about potentially divisive issues like the monarchy, human rights, immigration and the future of Europe (issues which during the Brexit referendum of 2016 caused significant social and political schisms to emerge) (Lamond & Reid, 2017).

The pedagogical approach was built on the potential that exists in leveraging and magnifying the power of the massive through social media, to empower citizens to engage in debate and identify solutions to what may be intractable, impossible or controversial problems or challenges. The design model drew tacitly on the application of a number of conceptual pedagogical and engagement frameworks such as peer learning (McLoughlin & Lee, 2007, 2010), incidental learning (Marsick & Watkins, 2001), digital pedagogies (McLoughlin & Lee, 2007; Siemens, 2005), crowd learning and ideation (Wexler, 2011) and the use and acquisition of crowd knowledge and crowd value for specific problems (Erickson, Petrick, & Trauth, 2012). As this project was rooted in political science as a discipline and with an outcome rooted in participatory democracy, we drew on well-established social practices such as online civic engagement (Mossberger, Tolbert, & McNeal, 2007), crowd wisdom and collective intelligence (Levy, 2015) and digital citizenship (Ohler, 2010). User stories and a design thinking approach (Meinel & Leifer, 2010) were used to help structure the activities, the learning pathway through the project and higher-level trans-disciplinary skills that would be needed to deliver on the projects ambitions. We were clear in our design that there would not be a linear pathway to participation, learning or finding meaning. The design thinking approach conceptualised the project as concentric, intersecting circles of engagement where ambiguity, redesign and tangible outcomes emerge as ways of participants creating meaning and generating content from debate and interaction.

This was not a traditional educational project, with learning outcomes and an aligned pathway towards mastery or expertise. Instead, we positioned learning as something that was incidental, tacit and exploratory. In this context learning might happen spontaneously and arise out of social structures, experiences or interactions (Johnson, 1999; Knowles, 1970; Marsick & Volpe, 1999). Constitution UK had no specified readings, and no lectures. There was no explicit dissemination of established theory. There was just a series of challenges for the community members and a semi-gamified process of engagement where points were allocated for different forms of participation (ideas, voting, commenting – see Figure 2). The project was informed by the assumption that learning can occur in informal spaces, supported by both peer and academic engagement, but not privileged by either, effectively flipping the role of the academic and academy. There was no defined entry point for the project, members being able to start as soon as they had registered and jump straight in. To that end, the size of the community grew over the duration of the project, with new members still joining in the final week. The project facilitated the creation of publicly visible 'educational situations' within an emerging and often agile democratic dialogue (Andersson & Olson, 2014; Linders, 2012). These situations emerged at non-sequential points within the project, as new users entered, old users bounced in and out and the community embraced and rejected opinion and thought leaders that arose from within the community itself.

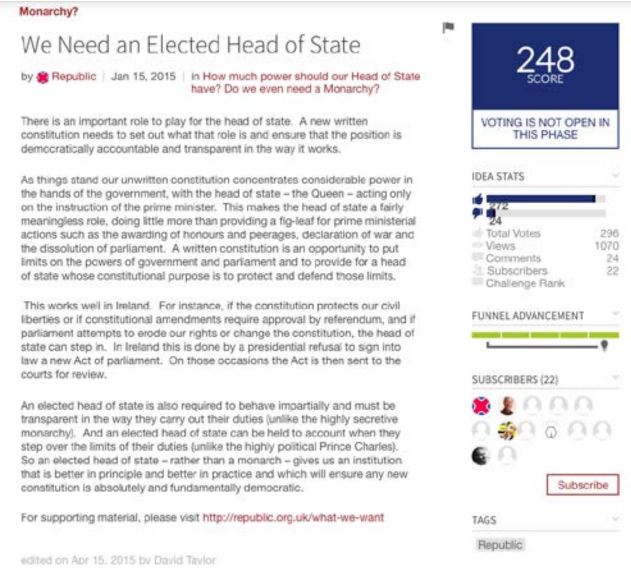

Figure 2: An example of the voting and engagement on the platform

Methodology

Due to the limited amount of analytics that were available through Crowdicity, we surveyed 208 participants in the project (124 of which completed over 70% of the survey) from a total population of 1536 active users. We also conducted qualitative interviews with 24 participants including moderators and members of the project team. The survey consisted of questions that sought to measure learning; the participant's motivations to participate, evaluations of the participation, frequency and length of participation, using Likert scale measurements against variables such as skills and knowledge gained, influence of other learners, attitudinal change, communications and motivation. The quantitative data was then analysed for the correlation between these dependent (learning) and independent variables. The qualitative data was aggregated together and subjected to a summative content analysis which looks for latent meanings within the data (Hsieh & Shannon, 2005). In this instance, the word learning (and its derivations) was used to identify patterns in the data connected to how the participants engaged in meaning making, knowledge acquisition and application (both tacit and explicit). Using what Porter and Hellsten (2014) refer to as participatory dynamics, which explore the modes in which social interaction leads to constructive action on political and social issues such as learning, we used the content analysis to identify behaviors that supported the assertion that learning happened within the project. We also used the data to identify whether the civic objectives of the project (to produce a truly crowd-sourced constitution for the United Kingdom) were achieved. A limitation of this type of analysis is that it relies on the credibility of the use of the words by the participants. We adjusted for this limitation by using the statistical analysis to assess the internal consistency of the link between learning and the ways it was described.

Results

Social interaction and engagement

One of the most critical design objectives for the project was to harness the power of the crowd to collectively solve the problem of writing a constitution. We sought to achieve this through creating a learning community within the crowd, as opposed to a community of individual learners. The organic development of connections and shared behaviours helped create the environment for community members to feel comfortable sharing, to engage in sometimes-controversial debates and most critically, remain civil through the process. The analysis identified three modalities through which the project supported learning and engagement through the sociality inherent in social media; inclusivity of behaviours, facilitation of learning and engagement and civility of discourse.

a) Inclusivity of behaviours

One of the most critical aspects of the learning design for the project was that without lectures or readings, and with a non-sequential path of participation allowing for multiple points of entry and exit, learning needed to emerge from more active and flexible sources than within a traditional online course. The project learning design assumed that our community would be willing to share what knowledge the participants already had (often in the form of opinions) with the community, in an inclusive manner.

For example, the project engaged the community in a debate about the role of the Queen in a future UK society governed by this constitution. We invited representatives from both the Monarchists and the Republicans special interest groups, who each brought to the project a set of principles and knowledge about why the monarchy represents the best (or worst) form of governance for the country. Instead of taking their respective cases to the people through own social media 'echo chamber', we used the platform to present their views to the wider community. We used the mechanism of idea generation to focus the debate around the need to put forward, defend or amend an idea for a constitutional clause. Under that idea, participants could argue for or against, make suggestions for amendments, refine and eventually vote the idea up or down. The views of participants were open to be challenged and tested by those with a different set of views. Within that practice of sharing and defending, some of the most powerful and transformative learning experiences occurred. 88% of participants were influenced by these community-led discussions and 50% of participants stated that working with others directly contributed positively towards their learning. A strong correlation emerged between the skills gained by the participants from the project and the influence that community discussions had on their participation. It was also clear that the positive, engaging nature of these interactions supported the desire to gain skills and knowledge, with 80% of respondents identifying the importance of a positive characterisation of the interactions as important or very important. It was clear that our community learnt through interacting with each other. This association was significantly stronger than the interactions with the participants had the wider academic presence and with the institution-created content, such as summaries, blogs, videos and Twitter.

b) Facilitation of learning

One of the risks of facilitating learning and civic engagement through social media arises from the potential for superficial learning, which manifests itself in processes like slacktivism and clicktivism, where engagement requires nothing more than a click, a like or a name on a virtual petition. Superficial learning in social media is not necessarily a pre-ordained outcome, but can present the illusion of meaningful engagement (Morozov, 2009). A critical role in most social media communities is the role of the moderator in facilitating social interaction and engagement (Kamboj & Rahman, 2016). Moderators can play a supporting or guiding role (Greenhow & Lewin, 2016) or can shape or influence the nature or patterns of the discourse by maintaining or infringing on the distance between the participants and the institution (Carter, Martin, & O'Malley, 2014; Joksimović et al., 2015).

Constitution UK embraced the views of over 1500 people on controversial topics such as the monarchy, human rights, citizenship, democracy and yes, the role of Europe. The community argued, debated, disagreed, came together, refined and voted, moderated in part by the small group of LSE student facilitators. An example in the data set that evidenced the impact of facilitation of learning was the role of the moderators, which evolved over the duration as they became partially engaged community members, participating in debates and in some cases driving the process of refining ideas into a coherent statement to vote on. In some cases, they were perceived as teachers, where community members sought validation or approval from them on specific ideas. In other cases, they simply performed essential maintenance functions like promoting voting, encouraging participation and promoting the various gamified aspects of the project. Overall the impact of the facilitators on learning came out as neutral or slightly negative in the study, with one participant noting:

> *This project belongs to the community not to the facilitators and it was - and is - absolutely wrong to give them the key role of drafting the ideas into a constitution.* (Participant free text comment)

c) Civility of discourse

From the capacity for misinterpretation that arises from text based communications through to the potential loss of deliberation, reflection and potential for increased hostility (Coffey, Kohler, & Granger, 2015), effective civic engagement is both democratised and challenged through social media. Superficial learning has the potential to impact the civility and cohesiveness of the community. This exposure can overcome some of the downfalls associated with clicktivist interactions as well as the dilution of the depth of engagement that can occur through the sometimes ‘narcissistic and attention seeking’ nature of likes (Rahm & Fejes, 2015). Equally, this superficial social engagement can create interactions between participants that can be abusive, discriminatory, offensive or dangerous, either through the impact of this fractured social dynamic or through the toxicity of a single participant (McFarland & Ployhart, 2015).

Whilst in the main, inclusivity and civility drove engagement between the community members (and was represented positively in both the qualitative and quantitative data), when the debate spilt into Facebook, the exact opposite occurred. When a call for participation on Facebook identified the need for greater female participation in the democratic discourse and in parliament (in part to address our own gender bias within the project), a misogynistic argument ensued in the comments, tainted with sexist vitriol, misinformed hate speech and implied threats of violence against women and their ‘sympathizers’, littered amongst some serious attempts at a cohesive debate. On the ideation platform, there were less than a handful of interactions that could have been perceived in the same light. There was some evidence that there were meaningful deeper connections built up between community members, mainly within specific areas of debate. This manifested itself in several deeply experiential ways. Conversations between some community members spanned the entire duration of the project. Issues of critical personal importance such as the rights of EU immigrants, the importance of human rights, discrimination and tolerance were described and argued in the form of personal experiences and were shared widely. Some community members argued they learnt from both the sharing of these stories and the construction of meaning that arose from that sharing.

This was not a universal pattern with the level of regular engagement patchy and the connections made sometimes fleeting (simple comments like ‘agree’ or ‘disagree’, voting up or down or simply reading and following the debate). What we observed through these fleeting connections was what Lewis, Pea and Rosen

(2010) called 'generative learning' where the learning and engagement grew as the project expanded. Within the design, we ensured that the connections being made were not limited by 'rules of engagement' or bounded by a more traditional sequence of topics approach. The delivery of the project was designed to ensure that there was no specified start point and only a logistical end (where the platform would be switched off). There were some process points where the project moved from an ideation phase to a refining of ideas phase with many of the same practices of communication, debate and construction continuing unabated throughout. The project also encouraged participation and learning within a wide spectrum of engagement modes, from idea generation to debate and discussion through to up/down voting on ideas. This created the conditions for a community relatively unbound to each other to act and interact at asynchronous times and perhaps only cross paths fleetingly.

The generative learning emerged where we did not provide formal participation structures of interaction but supported the emergence of interpretive communications (the community formed its own rules) and that people were not restricted to a single topic on offer that week, but could roam or be constrained to whatever scope of topics and debates they felt comfortable with, with one participant noting:

> *…community members were surprisingly good at separating their own views (I voted this idea down) from the broader task (but the community supports it, so what is a workable provision).* (Participant free text comment)

Digital identity and community membership

The capacity of a community to move from simply being a collection of individuals to one that has its own momentum and identity shaped by those individuals is integral to supporting successful civic engagement in a digital age. The characteristics and tropes of social media define the way in which identity can be represented and its influence on the way people behave. The analysis exposed two modalities that explained the relationships between identity and community with the capacity of the project to support learning.

a) Community member identity

Constitution UK project was designed to allow the participants the opportunity to represent themselves in whatever context or construct they felt comfortable with. They were asked for a user name (which did not have to be their own name) and for an email. One of the affordances of social media learning is that online interaction affords both the opportunity to represent ourselves in different and (sometimes) untraceable and hidden ways as well as the ability to express ideas, opinions and emotions that because of the apparent anonymity of the virtual environment, we might be unwilling to do face to face (Stoller, 2013; Williams, Fleming, Lundqvist, & Parslow, 2012). Many participants took user names with historical contexts (*Boadicea, King Richard Third, Titus Alexander*) whilst others used the opportunity to have a user name that represented their political views (*Liberty, LiberalAnne, English Democrat*).

Identity also played into the complexity of the task put before the community. The writing of a constitution is a dense, specialised and sometimes arcane discipline with deep understanding arising from an expertise in history, civics, law and human rights. We identified from previous attempts to crowd-source a constitution that it was very easy to construct an environment where the participants felt like imposters, writing a document in the abstract, almost as an intellectual or gamified experience. In the context of critical reflection, Brookfield (1994) identifies impostership as a reflective barrier to accepting that your engagement and interactions are real and valued, and that you are not an imposter or a fake in the discourse. The risks that the project faced were two-fold, firstly would people outside of those worlds participate and engage on a deeper level (the answer was overwhelmingly yes) and secondly would the community feel they needed to demonstrate a set of behaviours and knowledge to have legitimacy in the discourse and to ensure that the final constitution meant something (or at least had meaning). After the completion of the project, we found that neither of these things mattered to the community. What mattered to them was the process, the engagement in an open and constructive civic debate and the repositioning of academic authority away from the arbiter of legitimate constitutional design.

> *Many other participants were considerably more educated than I am, and I don't usually get the opportunity to attend things like this, while I expect it is more normal for the (large!) group of people who had postgraduate degrees. It was wonderful to be included. (Participant free text comment)*

> *On the whole I found the experience very stimulating and to discover there are a lot of folk out there who are thinking along very similar lines to my own leads me to hope that such exercises are the seed to seeing real change in this country. (Participant free text comment)*

b) Academic identity

Most traditional online courses require a number of delivery roles for the academic; including the teacher, the validator and the facilitator (Goodyear, Salmon, Spector, Steeples, & Tickner, 2001). As noted earlier there was not a strong correlation identified between the role of the facilitators and learning. There was however a strong correlation between the role of the lead academic (represented on the platform generally by weekly videos and interviews) and learning. The lead academic took a relatively passive delivery role, acting not as a validator or facilitator but more as a leader or a guru. A number of participants questioned the potential impact of the 'academic voice' within the platform, arguing that it represented a privilege that diluted the community, whilst others were concerned that the involvement of a university in the process might render the project and its outcomes academic:

> *(I) have noticed there was a tendency to assume only academics could properly understand and assess the issues, a common problem not just with academics but other professionals, we tend to assume it is only our own professions that can really grasp the issues in full. (Participant free text comment)*

> *From the start, the nature of the project was unclear. Was it simply an academic outreach project or was LSE open to the possibility that getting people to write a constitution might launch a serious, popular movement for constitutional reform? (Participant free text comment)*

Problem Solving
The learning design approach of Constitution UK sought to cultivate learning through finding collective and crowd informed solutions to a problem. One of the key assumptions was that to collectively (and successfully) solve that problem, community members needed to bring and apply knowledge, as well as be open to acquiring new skills and knowledge through that process of sharing. This manifested itself in two ways; collective problem solving and supporting solutions through discontinuous engagement.

The idea that learning can be discontinuous, chaotic and self-paced and, critically, allow for self-selected community members to bring to the project a wide variety of schema, learning trajectories and experiences was a key part of the learning design for the project. The learners chose when to engage and when to withdraw, and most interestingly, when to return. Participation was not a linear process. Social media both through its asynchronous engagement and through common use of discussion forum style modes of comment encourages linear debates, where the idea that started the discussion can get lost in a never-ending scroll of conversation. In the end, the problem may never be solved, it just gets exhausted. The learning design for the project positioned the problem to be solved at centre of the process, returning members back to it iteratively and built it into the fabric of the delivery and engagement activity. Ideation, intervention, debate and agreement became tools within the platform that supported collective problem solving.

Community members chose to 'dip in and out' of the project at a variety of different stages, with some returning for voting or for refining to defend or promote their ideas and other orphaning their own ideas to engage with others. There was no penalty for joining late, although there was a task attached (the sheer volume of contributions and the breadth of the debates) which for some was simply too big (around 15% dropped out for this reason). The discontinuity allowed participants the opportunity to enter with an assumption that the solutions had not already been found. During the refining phase (where ideas were aggregated and debated to find some agreed collaborative clauses for the Constitution) we encouraged participants to nuance slightly different approaches to the same problem and have their voice heard, even in the last days. There was no privileging of an idea that had been there since day one or one that had been posted on day 57. Participants could dip in one day and visit their idea or contribution weeks later and encourage people to support it. They could 'orphan' an idea and see others take up the mantle and make the connections they were trying to build. Being a part of the solution was a critical motivation for a majority of participants with the capacity to find different learning pathways within the project especially important. Although interestingly, in terms of participation, the engagement with community peaked at the second to last phase of writing and refining the final document, with the last stage that voted the constitution up or down involving less than 5% of the total users (and narrowly voting the final constitution down).

Conclusions

The use of social media on Constitution UK as both a platform for collective community (or crowd) problem solving and as a site for deep experiential learning threw out a stark challenge to the dominant pedagogical approaches that have been utilised previously across a variety of online and blended projects, especially in terms of learning at scale. We argue that our use of social media has exposed an inherent volatility and tension within higher education, with the complexities of social interaction, the breakdown of logical patterns of subject search and linear consumption of information and the blurred and sometimes dark constructions and representations of identity within social media running counter to the shining idealism (and some would argue blind hype) of MOOCs and face-to-face learning at scale. Much of the discourse has centred on social media as a way of facilitating communications and interaction between individuals and the academy, often described only in terms of the tropes and user experiences of Facebook and Twitter. Constitution UK tested the capacity of social media to integrate learning and citizenship by facilitating innovative pedagogical practices like making, ideation, creation, critique, sociality, connected practice, crowd-sourcing, entrepreneurship, digital citizenship, media making, identity, politics and policy. Not all of these practices were present in the initial design, but as the project grew, they emerged from within the learning community, supported by a civil and inclusive environment.

These practices in themselves work towards redefining what constitutes successful learning at scale. The communities formed by Constitution UK were equally fleeting as they were lasting, large as they were intimate, collaborative as they were individual. The project supported lurkers, talkers, loudmouths, itinerants and the simply curious or aspirational. But through the process of problem solving and civic engagement, the project supported learning, explicit and tacit and expected and unexpected for the clear majority of community members. Constitution UK was a community made up of experts, emerging experts, novices and those members seeking to gain expertise through engagement. There were experts, but they didn't dictate in any way what the community should think. There were novices, people who had never engaged in higher education or political discourse. There were people participating in the project who were advocates for civic engagement but had never thought about a constitution. To that extent, it also challenged the role of the academic as expert and questioned the ways higher education 'does' learning, both as actors and as directors. The 'traditional' constructs and practices that define scaffolded learning, course design and pedagogy and constructive alignment can be flipped to entrust learning to an engaged, creative and critical community interacting through social media and that these participants perhaps did not need to be presented with the beginning, middle and end as a fair accompli.

Finally, this project was the touchstone for a wider ambition to embed similar principles centred on the power of the crowd to support students as co-producers of knowledge and content. The key lessons learnt here that ranged from the critical importance of civility and collegiality through to how to ensure not all knowledge production needs to be equal informed nearly seventy projects since the completion of Constitution UK, from media making through to research informed teaching through to the co-design of transferable skills developments. Our conceptualisation and implementation of how to use social media to harness the power of the crowd has extended into more connectivist approaches of pedagogical design, building on the capacity of social media practices to support engagement across and through wider professional and personal networks, affording even greater opportunities for learning.

References

Aagaard, J. (2015). Drawn to distraction: A qualitative study of off-task use of educational technology. *Computers & Education, 87*, 90-97.

Altbach, P. G., Reisberg, L., & Rumbley, L. E. (2009). Trends in global higher education: Tracking an academic revolution: UNESCO Pub.; Sense.

Andersson, E., & Olson, M. (2014). Political Participation as Public Pedagogy – The Educational Situation in Young People's PoliticalConversations in Social Media *Journal of Social Science Education, 13*(4), 115-126.

Barnes, C., & Tynan, B. (2007). The adventures of Miranda in the brave new world: learning in a Web 2.0 millennium. *ALT-J, 15*(3), 189-200.

Berthon, P. R., Pitt, L. F., Plangger, K., & Shapiro, D. (2012). Marketing meets Web 2.0, social media, and creative consumers: Implications for international marketing strategy. *Business horizons, 55*(3), 261-271.

Blin, F., & Munro, M. (2008). Why hasn't technology disrupted academics' teaching practices Understanding resistance to change through the lens of activity theory. *Computers & Education, 50*(2), 475-490.

Boyd, D. (2014). *It's complicated: The social lives of networked teens*. New Haven, CT: Yale University Press.

Brookfield, S. (1994). Tales from the dark side: A phenomenography of adult critical reflection. *International Journal of Lifelong Education, 13*(3), 203-216.

Bryant, P., Coombs, A., & Pazio, M. (2014). Are we having fun yet? Institutional resistance and the introduction of play and experimentation into learning innovation through social media. *Journal of Interactive Media in Education, 2014*(2), Art. 4.

Bugeja, M. J. (2007). Distractions in the wireless classroom. *Chronicle of Higher Education, 53*(21), C1-C4.

Carter, C. J., Martin, L., & O'Malley, C. (2014). Understanding the social media ecologies of employees within higher education institutions: a UK-based case study. *An Education in Facebook?: Higher Education and the World's Largest Social Network*, 217.

Chen, B., & Bryer, T. (2012). Investigating instructional strategies for using social media in formal and informal learning. *The International Review of Research in Open and Distributed Learning, 13*(1), 87-104.

Coffey, D. J., Kohler, M., & Granger, D. M. (2015). Sparking debate campaigns, social media, and political incivility. *Controlling the message: New media in American political campaigns*, 245.

Cook-Sather, A., Bovill, C., & Felten, P. (2014). *Engaging students as partners in learning and teaching: A guide for faculty*: John Wiley & Sons.

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education, 15*(1), 3-8.

Dantonio, L., Makri, S., & Blandford, A. (2012). Coming across academic social media content serendipitously. *Proceedings of the American Society for Information Science and Technology, 49*(1), 1-10.

Davis, B., & Sumara, D. (2009). Complexity as a theory of education. *TCI (Transnational Curriculum Inquiry), 5*(2), 33-44.

Davis, J. S. (2016). *Building a Professional Teaching Identity on Social Media: A Digital Constellation of Selves*. London, UK: Springer.

Dennen, V. P., & Burner, K. J. (2017). Identity, context collapse, and Facebook use in higher education: putting presence and privacy at odds. *Distance Education*, 1-20.

Erickson, L., Petrick, I., & Trauth, E. (2012, August 9-12). *Hanging with the right crowd: Matching crowdsourcing need to crowd characteristics.* Paper presented at the Proceedings of the Eighteenth Americas Conference on Information Systems, Seattle, Washington.

Ferguson, R., & Sharples, M. (2014). Innovative Pedagogy at Massive Scale: Teaching and Learning in MOOCs *Open Learning and Teaching in Educational Communities* (pp. 98-111): Springer.

Fischer, G. (2009, 15-17 July). *Cultures of Participation and Social Computing: Rethinking and Reinventing Learning and Education.* Paper presented at the 2009 Ninth IEEE International Conference on Advanced Learning Technologies, Riga, Latvia.

Flavin, M. (2016). Technology-enhanced learning and higher education. *Oxford Review of Economic Policy, 32*(4), 632-645.

Fuchs, C. (2017). *Social media: A critical introduction*. Thousand Oaks, CA: Sage.

Goodyear, P., Salmon, G., Spector, J. M., Steeples, C., & Tickner, S. (2001). Competences for online teaching: A special report. *Educational Technology Research and Development, 49*(1), 65-72.

Green , H., & Hannon, C. (2007). *Their space: Education for a digital generation* Retrieved from http://www.demos.co.uk/files/Their space - web.pdf

Greenhow, C., & Lewin, C. (2016). Social media and education: reconceptualizing the boundaries of formal and informal learning. *Learning, media and technology, 41*(1), 6-30.

Greenhow, C., Sonnevend, J., & Agur, C. (2016). *Education and Social Media: Toward a Digital Future*: MIT Press.

Gruzd, A., Staves, K., & Wilk, A. (2012). Connected scholars: Examining the role of social media in research practices of faculty using the UTAUT model. *Computers in Human Behavior, 28*(6), 2340-2350.

Gupta, N., & Irwin, J. D. (2016). In-class distractions: The role of Facebook and the primary learning task. *Computers in Human Behavior, 55*, 1165-1178.

Hemmi, A., Bayne, S., & Land, R. (2009). The appropriation and repurposing of social technologies in higher education. *Journal of Computer Assisted Learning, 25*(1), 19-30.

Hong, C., Caldwell, L., Ashley, T., & Alpert, V. (2008). *Trans-Cultural Perspectives on Digital Practices and the Arts in Higher Education.* Paper presented at the Dance Dialogues: Conversations Across Cultures, Artforms and Practices : World Dance Alliance Global Summit, Brisbane, Australia.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative health research, 15*(9), 1277-1288.

Jenkins, H. (2009). *Confronting the challenges of participatory culture: Media education for the 21st century*. Boston, MA: MIT Press.

Johnson, D. S. (1999). A learning model for learning organizations. *Futurics, 23*(1/2), 74.

Joksimović, S., Kovanović, V., Jovanović, J., Zouaq, A., Gašević, D., & Hatala, M. (2015). *What do cMOOC participants talk about in social media?: a topic analysis of discourse in a cMOOC.* Paper presented at the Proceedings of the Fifth International Conference on Learning Analytics And Knowledge.

Junco, R., & Chickering, A. W. (2010). Civil discourse in the age of social media. *About Campus, 15*(4), 12-18.

Kamboj, S., & Rahman, Z. (2016). The influence of user participation in social media-based brand communities on brand loyalty: age and gender as moderators. *Journal of Brand Management, 23*(6), 679-700.

Kaplan, A. M., & Haenlein, M. (2016). Higher education and the digital revolution: About MOOCs, SPOCs, social media, and the Cookie Monster. *Business horizons, 59*(4), 441-450.

Kirkup, G., & Kirkwood, A. (2005). Information and communications technologies (ICT) in higher education teaching—a tale of gradualism rather than revolution. *Learning, media and technology, 30*(2), 185-199.

Knowles, M. (1970). *The modern practice of adult education*: Association Press New York.

Kukulska-Hulme, A. (2010). Learning Cultures on the Move: Where are we heading? *Journal of Educational Technology and Society, 13*(4), 4-14.

Lamond, I. R., & Reid, C. (2017). The 2016 EU Referendum *The 2015 UK General Election and the 2016 EU Referendum* (pp. 51-59): Springer.

Lee, M. J. W., & McLoughlin, C. (2007). Teaching and learning in the Web 2.0 era: Empowering students through learner-generated content. *International Journal of Instructional Technology and Distance Learning, 4*(10), 21-34.

Levy, P. (2015). Collective Intelligence for Educators. *Educational Philosophy and Theory, 47*(8), 749-754.

Lewis, S., Pea, R., & Rosen, J. (2010). Beyond participation to co-creation of meaning: mobile social media in generative learning communities. *Social Science Information, 49*(3), 351-369.

Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly, 29*(4), 446-454.

Liote, L., & Axe, h. (2016). *LSE 2020: Capturing the Student Voice On the Future of Educational Technology*. Retrieved from London, UK: http://lti.lse.ac.uk/wp-content/uploads/2016/08/LSE2020visionReport-FINAL.pdf

Losh, E. (2014). *The war on learning: Gaining ground in the digital university*: MIT Press.

Manca, S., & Ranieri, M. (2016). Facebook and the others. Potentials and obstacles of social media for teaching in higher education. *Computers & Education, 95*, 216-230.

Marsick, V. J., & Volpe, M. (1999). Informal learning on the job. *Advances in Developing Human Resources, Berrett-Koehler, San Francisco*.

Marsick, V. J., & Watkins, K. E. (2001). Informal and incidental learning. *New directions for adult and continuing education, 2001*(89), 25-34.

McFarland, L. A., & Ployhart, R. E. (2015). Social media: A contextual framework to guide research and practice.

McLoughlin, C., & Lee, M. J. W. (2007). *Social software and participatory learning: Pedagogical choices with technology affordances in the Web 2.0 era*.

McLoughlin, C., & Lee, M. J. W. (2010). Personalised and Self Regulated Learning in the Web 2.0 Era: International Exemplars of Innovative Pedagogy Using Social Software. *Australasian Journal of Educational Technology, 26*(1), 16.

Meinel, C., & Leifer, L. (2010). Design thinking research. *Design thinking: understand–improve–apply. Springer, Heidelberg*.

Morozov, E. (2009). The brave new world of slacktivism. *Foreign Policy, 19*(05).

Mossberger, K., Tolbert, C. J., & McNeal, R. S. (2007). *Digital citizenship: The Internet, society, and participation*. Boston, MA: MIT Press.

Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. *Psychological science, 25*(6), 1159-1168.

Neary, M., & Winn, J. (2009). The student as producer: reinventing the student experience in higher education.

O'Reilly, T. (2006). What is Web 2.0: Design patterns and business models for the next generation of software. Retrieved from http://www.oreillynet.com/lpt/a/6228

O'Callaghan, F. V., Neumann, D. L., Jones, L., & Creed, P. A. (2017). The use of lecture recordings in higher education: A review of institutional, student, and lecturer issues. *Education and Information Technologies, 22*(1), 399-415.

Ohler, J. B. (2010). *Digital community, digital citizen*. Thousand Oaks, CA: Corwin Press.

Peck, J. L. (2014). Social media in nursing education: responsible integration for meaningful use. *Journal of Nursing Education, 53*(3), 164-169.

Piller, F. T., Vossen, A., & Ihl, C. (2012). From social media to social product development: The impact of social media on co-creation of innovation. *Die Unternehmung, 65*(1).

Porter, A. J., & Hellsten, I. (2014). Investigating Participatory Dynamics Through Social Media Using a Multideterminant "Frame" Approach: The Case of Climategate on YouTube. *Journal of Computer-Mediated Communication, 19*(4), 1024-1041.

Rahm, L., & Fejes, A. (2015). Ubiquitous computing, digital failure and citizenship learning in Swedish popular education. *Citizenship Teaching & Learning, 10*(2), 127-141.

Ravenscroft, A., Schmidt, A., Cook, J., & Bradley, C. (2012). Designing social media for informal learning and knowledge maturing in the digital workplace. *Journal of Computer Assisted Learning, 28*(3), 235-249.

Roberts, N., & Rees, M. (2014). Student use of mobile devices in university lectures. *Australasian Journal of Educational Technology, 30*(4).

Rosen, L. D., Carrier, L. M., & Cheever, N. A. (2013). Facebook and texting made me do it: Media-induced task-switching while studying. *Computers in Human Behavior, 29*(3), 948-958.

Selwyn, N. (2012). Social media in higher education. In A. Gladman (Ed.), *The Europa world of learning* (pp. 1-10). London, UK: Routledge.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3-10.

Siemens, G., & Weller, M. (2011). Higher education and the promises and perils of social network. *Revista de Universidad y Sociedad del Conocimiento (RUSC), 8*(1), 164-170.

Stein, J. (2008). Defining Creepy Treehouse. Retrieved from http://flexknowlogy.learningfield.org/2008/04/09/defining-creepy-tree-house/

Stoller, E. (2013). Our shared future: social media, leadership, vulnerability, and digital identity. *Journal of College and Character, 14*(1), 5-10.

Taneja, A., Fiore, V., & Fischer, B. (2015). Cyber-slacking in the classroom: Potential for digital distraction in the new age. *Computers & Education, 82*, 141-151.

Tapscott, D., & Williams, A. D. (2010). Innovating the 21st-Century University: It's time! *Educause review*, 11.

Tennant, J. E., Demaray, M. K., Coyle, S., & Malecki, C. K. (2015). The dangers of the web: Cybervictimization, depression, and social support in college students. *Computers in Human Behavior, 50*, 348-357.

Veletsianos, G. (2013). Open practices and identity: Evidence from researchers and educators' social media participation. *British Journal of Educational Technology, 44*(4), 639-651.

Waltz, S. B. (2003). Everything new is old again: Technology and the mistaken future. *Bulletin of Science, Technology & Society, 23*(5), 376-381.

Watty, K., McKay, J., & Ngo, L. (2016). Innovators or inhibitors? Accounting faculty resistance to new educational technologies in higher education. *Journal of Accounting Education, 36*, 1-15.

Wexler, M. N. (2011). Reconfiguring the sociology of the crowd: exploring crowdsourcing. *International Journal of Sociology and Social Policy, 31*(1/2), 6-20.

Williams, S., Fleming, S., Lundqvist, K., & Parslow, P. (2012). This Is Me: Digital Identity and Reputation. *Digital Identity and Social Media*, 104.

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Internet of Things (IoT), PBL and 3D Holographic modelling for smart agricultural education at The University of Queensland

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The project described in this paper builds on exciting technological developments in real time biophysical data gathering that are currently happening at The University of Queensland (UQ)'s regional campus (UQGatton ~1000ha of prime agricultural land ~85km SW of Brisbane in SE Queensland), via the Internet of Things (IoT) UQ Smart Campus Project.

This paper will describe the development of multifaceted web-based interfaces, problem based learning modules, and 3D modelling using the real time streaming data acquired through the Internet of Things (IoT) technology of the UQGatton Smart Campus Initiative. The idea is to produce innovative teaching and assessment modules for multiple different courses in the UQ Science Faculty, and across 2 Campuses separated by 85kms of highway. The paper describes the technology involved, the challenges and workarounds and a number of examples of using the data collected for problem-based learning modules. Some discussion is included on what these technologies could provide for further Teaching & Learning developments in the "E" space being trialed with partners UQ ITS, Microsoft and Telstra/Readify.

Introduction

The world has a problem. There is a soaring global population, we need to feed more with less resources and food production must become smarter and more sustainable (FAO 2009). Additionally, a very real issue for the agrifood sector as a whole (broadly speaking the category structure of the agrifood industry consists of grain, livestock (beef and dairy), and horticulture), is that the average demographic of people in the production sector across the world has increased significantly over the last 20 years. In Australia the median age of farmers in 2011 was 53 years, compared with 40 years for people in other occupations, and almost a quarter (23%) of farmers were aged 65 years or over, compared with just 3% of people in other occupations. Moreover, the number of farmers in Australia has been declining for many decades as small farmers sell up to large-scale farming operations, and fewer young people take over family farms. (Productivity Commission, 2005).

In essence, it is difficult to get young people into agriculture and related areas because it is perceived as labour intensive, non-academic and lowly paid. Actually, is far from the truth, but the perception is there among young people and their parents (Bryceson 2006) and it is not only frustrating the agrifood industry generally, but also educators in the sector.

A potential solution – or at least part of a potential solution to these problems in the agrifood sector are a combination of: (i) the use of technology for developing smart agricultural practices, and; (ii) the use of technology as a student engagement and teaching tool (Bryceson et al 2016). We believe this to be the case because technology is all pervasive in the business world today and is a strong focus of domestic and international deliberations in the agrifood industry (Australian Farm Institute 2016; Gasiorowski-Denis 2017). Finally, miniaturisation of electronics & automation are key drivers of innovation and are being pursued avidly around the world as a way to 'disruptively' innovate legacy systems in various industry sectors. Indeed, the Australian Farm Institute's 2016 paper and associated Conference "Disruptive technologies in Agriculture, Sydney 2016" refer to disruptive technologies in Agriculture as being key to success for the sector the future.

A disruptive innovation or technology is one that 'disrupts' or 'overturns' traditional business methods and practices and which in the long term leads to the creation of new 'ground-breaking' products (Christensen and Overdorf, 2000). Over the last decade, disruptive technologies in the form of mobile computing (including social media for marketing purposes), Internet of Things (IoT) technologies to collect and transmit real time data, the use of cloud computing to facilitate the analysis of such generated ‘Big Data’ and Robotics to make use of the data, have been identified as having impacted the agrifood industry in an unprecedented way to create and capture value across the whole chain (Bourlakis et al., 2011; Lehmann et al., 2012, Hall 2016).

In this paper we will describe three technologies that have potential to disrupt agricultural and related education to create engagement in agriculture by young people through more technologically enabled and more realistic learning opportunities for tertiary students. These technologies are the Internet of Things and big data capture and use, “Active” Problem Based Learning in a technologically enhanced learning environment, and 3D Holographic modelling.

The Internet of Things (IoT) & UQ Gatton Smart Campus initiative

The ‘Internet of Things’ (IoT) is defined as: “A network of physical objects that contain embedded technology to communicate, sense &/or interact with their internal states or the external environment and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction” (Gartner, 2016). In fact we are in the midst of an Internet of Things (IoT) revolution (Xu, et al., 2014). While the smartphone still rules as the de facto Internet connected device, many everyday “things” are becoming connected to the Internet and gaining a cyber-presence. These include not only man-made artefacts but also components of nature such as an individual tree in the landscape in which it resides (Harris, 2015).

With the growing popularity of the Internet of Things (IoT) technology, (which includes both smart wireless network technology and sensor nodes), there has been extensive research on the use of wireless sensor networks or IoT in agricultural research studies, ranging from on farm through to market and into agricultural education. For example, IoT systems have been set up for real time biophysical data collection for use in environmental monitoring, precision farming, precision irrigation, precision livestock and cold chain logistics. Of great interest in a world of changing climate is efficient waste water management practices which can be facilitated by the use of IoT technologies. Vellidis et al., (2008) developed a smart sensor system integrating moisture sensors, thermocouples and RFID tags for scheduling irrigation in cotton. Kim et al., (2008) reported a wireless sensor network for controlling irrigation interfaced using low-cost Bluetooth wireless radio communication with the base station. Sensors attached to a can be used for monitoring the presence and concentration of toxic substances near rivers and aquifers, where chemical runoff can contaminate drinking water supplies.

The ‘Smart Campus’ project at UQ commenced in December 2014 and was aimed at developing an IoT multisensory mesh network encompassing everywhere on The University of Queensland’s rural 1000ha campus at Gatton (Figure 1) and which is covered by Wi-Fi and/or LORA radio technologies.

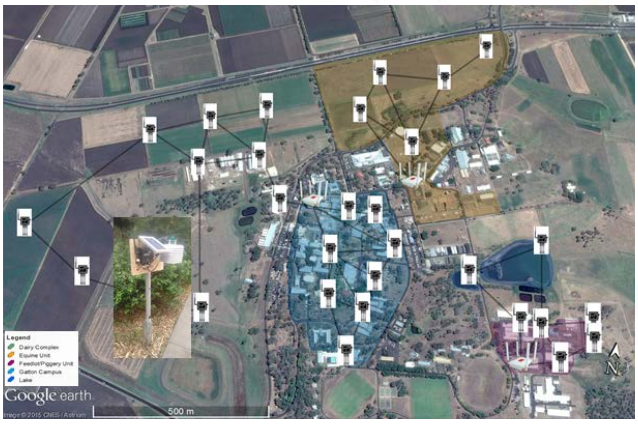

Figure 1: UQ Gatton Campus with identified multi-sensor nodes located on a Google Map image of the area

The specific areas covered by the network include: cattle backgrounding paddocks and feedlot, horticultural fields, equine foaling unit and collocated equine paddocks, piggery, dairy and the “built environment” (particularly for radiance, dust, noise etc). The mesh network also includes sensors capable of measuring the water level and chemical content of the farm ring tanks, dams and the piggery effluent and associated waste water management lakes (Figures 2 and 3). Data is collected continuously in real time and stored in the Australian National Research Infrastructure Cloud (Nectar).

Figure 2: Libelium Smart Agriculture, Water, Environment, and Security Models used in UQSmart Campus initiative 2016. Images of models from Libelium webpage - http://www.libelium.com/products/plug-sense/models/ and a list of sensors being used at UQGatton from Libelium http://www.libelium.com/products/plug-sense/models/

Figure 3a): Multisensor Mesh physical set up on farm; Figure 3b) Smart Water node on UQGatton Environmental Management lake – Lake Galletely

IoT technology as a sustainable educational infrastructure for delivering real time biophysical data

The UQGatton IoT network comprises approximately 40-60 multisensor nodes (dependant on academics' needs) in a wireless enabled network, was originally set up for agricultural and environmental biophysical data collection in the managed landscape, mainly for research purposes. The data collected amounts to a big data set (a collection of data from traditional and digital sources). Appropriately analysed, it can improve visibility (Barratt & Oke, 2007) and sustainability performance (Schoenherr & Speier-Pero, 2015).

A significant amount of time went into the design of the IoT mesh network and in choosing the technologies involved. The main requirements were that we had a large area to cover so needed a network typology that was flexible, self-configuring, self-healing (ie fault tolerant) and able to relay data over long distances, we chose a mesh multi-hop network (Zawawi et al., 2012), (Fig 4). We also needed a wide choice of sensors enabling many problem scenarios to be developed and the network needed to be robust & have low set up and maintenance needs and costs.

Figure 4: Waspmote mesh network typology

The Waspmote technology of Libelium addressed these needs with the added benefit that each node is solar powered (imperative for field implemented technology), with 12+ hours of backup power and the UQ network link failure protection in place to ensure data integrity. When using Wi-Fi the system is connected to Eduroam.

The system has modular embedded "Plug & Play" components and sensors that are compatible with standard interfaces and protocols, e.g. RS-232, RS-485, Modbus which are capable of reading & transmitting as many as 20+ variables (most of ours currently = 6+). The nodes are autonomous with a smart CPU and all are remote wireless programmable using Arduino-like software (IDE) (Arduino 2016) which is also compatible with what is currently being taught as part of the Australian High School curriculum.

However, the IoT system has since been further developed to create a multifaceted web-based interface to the data (Data Dashboard) and problem based learning modules using the real time streaming data from the IoT to produce more engaging and active learning based teaching tools (Figure 5).

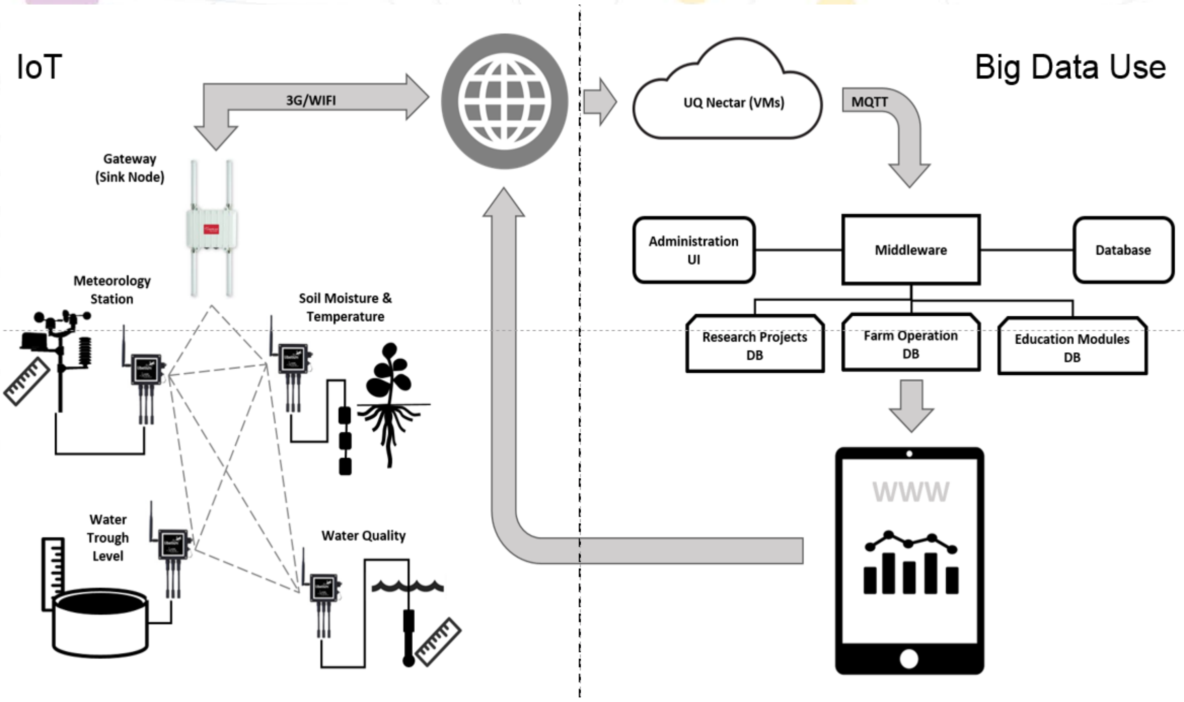

Figure 5: UQGatton IoT multisensory mesh network development and Big Data use in 2017

Technology Enhanced Learning (TEL) Project

The TEL project has a pedagogical philosophy of 'active learning' which is generally defined as any instructional method that engages students in the learning process and where students are required to do meaningful learning activities and think about what they are doing rather than just listen: they must read, write, discuss, or be engaged in solving problems through higher order thinking tasks such as analysis, synthesis, and evaluation (Bonwell & Eison, 1991).

Of the three active learning scenarios defined by Prince (2004), (collaborative learning, collective learning and problem-based learning) this project addresses the development and use of in-context problem based learning (PBL) where relevant problems are introduced during instruction and are then used to provide the motivation for the learning of other material. Wood (2003) identifies how the learning takes place in a PBL approach when she says: *"In problem based learning (PBL) students use "triggers" from the problem case or scenario to define their own learning objectives. Subsequently they do independent, self-directed study before returning to the group to discuss and refine their acquired knowledge. Thus, PBL is not about problem solving per se, but rather it uses appropriate problems to increase knowledge and understanding".*

To value add to the PBL approach this project is using real time data streaming in from a range of biophysical sensors located around the UQGatton Campus and associated farms as the basis for agricultural and environmental problem solving exercises for students in a range of courses across the Faculty of Science at UQ (for example Agronomy, Agribusiness, Equine Science, Animal Production (various aspects), Maths and Statistics, Waste water science and management, Soil science, Chemistry, Wildlife Monitoring, Animal Reproduction, Sustainability monitoring, Plant pathology, etc etc). The idea being to engage students in real world issues that they will have to deal with when employed, using the current fascination of young people with the ubiquitous 'e' enabled environment of today, to provide the source of learning.

Wood (2003) points out that PBL is successful only if the scenarios are of high quality and suggests that for this to occur the following should be adhered to:

- Learning objectives of the problem to be presented should be consistent with the course learning objectives
- Problems should be appropriate to the stage of the curriculum and the level of the students' understanding

- Scenarios should have sufficient intrinsic interest for the students or relevance to future practice
- Basic science should be presented in the context of the scenario to encourage integration of knowledge
- Scenarios should contain cues to stimulate discussion and encourage students to seek explanations for the issues presented
- The problem should be sufficiently open, so that discussion is not curtailed too early in the process
- Scenarios should promote participation by the students in seeking information from various learning resources

The PBL design process that is being used is a simple step based approach to the development of each PBL module following a modified design process of the Frey & Sutton (2010) Step Multi-media design approach:

Step 1. Define the instructional goals, objectives, and audience
Step 2. Review and investigate existing options (e.g. in our case system software)
Step 3. Determine the content, activities, and assessment strategies
Step 4. Develop the flowchart, site map, and/or storyboard for each module
Step 5. Develop a prototype
Step 6. Perform a formative evaluation (does it do what you want it to do)
Step 7. Complete the design.

The PBL scenarios within this project are/will be delivered online and will be useful for a number of years without necessarily needing updating or changing. This is because the data changes in real time so that problems developed, while the same for each year, will have different outcomes dependent on a specific year's data. Given this, we suggest that functional aspects of the delivery, and the interface with the technology such as software, applications system and graphics design, are very important to 'get right' in order to provide a sustainable quality learning experience.

Technology enhanced learning system

The proposed system consists of several software modules that will enable the creation of multifaceted applications from real-time biophysical sensor data collected at the UQ Gatton campus. Primary among these software modules is an Internet of things (IoT) middleware whose main purpose is to act as a hub which connects heterogeneous sensor devices and data gathered by them to multiple applications (Fig 5). The existing IoT platform is being leveraged for this purpose and provides the following functionality:

- Receive sensor data in real-time from the Gateways (i.e. Meshliums) and make them available to applications and store them in a database in a flexible format.
- Provide APIs (Application Programming Interfaces) which can be used to build applications that make use of real-time and historical sensor data.
- Be robust and scalable as number of devices, data volume and application usage grows.
- Maintain a registry of sensor devices and thereby provide device management capabilities.

Having evaluated several IoT platforms we have chosen the SiteWhere open source IoT platform. While communication with the current Libelium devices is done using the IoT specific machine-to-machine protocol MQTT (http://mqtt.org/) the middleware allows use of other protocols if needed. We intend to build multiple applications which feed off the UQ Gatton sensor data. These will connect to the REST APIs exposed by the middleware module.

The existing applications include a generic Data Dashboard dashboard app to visualise sensor data in real-time via charts and a mapping tool, plus multiple other eLearning applications which can provide course focused visualisations and assessments. As part of the dashboard app, users have the option of downloading raw sensor data (e.g. in CSV format) for use with external applications such as Excel or the statistics package 'R'. We have also have an app to enable an existing gamified crop fungal development program to use the IoT data, the development of an online 'fishtank' linked into the IoT that represents a water chemistry scenario and a Waste Water Management module which we detail below.

Further possibilities include applications which will perform business-oriented data analysis and provide more relevant information for the likes of farmers, land managers etc.

Waste Water Management PBL

In the water management PBL the basic scenario is that of a Waste Water Management issue associated with a Piggery effluent system – in particular managing the development of algal blooms that are an indicator of poor nutrient management.

In Fig 6 there are four Smart Water Nodes with sensors measuring chemical variables in the water, distributed throughout a series of Lakes and Ponds that make up the Piggery Effluent Management System at UQGatton. Piggery effluent gets released into Lake Galletly from effluent settling ponds directly below the piggery. Smart Water Node 1 is located at the entry point of effluent into the Lake. The effluent gets diluted as it is moved through Lake Galletly by water aerators and pumped out into

Mac's Pond where Smart Water Node 2 is recording incoming chemical content of water. The effluent is further diluted in Mac's Pond over x time period and allowed to move via gravity through a bio-filter (small native forest and grassland), to Lake Lenore where Smart Water Node 3 is recording water quality. Water then overflows into Lake Galletly and moves (without aerators turned on) towards the outlet pump at top right hand side of image where it will be pumped out onto the paddocks surrounding the piggery as irrigation water. This water then seeps down and back into Lake Galletly (which is a constructed lake).

Various scenarios can be developed and storyboarded around monitoring chemical content of water and management practices: for example changes over time, changes around the Lakes and Pond systems, diurnal fluctuations, impact of events such as effluent input and natural rain input allowing nuances in chemical content to be analysed and questioned in relation to management practices. The mesh network does also allow both the aerators and the pumps to be turned on and off if required - however as this is a working piggery and waste water management system, these services these services will only be available to the Farm staff – and will NOT be available to students other than in a simulation.

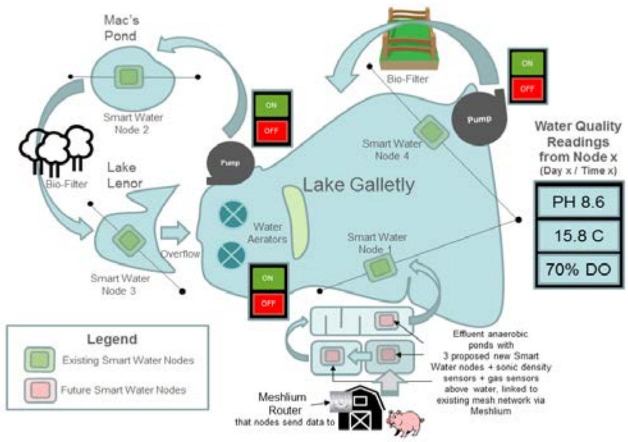

Figure 6: Piggery Effluent and Waste Water Management Scenario

Waste Water Management PBL Module in Augmented Reality
This module is currently being further developed as part of a project investigating the value of other online educational tools including Augmented Reality, Virtual Reality and Mixed Reality (Bonde et al., 2014; Makransky, et al., 2016; Thisgaard & Makransky, 2017). A single water unit in the waste water management system (Lake Galletly) is being developed into a 3D holographic model (both above and below water) using IoT data from the physical environs of the Lake (e.g. rainfall and temperature) and chemical data from below the surface of the Lake as input into the model.

A rules based model of the various chemical systems working in the Lake (e.g. nutrient acquisition, dissolved oxygen build up or decline, phytoplankton build up/decline and fish health as a result) was first developed in STELLA (agent based deterministic modelling software) and then further developed using UNITY (a "game engine in a box") (Infante, 2017), and CSharp to build the 3D assets. The scenario being storyboarded is that of a Fish Farm that has befallen a disaster of dead and dying fish and what does the student do about it?

The idea is for students to interact with the holographic model to pull apart the system using Microsoft's Augmented Reality technology, the Hololens (https://www.microsoft.com/en-au/hololens). This technology will provide a very different (disruptive) teaching tool by providing an immersive experience for students that is not possible with standard lectures and practicals (Christian, 2016). Evaluation of the Project in terms of student learning outcomes, student enjoyment and feasibility over the long term will be available by the end of November 2017.

Challenges and conclusions to date of IoT + TEL project

There have been a number of challenges associated with TEL project. These include:

Technological

- Managing costs and ensuring sustainability of the overarching system by keeping the system design based around freeware (i.e. no long term costs for ongoing software licences).
- The development of appropriate design rules for the system around data management and storage so that additional PBL modules can be developed easily and quickly as they come to mind or as other organisations wish to build them from the UQGatton datasets for their own students.
- Creating assets in UNITY so academics can develop their own teaching scenarios using off the dashboard data and tools.

Pedagogical

- Getting academics to visualise how they can use real time data in an online or web-based format in their courses for adding value to the learning experience.
- Finessing the storyboarding for each PBL and developing challenging assignments associated with them is key to providing quality learning outcomes.
- A particular challenge in developing eLearning applications using real-time sensor data are that assessments need to match the conditions

represented by the data. Possible solutions include:

- Creating generic questions that do not depend on the trends displayed by the data.
- Incorporating into the application, the ability for the student to deduce the correct answer from the real-time data provided.
- Providing a snapshot of the data together with the student's answer so that the teacher can make use of it in marking.
- Including a simulation (as discussed in the waste water management example above) of an 'event' or 'hazard' or 'disaster of management issue' that uses real time data in order for students to develop a solution.

In conclusion - we have had good interest from academics across a range of disciplines with the idea of using real time data for developing PBL modules for their courses. An unexpected benefit is that while most academics started their involvement with the project with a strong discipline focus, it is pleasing to note that many are now talking about integration across the broad spectrum of content to better enable students to see the relevance of an individual course in the context of their whole Program/ learning experience.

References

Arduino Software (2016). Available at: https://www.arduino.cc/en/Main/Software

Barratt, M. & Oke, A. (2015) Antecedents of supply chain visibility in retail supply chains: a resource-based theory perspective. *Journal of Operations Management,* 25(6), 1217-1233.

Bonde, M.T., Makransky, G., Wandall, J., Larsen,M.V., Morsing, M., Jarmer, H. & Sommer M.O.A. (2014). Improving biotech education through gamified laboratory simulations. *Nature Biotech*, Vol 32(7)

Bonwell, C. & Eison, J. (1991). Active Learning: Creating Excitement in the Classroom, *ERIC Clearinghouse on Higher Education*, Washington, D.C. http://ericae.net/db/edo/ED340272.htm

Bryceson K.P., Navas Borrero, A., Gunasekera K., (2016). The Internet of Things (IoT) - Smart Agriculture Education at The University of Queensland. *Proceedings of Edulearn16, 8th International Conference on Education and New Learning Technologies,* Barcelona July 2016. 8036-8044.

Bourlakis, M., Vlachos, I. & Zeimpekis, V. (2011). *Intelligent Agri-food Chains and Networks,* Oxford, Blackwell-Wiley.

Christensen, C. M. & Overdorf, M. (2000). Meeting the challenge of disruptive change. *Harvard Business Review,* 78**,** 66-76.

Christian, M. (2016) How Can Immersive Technologies Improve Learning in Higher Ed? Tech Decisions, Dec 2016. Available at: https://techdecisions.co/mobility/can-immersive-technologies-improve-learning-higher-ed/

Hall, A. (2016). Thoughts about what disruptive innovation means for agriculture research organisations. Food Systems & Innovation, Available at: https://foodsystemsinnovation.org.au/blogs

FAO (2006). World agriculture: towards 2030/2050 Interim report: prospects for food, nutrition, agriculture and major commodity groups. Food and Agriculture Organization of the United Nations (FAO), 2006, 2009. Available at: http://projects.mcrit.com/foresightlibrary/index.php/megatrens2/economy-sp-988843696/59-land-uses/land-uses-trends/260-how-to-feed-the-world-in-2050

Frey B, and Sutton J.M. (2010). A Model for Developing Multimedia Learning Projects *MERLOT Journal of Online Learning and Teaching* Vol. 6, No. 2, June 2010.

Gasiorowski-Denis (2017). Feeding 9 billion people sustainably is the latest iso focus. International Organisation for Standardization. Available at: https://www.iso.org/news/ref2182.htm

Gartner IT Glossary (2016). Available at: http://www.gartner.com/it-glossary/internet-of-things/,

Harris, M. (2015). The Internet of Things - wireless sensor networks and their application to forestry. IEEE Spectrum 26 February, Available at: https://www.researchgate.net/publication/314115194_The_internet_of_things_-_wireless_sensor_networks_and_their_application_to_forestry

Infante A. (2017). A Beginners Guide to Unity. Available at: http://www.makeuseof.com/tag/programming-game-unity-beginners-guide/

Jeschofnig L.P. (2011). Teaching Lab Science Courses online: Resources for Best Practices, Tools and Technology. Jossey-Bass

Kim, Y., Evans, R. G. & Iversen, W. M. (2008). Remote sensing and control of an irrigation system using a distributed wireless sensor network. *IEEE*

Transactions on Instrumentation and Measurement, 57**,** 1379-1387.

Lehmann, R. J., Reiche, R. & Schiefer, G. (2012). Future Internet and the Agrifood sector: state-of-the-art in literature and research. *Computers and Electronics in Agriculture,* 89**,** 158-174.

Libelium (2016). Waspmote Products. Available at: http://www.libelium.com/products/waspmote/),

Makransky, G., Bonde, M.T., Wulff, J.S.G., Wandall, J., Hood, M., Creed. P. A. Bache, I.B., Silahtaroglu, A. & Nørremølle A. (2016). Simulation based virtual learning environment in medical genetics counselling: an example of bridging the gap between theory and practice in medical education*, BMC Medical Education*, Vol 16(98).

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223-231. Full text available through MIT Libraries

PC World –Available at: https://www.pcworld.idg.com.au/article/612834/microsoft-first-tethered-windows-10-vr-headsets-ship-march/

Productivity Commission (2005). Trends in Australian Agriculture, Research Paper, Commonwealth of Australia, Canberra. Available at: http://www.pc.gov.au/research/supporting/agriculture/agriculture.pdf

Schoenherr, T. & Speier-Pero, C. (2015). Data science, predictive analytics, and big data in supply chain management: current state and future potential. *Journal of Business Logistics,* 36**,** 120-132.

Thisgaard, M. & Makransky, G. (2017) Virtual Learning Simulations in High School: Effects on Cognitive and Non-cognitive Outcomes and Implications on the Development of STEM Academic and Career Choice. *Frontiers in Psychology* | www.frontiersin.org, 1 May 2017, Vol8, Article 805.

Vellidis, G., Tucker, M., Perry, C., Kvien, C. & Bednarz, C. (2008). A real-time wireless smart sensor array for scheduling irrigation. *Computers and Electronics in Agriculture*, 61, 44-50.

Wikipedia (2016). Big Data. Available at: https://en.wikipedia.org/wiki/Big_data.

Wood D. (2003) Problem Based Learning. In: Cantillon, P.; Hutchinson, L. and D. Wood (Eds) *ABC of Learning and Teaching Medicine*, Ch 3, pp 8-11. BMJ Publishing Group, London, UK.

Xu, L. D., He, W. & Li, S. (2014). Internet of Things in Industries: A Survey. *IEEE Transactions on Industrial Informatics,* 10**,** pp 2233-2243.

Zawawi, Amr El, and Ali Ibrahim (2012). 'Using Zigbee to Build a Web-Based DCS System', IEEE Power and Energy Society General Meeting.

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CMALT cMOOC: Developing a scalable lecturer professional development framework

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This paper outlines the design stage of a project that reimagines lecturer professional development around a network of communities of practice scaffolded by a cMOOC (connectivist Massive Open Online Course), where sustained collaborative engagement with innovative teaching practice is recognised via established international peer-based professional accreditation pathways such as CMALT (Certified Member of the Association for Learning Technology). Informed by a design based research methodology, the CMALT cMOOC leverages a network of national and international collaboration and innovative teaching expertise, providing an agile and scalable framework to support the development of participants' CMALT portfolios as evidence of critical engagement with new modes of practice and enhanced student outcomes.

Introduction

Kopcha, Schmidt and McKenney (2015) identify three phases of design based research (DBR): analysis and exploration, design and construction, and evaluation and reflection. Kopcha et al., argue that DBR studies can provide depth by reporting upon each specific phase. Thus this paper explores the design and construction phase of a design based research project based upon McKenney and Reeves' (2012) model. The overall project aims to evaluate the implementation of an agile and scalable framework providing an authentic professional development experience using innovative teaching and learning approaches that participants can then apply to their own teaching praxis. The project reimagines lecturer professional development (PD) as a network of communities of practice within a cMOOC (connectivist Massive Open Online Course) hub, where sustained collaborative critical engagement with innovative teaching and learning praxis is recognised via CMALT accreditation (Certified Member of the Association for Learning Technology). MOOCs come in two main types: xMOOCs and cMOOCs (Bates, 2014), while xMOOCs focus upon content delivery and a transmission model of teaching and learning, cMOOCs focus upon globally connecting peer learners and facilitating shared experiences. The CMALT cMOOC aims to scaffold a network of communities of practice (COPs) exploring technology enhanced learning in a variety of higher education contexts, it also provides a platform for developing and nurturing global research collaborations.

The CMALT cMOOC is a professional development support strategy and is designed based upon up-scaling the researchers' community of practice (COP) model of lecturer professional development (Cochrane & Narayan, 2016c). Key to this model is the embedding of the scholarship of technology enhanced learning or SOTEL (Haynes, 2016), within lecturer praxis supported by a collaborative curriculum design process. The cMOOC provides a framework to support the development of lecturer COPs across a series of several weeks of participation throughout the academic year. The cMOOC is not conceptualised as a professional development course in the traditional sense, rather a mutual and collaborative initiative of willing participants to work together in order to enhance their understanding and knowledge of technology enhanced learning and teaching. Participation in the cMOOC is open, free and largely participant driven. Participants are not assessed in anyway (there are no assessments events or grades attached to any of the activities the participants undertake for the duration of the cMOOC). The CMALT cMOOC is a true endeavour to nurture scholarship of learning and teaching through a community and collaborative based approach. The outcome of the CMALT cMOOC is the development of lecturer eportfolios of technology enhanced learning practice that can be submitted for accreditation via the Certified member of Learning Technologists (CMALT) process (https://ascilite.org/get-involved/cmalt/). Thus the CMALT cMOOC is designed to support the development of innovation in teaching and learning practice and deepen reflective practice via SOTEL. The next phase of the research will evaluate the effectiveness of the CMALT cMOOC model and help inform the redesign of subsequent iterations. The role of the researchers in this cMOOC is that of a guide and facilitators and play no role in the CMALT certification/accreditation process. The certification process is totally independent of CMALT cMOOC and is undertaken by a third party organisation based in australasia (https://ascilite.org/get-involved/cmalt/) and the UK (https://www.alt.ac.uk/certified-membership). The researchers in the CMALT cMOOC are not teachers nor are the enrollees students. There is no distinct hierarchy as in a traditional classroom, rather the CMALT cMOOC is a community attempt to grow teaching praxis in a variety of teaching and learning domains.

Literature review

Barnett argues that we live in a rapidly changing world where education must refocus as "learning for an unknown future, in short, for an ontological turn" (Barnett, 2012, p. 65). An ontological turn implies a reconception of one's self or being: for learners this is a shift from passive receptor of knowledge to active participation in new knowledge creation and professional participation, while for teachers this is a shift from gate-keepers of knowledge and assessment to collaborative co-learning and modelers of professional practice. This calls for new models of lecturer professional development (PD) that model active participation within authentic contexts that support a culture of pedagogical change. These new PD models need to be agile, sustainable, scalable, and authentic. Examples of new models of Lecturer Professional Development include flexible online courses ranging from certificates of teaching to Masters of higher education, and the development of communities of practice (McDowell, Raistrick, & Merrington, 2013). The default approach has become the provision of an in-house Postgraduate Certificate of Teaching and Learning in Higher Education (PgCert) (Hall, 2010). MOOCs have also begun to emerge as platforms for teacher professional development (Milligan & Littlejohn, 2014; Salmon, Gregory, Lokuge Dona, & Ross, 2015). Laurillard (2016) argues that the MOOC format is predominantly suitable for highly self-directed and motivated learners, such as teachers who regularly engage in professional development to hone their teaching skills. While MOOC completion rates are typically low (Jordan, 2014), analysis of MOOC participation data indicates the effectiveness of the MOOC format for professional learners (Kill & Stroud, 2016; Milligan & Littlejohn, 2014). Therefore MOOCs can be powerful experiences for a motivated core group of participants (Mackness & Bell, 2015).

Increasingly higher education institutions globally are under pressure to demonstrate the effectiveness of their academics in teaching and learning, with implications for levels of government funding. Currently every university in New Zealand offers their own version of a PgCert as a key professional development strategy. The ineffectiveness of this as a strategy is demonstrated by the low level of uptake by academics. We propose a reimagined PD strategy leveraging professional accreditation pathways. Professional accreditation pathways are based upon demonstrating alignment with the UK professional standards framework (UKPSF). Two of the most mature accreditation pathways are through the Higher Education Academy (HEA) and the Certified Member of the Association for Learning Technology (CMALT), both of which are based upon the UK Professional Standards Framework (https://www.heacademy.ac.uk/recognition-accreditation/uk-professional-standards-framework-ukpsf). HEA has accredited 85000 fellowships since 2003 (https://www.heacademy.ac.uk/recognition-accreditation/hea-fellowships), while CMALT (Deepwell & Slater, 2012) has just over 360 accredited members since 2005 (https://www.alt.ac.uk/certified-membership). HEA has four levels of membership accreditation, two of which require a combination of portfolio and accredited course completion (Associate Fellow and Fellow), with the two higher levels evidenced solely through portfolios (Senior Fellow, and Principle Fellow). CMALT is based around a portfolio mapped to the UK Professional Standards Framework (UKPSF) (Association for Learning Technology (ALT), 2015; Deepwell & Slater, 2012), and requires renewal of the portfolio every three years plus current membership of either ALT or Ascilite professional societies for continued accreditation.

While the goal of professional accreditation pathways is to provide an evidence pathway for good teaching practice, they have been criticised for focusing upon measuring practice rather than being an effective vehicle for professional development themselves, and a reflection of a neoliberal regulatory environment (Connell, 2009; Gosling, 2010; Hall, 2010). However, much work has been done on mapping these professional accreditation pathways to various professional development activities, including courses, and MOOCs such as the Blended Learning Essentials xMOOC (University of Leeds, 2016). Both HEA and CMALT map to the UKPSF areas of professional activity, core knowledge, and professional values. In comparison to HEA accreditation, CMALT adds the integration of technology within these areas of teaching practice more explicitly than HEA (Association for Learning Technology (ALT), 2015). CMALT accreditation is thus highly relevant to lecturers who integrate and engage with technology in their teaching, and those who support technology enhanced learning (for example eLearning designers). Thus we have mapped the design of the project cMOOC to the CMALT accreditation pathway as an appropriate measure of the development of technology enhanced learning practice and reflection. It also builds upon the close links between the international communities of educational technologists represented by Ascilite (Australasian Society for Computers In Learning In Tertiary Education) and ALT (Association for Learning Technology, UK) to facilitate a supportive community (https://ascilite.org/get-involved/cmalt/).

Methodology

We have piloted the concept of a PD cMOOC through the design and implementation of two iterations of the Mosomelt (Mobile Social Media Learning Technologies) cMOOC (Cochrane & Narayan, 2016a; Cochrane, Narayan, Burcio-Martin, Lees, & Diesfeld, 2015), with a structure outlined at http://mosomelt.wordpress.com and a supporting G+ Community https://plus.google.com/u/0/communities/106393655203803851791?cfem=1. With the development of the CMALT cMOOC we aim to test and evaluate the scalability of this concept by collaborating with like-minded individuals, departments, and institutions both nationally and internationally in this project.

Hall (2010) argues that there has been a lack of theorising around the application of professional standard frameworks to professional development activities. Hall suggests an engagement with new and emergent educational development theories such as rhizomatic learning (Cormier, 2008). Cormier (2008) refers to the design of a collection of tools to support learning as an ecology of resources (EOR). In our case the ecology of resources utilised to support the CMALT cMOOC, illustrated by the EOR designed for the pilot Mosomelt cMOOC include:

- A Wordpress course hub
- Google Plus Community
- A collaborative Participant Map
- A social media hashtag for curation: #mosomelt, with Twitter analysis via TAGSExplorer (Hawksey, 2011)
- A prior teaching practice survey of the participants: Post PowerPoint Survey
- A survey of participant engagement with SOTEL
- The Project Bank for sharing participant curriculum design ideas
- A blog roll of participant reflective blogs
- An archive of online webinars, reflections, and tutorials via YouTube

The design of the CMALT cMOOC scaffolds a network of communities of practice of lecturers across national and international higher education institutions. The cMOOC focuses upon facilitating collaboration and critical discussions between the participants, and the sharing of user-generated content, rather than the delivery of a prescribed body of pre-developed content. The design of the cMOOC is mapped to the CMALT accreditation pathway as an appropriate measure of the development of technology enhanced learning practice and reflection, that also builds upon the close links between Ascilite and ALT (https://ascilite.org/get-involved/cmalt/) to facilitate a supportive community. The design and implementation of the cMOOC is founded upon a qualitative design based research (DBR, often used synonymously with Educational Design Research or EDR) methodology.

The cMOOC explicitly integrates SOTEL through preparing participants to submit eportfolios for certified membership of the association for learning technology (CMALT) accreditation, effectively updating Boyer's (1990) fourfold DIAT (Scholarship of Discovery or SOD, Scholarship of Integration or SOI, Scholarship of Application or SOA, and the Scholarship of Teaching and learning or SOTL) model of scholarship for the open social scholarship age. The project will involve multiple case studies involving each of the partner institutions and their experiences of participating in the cMOOC and in modifying the framework for their own institutional priorities. The impact of the project will be demonstrated through the completion of participants CMALT accreditation. The DBR framework consists of four iterative stages: literature review; design of prototype cMOOC; evaluation of the impact of the cMOOC on participants' practice; and, evaluation of the transferability of the cMOOC framework into other educational and organisational work-related contexts via the development of a set of design principles for peer review and publication.

Research questions

Two research questions guide the overall project design and evaluation of the impact of the CMALT cMOOC framework:

1. Can a cMOOC provide a scalable and agile framework to support authentic lecturer professional development?
2. How effective is an ecology of resources (EOR) based upon social media for sustaining an authentic professional development cMOOC and supporting the development of participant eportfolios for CMALT accreditation?

Research design

Participants will be drawn from academic development units across New Zealand, in partnership with three leading international educational technology research units. This includes six tertiary education institutions across New Zealand, and three international academic development unit partners. Each member of the research team will coordinate a local COP of lecturers as practitioners exploring the development of eportfolios and SOTEL to enhance and reflect upon their teaching praxis. Each COP will be comprised of 4 to 6 lecturers and an academic advisor to base the projects within a collaborative design-based research methodology. These COPs will be formed within a department that will meet weekly face-to-face to support one another as they participate within the wider CMALT cMOOC online network. We aim for approximately 50 participants in the first iteration of the CMALT cMOOC. While this number of participants is hardly ‘massive’ in the traditional sense of a MOOC, we are more interested in the quality of the participant experience and the capacity to scale this model in future iterations.

Guiding design principles

Design principles were identified through the literature on designing authentic learning and scaffolding innovative pedagogies (Cochrane, Narayan, & Burcio-Martin, 2015; Cochrane, Narayan, Burcio-Martin, et al., 2015), and through our prior experiences of developing PD cMOOCs to support projects such as the #NPF14LMD AKO Aotearoa funded project (Cochrane & Narayan, 2016b; Cochrane, Narayan, Burcio-Martin, et al., 2015; Frielick et al., 2014). The six design principles (DP1-DP6) are summarized as:

- DP1: Creating a supporting ecology of resources
- DP2: Nurturing a network of communities of practice
- DP3: Design of activities to trigger sharing of participant-generated praxis examples
- DP4: Modelling collaboration and active participation within a global community
- DP5: Embedding SOTEL within an EDR framework
- DP6: Mapping activities and user-generated content to existing accreditation pathways

These design principles inform four key elements of the project:

1. Establishment of an online network of face-to-face communities of practice
2. Design of a supporting Ecology Of Resources (EOR) using mobile social media
3. Design of weekly activities to trigger sharing of participant-generated praxis examples
4. Accreditation of participant eportfolios via CMALT

The CMALT cMOOC scaffolds a network of COPs exploring technology enhanced learning in a variety of higher education contexts, and also provides a platform for developing and nurturing global research collaborations. The cMOOC explicitly integrates SOTEL through preparing participants to submit eportfolios for certified membership of the association for learning technology (CMALT) accreditation, effectively updating Boyer’s (1990) SOTL model of scholarship for the open social scholarship age. The cMOOC is designed around a series of triggering events intended to facilitate the sharing of participant-generated content, open scholarship, and SOTEL within a foundational DBR methodology (Bannan, Cook, & Pachler, 2015), connecting theory, practice, and critical reflection. We have applied McKenney and Reeves (2012) generic model of educational design research to the context of designing the CMALT cMOOC. Figure 2 outlines the generic EDR model aligned to our key supporting learning theories and frameworks embodied in our six design principles (DP1-DP6) added to the diagram in italics.

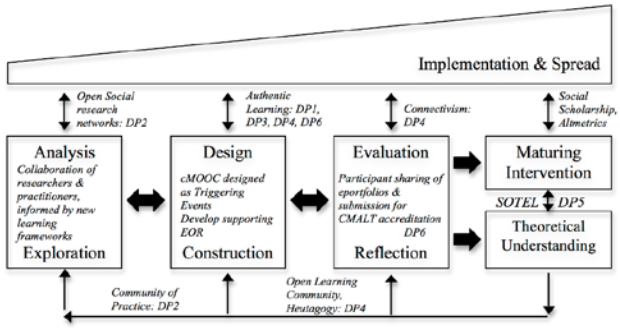

Figure 2: Generic model of EDR (from McKenney and Reeves, 2012; p159) applied to the design of the CMALT cMOOC framework.

While McKenney and Reeves do not assign a separate phase to the wider dissemination and evaluation of research (they label this maturing intervention and theoretical understanding in their generic model), we follow Bannan, Cook and Pachler (2015) in assigning this as a fourth DBR/EDR phase via Haynes (2016) definition of the scholarship of technology enhanced learning (SOTEL). The goal of our framework is to enable the explicit design of learning experiences around new pedagogies such as rhizomatic learning (Cormier, 2008), social constructivism (Head & Dakers, 2005; Vygotsky, 1978), heutagogy (Hase & Kenyon, 2007; Luckin et al., 2010), authentic and ambient learning (Herrington, Reeves, & Oliver, 2009), and connectivism (Siemens, 2005). The principles and values that inform the development of participant CMALT portfolios are (from CMALT Guidelines, https://www.alt.ac.uk/get-involved/certified-membership/cmalt-support):

- A commitment to exploring and understanding the interplay between technology and learning.
- A commitment to keep up to date with new technologies.
- An empathy with and willingness to learn from colleagues from different backgrounds and specialist options.
- A commitment to communicate and disseminate effective practice.

The content of a CMALT portfolio should include several sections that each includes a description of what the participant has done, recent evidence to support this, and reflection upon what was learnt. The CMALT portfolio can take a range of digital formats including: A Word document; A Google Site; An e-portfolio; and a PODcast or VODcast. Table 2 provides an indicative overview of a model of the CMALT cMOOC design mapped to the CMALT portfolio criteria, based upon our Mosomelt cMOOC prototype (Cochrane, Narayan, & Burcio-Martin, 2015).

Data collection

1. Ethics consent process

At the beginning of the first iteration of the CMALT cMOOC participants will be invited by an independent colleague to view an online consent form, online participant information document, and participate in an anonymous online feedback survey using Google Forms. Participants will be informed that their social media activity and online profiles will be public, but their data will not be included in analysis if they choose to later withdraw from the project.

2. Pre cMOOC survey

In order to gain insights into the prior experiences and teaching strategies of the participants we will invite participants to complete a simple Surveymonkey survey in the first week of each iteration of the cMOOC. The #mosomelt pilot survey indicated that while #mosomelt participants had experience of using a variety of technologies in teaching, the use of a presentation tool such as PowerPoint/Keynote/Prezi as their main teaching tool dominated their in class use of technology (65% 2015, 64% 2016). The prior use of any form of social media in teaching was typically used by less than 20% of respondents. 50% of respondents associated their teaching practice as student-centred (andragogy), with social constructivism and problem based learning being the most popular theoretical frameworks employed (57%). Similarly, we anticipate that participation in the CMALT cMOOC will challenge participants to move beyond teacher-centred presentation technologies and their accustomed safe set of interaction tools to explore technologies that enable student-determined learning environments.

Table 2. CMALT cMOOC weeks 1-7 model outline

Topic	CMALT mapping	Triggering events
Week 1	Introduction to CMALT accreditation process and establishment of participant eportfolios, and Developing a contextual statement	Participants invited to join the CMALT cMOOC G+ community, and share ideas and social media via the #CMALTcMOOC hashtag. Setup of individual Wordpress eportfolios, ethics consent, and initial participant survey of prior experience. Shared collaborative participant map. Creating a concise biography and professional goals on Wordpress, and shared research profiles on: Researchgate, Academia.edu, Mendeley, ORCID, and LinkedIn. Introductory Webinar
Week 2	Exploring operational issues	Blog post or VODCast discussing the constraints and benefits, technical knowledge, and deployment of learning technologies. Digital Literacy mapping exercise. Exploring innovative pedagogies – guest webinar from international partner.
Week 3	Exploring learning, teaching and assessment	Invitation to participate in SOTEL survey. Sharing assessment designs for peer feedback via Google Docs and a shared Project Bank via Wordpress. Webinar on TEL frameworks
Week 4	Exploring the wider context	Blog post or VODCast discussing legislation, policies and standards, and exploring the wider impact of Altmetrics and SOTEL. Webinar on collaboration
Week 5	Collaboration and Communication	Share examples of how you collaborate with your peers - this could be an interactive Google Map of research presentations or a team project, a G+ Community, a social media hashtag, a Twitter 'Moment' of a collaborative event, etc. Group G+ Hangout
Week 6	Choosing a specialisation	Blog post or VODCast describing an area of specialisation relevant to your context. Hangout sharing specialisations
Week 7	CMALT portfolio publication options	Overview of digital publishing formats and CMALT portfolio submission requirements. Invitation to further PD cMOOCs such as Mosomelt. Invitation to final participant survey. Participant Hangout reflecting upon their CMALT cMOOC experience.

3. Participant ePortfolios
cMOOC participants will be invited to locate themselves on a collaborative participant map. The map will create a geographical context for the cMOOC that can be built over multiple iterations. Participants will be invited to link elements of their social media portfolios into their own points of interest on the collaborative map. The map will be public, however contributions to the map will be limited to cMOOC participants. This will help create a sense of participation within a global community. For example, the #mosomelt map generated 533 views in 2016. Participants who submit completed portfolios for CMALT accreditation will be invited to share their portfolios as examples for others. We will model and encourage the development and sharing of open educational resources, and active participation in open research networks.

4. Social media activity
Participants will sign up for the cMOOC by creating and sharing several social media profiles via an online form. These include: Twitter, a blog site, and Google Plus. As participants sign-up they will be welcomed into the community via a Twitter post and invited to become members of the cMOOC G+ Community. Their blogs will also curated via RSS feeds into a shared blog roll. These form the basic communication and community channels for the cMOOC.

5. Post cMOOC survey
Participants will be invited to complete an online evaluation survey at the end of the CMALT cMOOC.

Data analysis
We will use triangulation of shared project activity via a variety of social media, community posts and comments, interviews, surveys and focus groups from the six institutional partners, and the identification of design principles for authentic designing professional development cMOOC. Participant social media usage will be analysed via visual conversational analysis tools such as TAGSExplorer (Hawksey, 2011) for Twitter. Other social media usage analytics such as Google Street View and YouTube views and peer ratings will provide analysis of the geographic reach and impact of the project artefacts. The participants are all peer participants, with no links between the project and formal career progression requirements at any of the participating institutions. All participant data will be anonymous.

Ethical and quality assurance processes
The project will apply through each of the participating institutions' ethics committee for ethics consent. All participants will be supplied with an information sheet regarding the aim and scope of the research, participants will choose to participate in the research by signing consent forms (administered by a third party), and surveys and interviews will be conducted by a third party. There are no departmental reporting lines between the researchers and the participating lecturers and therefore no issues impacting performance appraisals. There are no foreseen conflicts of interest between the participants and the researcher or the co-researchers of the project. The CMALT cMOOC does not involve any formal assessment processes, assessment is purely via participation and formative peer feedback. The CMALT accreditation process is external to the participating institutions and the researchers, and is part of an existing third party accreditation system administered by Ascilite and the UK Association for Learning Technologies as third party professional societies. The researchers and lecturers will collaborate as peers within the project COPs with a shared domain of interest of exploring creative pedagogies for better student outcomes. Participants will be made aware that participation in the research is voluntary, they can withdraw at anytime, and participation or non-participation will not impact their career progression or CMALT submissions. The framing of the project around a network of COPs also means that any identified issues can be discussed and dealt with in a timely matter as each COP will meet weekly face-to-face. Publication of the research will be targeted towards high-ranked open access peer reviewed journals and conference proceedings, and the Altmetrics (Priem, Taraborelli, Goth, & Neylon, 2010; Williams & Padula, 2015) impact of the research will be tracked via social media such as Twitter conversations, and the development of participating researcher and lecturer ORCID (Open Researcher and Contributor Identifier) profiles (Buckland & Bass, 2015; ORCID, 2015). Two external SOTEL research experts will be asked to become moderators and advisors for the project, and will meet with the research team at least once per year.

Next steps of the project
Initial reaction to the CMALT cMOOC project have been very positive, with over 130 interested readers and 21 followers on our Researchgate project page https://www.researchgate.net/project/CMALT-cMOOC-Developing-a-scalable-lecturer-professional-development-framework. The project aims to produce direct and tangible outcomes for students through developing an agile and scalable framework for lecturer professional development, enabling lecturers to design and implement innovative teaching and learning strategies for their students. Laurillard (2016) argues that professional development MOOCs can indirectly benefit disadvantaged learners. The project cMOOC will provide participating lecturers with an authentic experience as learners themselves within an innovative collaborative framework that will model new pedagogical strategies that they can integrate into their own teaching praxis, improving student experience and outcomes. The project cMOOC will be mapped to the five key areas of CMALT accreditation. Each of these key areas has benefits for

learners. Students will benefit from lecturers who gain deeper understandings of how to integrate educational technology within the curriculum and the supporting infrastructure requirements. Students will also directly benefit through the design of more authentic learning experiences and assessment strategies. Participating lecturers will also develop the confidence to have a voice within their institutions around the critical issues surrounding educational technology. Participants will be supported by participation within a global network of educational technologists and this collaborative experience will influence their design of collaborative learning experiences for their own students. Students will also benefit from their lecturers exploring new and emerging technologies for teaching and learning within a supporting framework.

As an integral element of participation in the project, participants will design and share examples of best practice and innovative teaching and learning activities and strategies. This will form a database of learning activities and assessments that can be used and modified by the participants, their colleagues, and potentially any interested academic globally. Learners will directly benefit as the participants put into practice these new strategies and critically reflect upon them as part of their CMALT portfolio. Thus participant's CMALT portfolios will provide critical evidence of their engagement and implementation of innovative teaching and learning strategies and technology integration. As a global community CMALT membership (Deepwell & Slater, 2012) initiated in 2005 (https://www.alt.ac.uk/certified-membership) is currently around 360 members. The project will provide a catalyst for significantly increasing this select membership, in particular growing current New Zealand membership from 6 current holders to between 60-100 by the end of the project. As each of these lecturers will be teaching at least 25 students each, the project will have direct impact on at least 1200 students over the first two years of the project, and many more beyond. Beyond the end of the project we anticipate participating institutions will continue with versions of the project cMOOC and CMALT accreditation, with intakes of lecturer cohorts every six months, leading to an annual completion of CMALT throughout New Zealand higher education institutions by an estimated 100 new members per year.

Project timetable

1. Literature review by primary research team: early 2016
2. Development of cMOOC professional development framework, and the evaluation of the Mosomelt cMOOC (Cochrane & Narayan, 2016a): 2016
3. Establishment of community of practice of the principle researchers from each institution: 2017
4. Establishment of local communities of practice at each participating institution comprised of a principle researcher and 4 to 6 lecturer practitioners each: semester 1 2018
5. Design, implementation and evaluation of CMALT cMOOC: semester2 2018
6. Identification of design principles for designing authentic learning experiences from first project iterations: end of 2018
7. Redesign of the CMALT cMOOC for a second iteration in 2019
8. Analysis of research project results and development of transferable design principles for designing authentic professional development via a cMOOC framework and CMALT accreditation: 2019
9. Publication and dissemination of research: end of 2019

Conclusions

In this paper we propose reimagining higher education professional development as a network of communities of practice supported by a cMOOC mapped to the CMALT accreditation pathway. Using a design based research methodology the cMOOC is designed to model innovative teaching practice and provide a transferable framework (Salmon et al., 2015) that leverages existing global accreditation via creating evidence for participant portfolios for submission to HEA and CMALT, without the neoliberal connotations of mandating completion of a generic PgCert in higher education. The CMALT cMOOC is designed to facilitate an authentic, flexible, agile, and scalable academic PD experience. We have informed the design of the cMOOC through the identification and implementation of six design principles. While this paper focuses upon the design and implementation phase of the project, future papers will focus upon the evaluation and reflection phase of the DBR project.

References

Association for Learning Technology (ALT). (2015, March 2015). Alt certified membership (cmalt), ukpsf and recognition of fellow of the higher education academy and accreditation of an institution's staff development provision. 2016, from http://bit.ly/2a9DljX

Bannan, Brenda, Cook, John, & Pachler, Norbert. (2015). Reconceptualizing design research in the age of mobile learning. *Interactive Learning Environments*, 1-16. doi: 10.1080/10494820.2015.1018911

Barnett, Ronald. (2012). Learning for an unknown future. *Higher Education Research & Development, 31*(1), 65-77. doi: 10.1080/07294360.2012.642841

Boyer, E. (1990). *Scholarship reconsidered: Priorities of the professoriate*. Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

Buckland, Amy, & Bass, Michelle. (2015, 8 December 2015). Author and research identifiers. Retrieved 27 January, 2016, from http://guides.lib.uchicago.edu/ORCID

Cochrane, Thomas, & Narayan, Vickel. (2016a). Evaluating a professional development cmooc: Mosomelt. In S. Barker, S. Dawson, A. Pardo & C. Colvin (Eds.), Show Me The Learning. Proceedings ASCILITE 2016 Adelaide (pp. 139-150). University of South Australia, Adelaide, Australia: Ascilite. Retrieved from http://2016conference.ascilite.org/wp-content/uploads/ascilite2016_cochrane_full_mon_pm.pdf.

Cochrane, Thomas, & Narayan, Vickel. (2016b, 24-26 October). *Nurturing collaborative networks of practice.* Paper presented at the Mobile Learning Futures – Sustaining Quality Research and Practice in Mobile Learning, Proceedings of the 15th World Conference on Mobile and Contextual Learning, mLearn 2016, UTS, Sydney, Australia.

Cochrane, Thomas, & Narayan, Vickel. (2016c). Principles of modeling cops for pedagogical change: Lessons learnt from practice 2006 to 2014. In J. McDonald & A. Cater-Steel (Eds.), *Implementing communities of practice in higher education:dreamers and schemers* (Vol. Part IV, pp. 619-643). Singapore: Springer.

Cochrane, Thomas, Narayan, Vickel, & Burcio-Martin, Victorio. (2015). Designing a cmooc for lecturer professional development in the 21st century. In J. Keengwe & G. Onchwari (Eds.), *Handbook of research on active learning and the flipped classroom model in the digital age* (pp. 378-396). Hershey, PA, USA: IGI Global.

Cochrane, Thomas, Narayan, Vickel, Burcio-Martin, Victorio, Lees, Amanda, & Diesfeld, Kate. (2015, 29 November - 2 December). *Designing an authentic professional development cmooc.* Paper presented at the Globally connected, digitally enabled, Proceedings the 32nd Ascilite Conference, Curtin University, Perth.

Connell, Raewyn. (2009). Good teachers on dangerous ground: Towards a new view of teacher quality and professionalism. *Critical Studies in Education, 50*(3), 213-229. doi: 10.1080/17508480902998421

Cormier, Dave. (2008). Rhizomatic education: Community as curriculum. *Innovate, 4*(5), np. available http://davecormier.com/edblog/2008/2006/2003/rhizomatic-education-community-as-curriculum/.

Deepwell, Maren, & Slater, John. (2012). *The changing role of learned bodies and membership organisations: Some UK experiences.* Paper presented at the ASCILITE-Australian Society for Computers in Learning in Tertiary Education Annual Conference.

Frielick, Stanley, Cochrane, Thomas, Aguayo, Claudio, Narayan, Vickel, O'Carrol, Dee, Smith, Nell, Wyse, Pam. (2014, 12 April 2015). Learners and mobile devices (#npf14lmd): A framework for enhanced learning and institutional change. from https://akoaotearoa.ac.nz/learner-mobile-devices

Gosling, David. (2010). Professional development for new staff – how mandatory is your post graduate certificate? *Educational Developments: The Magazine of the Staff and Educational Development Association Ltd (SEDA),* 1-4.

Hall, Julie. (2010). Theorising resistance to engagement with the professional standards framework. *Professional development for new staff–how mandatory is your Post Graduate Certificate?, 11,* 14-16.

Hase, Stewart, & Kenyon, Chris. (2007). Heutagogy: A child of complexity theory. *Complicity: an International Journal of Complexity and Education, 4*(1), 111-118.

Hawksey, Martin. (2011). Twitter: How to archive event hashtags and create an interactive visualization of the conversation. Blog Retrieved from http://mashe.hawksey.info/2011/11/twitter-how-to-archive-event-hashtags-and-visualize-conversation/

Haynes, Daniel. (2016). Introducing sotel. *International Journal for the Scholarship of Technology Enhanced Learning, 1*(1), 1-2.

Head, George, & Dakers, John. (2005). Verillon's trio and wenger's community: Learning in technology education. *International Journal of Technology and Design Education, 15*, 33-46.

Herrington, Jan, Reeves, Thomas, & Oliver, Ron. (2009). *A guide to authentic e-learning*. London and New York: Routledge.

Jordan, Katy. (2014). Initial trends in enrolment and completion of massive open online courses. *The International Review of Research in Open and Distributed Learning, 15*(1).

Kill, Megan, & Stroud, Joanna. (2016, 19-20 April). *Massive open online courses and professional* *development.* Paper presented at the OER16: Open Culture, University of Edinburgh, UK.

Kopcha, Theodore J, Schmidt, Matthew M, & McKenney, Susan. (2015). Editorial 31(5): Special issue on educational design research (edr) in post-secondary learning environments. *Australasian Journal of Educational Technology, 31*(5), i-ix. doi: http://dx.doi.org/10.14742/ajet.2903

Laurillard, Diana. (2016). The educational problem that moocs could solve: Professional development for teachers of disadvantaged students. *2016, 24*. doi: 10.3402/rlt.v24.29369

Luckin, Rosemary, Clark, Wilma, Garnett, Fred, Whitworth, Andrew, Akass, Jon, Cook, John, Robertson, Judy. (2010). Learner-generated contexts: A framework to support the effective use of technology for learning. In M. Lee & C. McLoughlin (Eds.), *Web 2.0-based e-learning: Applying social informatics for tertiary teaching* (pp. 70-84). Hershey, PA: IGI Global.

Mackness, Jenny, & Bell, Frances. (2015). Rhizo14: A rhizomatic learning cmooc in sunlight and in shade. *Open Praxis, 7*(1), 25-38. doi: http://dx.doi.org/10.5944/openpraxis.7.1.173

McDowell, James, Raistrick, Andrew, & Merrington, Jane. (2013). *Enhancing institutional practice through cmalt accreditation*. Paper presented at the ALT-C 2013 - Building new cultures of learning, University of Nottingham, UK. http://eprints.hud.ac.uk/19914/

McKenney, Susan, & Reeves, Thomas. (2012). *Conducting educational design research*. London: Routledge.

Milligan, Colin, & Littlejohn, Allison. (2014). Supporting professional learning in a massive open online course. *2014, 15*(5).

ORCID. (2015). Orcid statistics. Retrieved 21 December, 2015, from https://orcid.org/statistics

Priem, J, Taraborelli, D, Goth, P, & Neylon, C. (2010, 26 October). Altmetrics: A manifesto. Retrieved 19 June, 2015, from http://altmetrics.org/manifesto/

Salmon, Gilly, Gregory, Janet, Lokuge Dona, Kulari, & Ross, Bella. (2015). Experiential online development for educators: The example of the carpe diem mooc. *British Journal of Educational Technology*, n/a-n/a. doi: 10.1111/bjet.12256

Siemens, George. (2005). Connectivism: Learning as network-creation. *eLearnspace,* (10 August). http://www.elearnspace.org/Articles/networks.htm

University of Leeds. (2016). Blended learning essentials: Accreditation pathways. 2016, from https://www.alt.ac.uk/sites/alt.ac.uk/files/public/Guide_paths to accreditation_v9.pdf

Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Williams, Catherine, & Padula, Danielle. (2015). *The evolution of impact factors: From bibliometrics to altmetrics* (pp. 31). Retrieved from http://docs.scholastica.s3.amazonaws.com/altmetrics/evolution-of-impact-indicators.pdf

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Blended learning as a disruption in a vocational education building program

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A building and construction teaching team in a vocational education school (within a university in Melbourne) introduced a blended learning model to one-third of their program. Traditionally, building students are accustomed to a high ratio of face-to-face learning, therefore, this new model disrupted the experience of both teacher and student. The model was examined using e-learning evaluation research methodology and findings are presented using the framework of Glazer's (2012) characteristics of blended learning. Examination of the program identified areas in need of attention, such as active learning and online interaction and communication. Finally the authors promote the use of Glazer's framework as a pedagogical evaluation tool for blended learning designs, while drawing out a particular focus on teacher presence as a distinct item in this framework.

Introduction

A building and construction teaching team in a dual sector university in Melbourne introduced a new technology-enhanced pedagogical model that disrupted the way the vocational teachers and students typically teach and learn. While building and construction students traditionally experience a high ratio of face-to-face learning, this discipline is a leader in the adoption of e-learning by trade teachers compared to other Australian vocational education (VE) disciplines (Callan, Johnston & Poulsen, 2015). The VE building teaching team was initially inspired to introduce an inverted or 'flipped classroom' model after attending a SoTL (Scholarship of Teaching and Learning) presentation in a higher education (HE) context. However, traditional HE styled lectures were introduced as part of the VE model, a decision that was somewhat antithetical to a flipped model. The team subsequently recognised that their intervention corresponded more broadly to the idea of blended learning practice.

Students in the Diploma of Building and Construction ('Building') learn business aspects of the industry, learning how to plan, coordinate and control construction projects from inception to delivery. The two-year Diploma has two entry points per year; a student may commence first year in February or July. The Building teachers refer to Semester 1 to 4 (S1-S4) to describe the stages of the diploma.

In 2015 the implementation of the model in a single Building course (subject) was endorsed by a university team teaching award. Simultaneously, the teaching team successfully pitched a project to target 600 of the diploma's 1,800 nominal teaching hours for similar intervention. Four subject areas, one from each semester of the program including three single courses and one cluster of three courses, were redesigned to a blended learning model using a rapid, just-in-time development model. The intention was for a consistent subject design involving the courses:

- ASP (S1 of 4): 'Apply structural principles to residential low-rise constructions'
- LCT (S2): 'Administer the legal obligations of a building or construction contractor'; 'Select, prepare a construction contract'; 'Prepare, evaluate tender documentation'
- ENV (S3): 'Environmental management practices and processes in building and construction'
- IDS (S4): 'Identify services layout and connection methods to medium rise construction projects'.

The owning school then contemplated wider adoption of the model and requested university support to evaluate the intervention, to allow evidence-based modifications, and to inform decision-making regarding up-scaling. The ensuing research project, as presented in this paper, was designed using e-learning evaluation research (Phillips, McNaught & Kennedy, 2012). The data collection involved a me-us-IT/it approach in which the 'me' view was harnessed from students, teachers and technology support staff who were individually interviewed (and students surveyed); the 'us' view from students interviewed in groups, and from a culminating workshop with the teaching team. In most individual interviews, participants demonstrated their activities via laptop to illustrate their interactions and role as related to the new model, thus providing their views of pedagogy and technology.

Literature review

Prior to focusing on blended learning this literature review begins by mentioning the inverted or 'flipped classroom' model, the genesis of the Building teachers' change in pedagogy. The flipped classroom intervention is one model of blended learning in tertiary education that utilises face-to-face and online learning modes in a symbiotic fashion. 'Front loading' where exposure to online content occurs first, is built upon in face-to-face class experiences (Glazer, 2012). The flipped classroom pivots on the notion that activities which students have traditionally experienced in the classroom or lecture theatre take place prior to on-campus attendance—relying heavily on videos, presentations or other media for learning via acquisition (*sensu* Laurillard, 2012)—while more interactive or 'homework' like activities are experienced in the physical classroom environment (Al-Zahrani, 2015; Lage, Platt & Treglia, 2000). This enables moving relatively passive learning of lower cognitive levels out of a lecture format to the online environment, while active learning experiences demanding a higher cognitive level become the focus of the physical, face-to-face environment (Toto & Nguyen, 2009).

Blended learning enables a wider range of pedagogical designs in tertiary education beyond the flipped classroom. In Bonk and Graham's much-cited *Handbook of Blended Learning*, Cross (2006) criticises oversimplifications of blended learning. This pedagogical approach is often defined in ways that avoid explicit use of the term 'blend' or its synonyms, referring simply to multi-modal (online and face-to-face) learning (e.g. de Leng et al, 2010; Garrison & Kanuka, 2004; Graham, 2006). It becomes important to look beyond simplistic definitions that may overlook the need for a synergy between the learning environments. For example, Garrison and Kanuka add the need for a "thoughtful integration of classroom face-to-face learning experiences with online learning experiences" using the strengths of both (2004, p.96). Graham's initially oversimplified working definition: "Blended learning systems combine face-to-face instruction with computer-mediated instruction" is given more weight by the qualifier: "the ongoing convergence of two archetypal learning environments" (2006, p.66). More recent technological enhancements in interaction, communication, and socialising, for example, enable a higher fidelity of learning in online environments.

In vocational education contexts blended learning has been described as:

> the systematic integration of learning in face-to-face and online situations within the same course in order to support the development of understanding (Bliuc et al, 2012, p.238)

> e-learning… as part of a blended learning experience where it is embedded into teaching, training and learning… [and] is at its best when it… encourages collaborative learning and interaction between many groups of people (e.g. teachers employers and apprentices) who accept the benefits of the integration of e-learning within other forms of delivery (Callan, Johnston & Poulsen, 2015, p.296).

Blended learning is more effective in a symbiotic relationship, developed through the mutual alignment and combination of complementary and connecting attributes from each learning environment (Garrison & Vaughan, 2008; Glazer 2012; Littlejohn & Pegler 2007). Glazer (2012) identifies several characteristics of blended learning, drawn from a range of practice examples, (paraphrased and/or further interpreted by the authors) here listed in our order of G1-G7:

- G1. Various pedagogies: specific pedagogical designs accommodated; not a one-approach-fits-all.
- G2. Active learning: going beyond supporting active learning to demanding it; provide strategies to process information, check their understanding, revise knowledge, and practice skills.
- G3. Time expansion: students may choose to spend longer learning online than they typically would in timetabled classes.
- G4. All students have a voice: online discussion allows each to contribute regardless of speed or personality; it is obvious who contributes; additional benefits of reflection and proofreading posts.
- G5. Face-to-face time is valuable: class time is freed from information transmission to include deeper learning opportunities, such as complex discussions, debates, team presentations, community building, hands-on activities, high-level evaluations, trouble-shooting and problem-solving.
- G6. Learning responsibility and knowledge organisation: develop lifelong learning attributes; organise new knowledge to employ as they move between modes; rise to the challenge of more control and responsibility; exercise discretion where they have choice to personalise their learning.
- G7. Subject layering: an interdependence between the learning environments to experience layers of content by attending to both online and face-to-face learning, with visible teacher presence/feedback in each.

Glazer's characteristics are supported by other theoretical and/or practice examples. Güzer and Caner (2014) reviewed blended learning studies from 1999 - 2012, finding that support, flexibility, enjoyment and motivational factors were insufficient to promote successful learning. They concluded that students needed to be more active (G2) via social interaction and collaboration (G4). They also found that despite use of blended learning from school through to postgraduate levels that pedagogical design needed more attention (G1, G7) to maximize the benefits of this approach.

Douglas et al (2014) studied blended learning with the aid of an online video annotation tool across nine student cohorts, comprising six discipline areas from three educational levels (vocational, undergraduate and postgraduate). They found that curriculum design involving online learning and how it aligned with other subject components was a significant success factor (G1, G7). Further, they found that sound pedagogical design should be coupled with clear communication of the purpose of the pedagogy, providing a narrative to aid students' understanding of the potential value they can glean from their learning (G6).

In engineering education, Toto and Nguyen (2009) received student survey feedback on their blended learning model indicating that the (flipped classroom) pedagogy was appropriate for the topics (G1) and suitable layering occurred (G7), in that students who watched a 30-minute video lecture online felt that they were more prepared to tackle problems provided in class. Additional scaffolding involved a 'door check quiz' where students answered a few short questions based on the video. This had the benefit of helping students create a mental knowledge organiser regarding key concepts (G6). The students largely valued the class time for group work and problem-solving, albeit some individuals disliked the new class structure, such as waiting time or lack of rigid order (G5). While active learning was promoted in the classroom, it appears that learning online was less active (G2). Students noted the tendency to 'sit back and absorb' or to be 'distracted' while watching a 30-minute video lecture.

Callan et al (2015) highlight that in blended learning design for vocational education more attention should be paid to interaction and collaboration (G2, G5) and subject layering (G7). Bliuc and colleagues reinforce the need for subject layering, arguing that it is "essential that different elements of the learning experience are integrated in order to provide students with a holistic learning experience" (2012, p.238).

Methodology

To achieve scholarly evaluation of the Building blended learning model, this study employed an e-learning evaluation research methodology, within a qualitative inquiry research paradigm. E-learning evaluation research recognises that online learning environments or e-learning artefacts are the result of design activities, including resources, communication technologies and learning tasks (Phillips, McNaught & Kennedy, 2012). This approach requires the input of key stakeholders (*ibid*.) therefore participation was sought from students, teachers and technological support personnel.

The research questions were originally framed in response to the flipped classroom brief provided to the researchers. After the initial stages of investigation the first question was subsequently updated to reflect the blended learning model:

1. How is the blended learning model designed? What constitutes the model and how do the components align?
   (a) How do students learn from, and
   (b) How do teachers teach using: the online components compared to the on-campus/face-to-face components of the program?
   (c) Do students value their learning from the model? Why/why not?
2. Can the design of the model be improved to enhance the learning experience? If yes, how?

Within an e-learning evaluation methodology (Phillips et al, 2012), a range of data collection methods were employed (see Table 1). A culminating teaching team workshop was inspired by activity theory and expansive learning, allowing contradictions related to the teaching objective to surface, with the potential to initiate new forms of practice (Engeström, 2001). Students enrolled across the Diploma numbered almost 500, yet the low student participation numbers are a limitation of this research. Conversely, almost all the Building teachers participated in either an individual interview, the teaching team workshop, or both. There was a gender mix across both groups, albeit the majority were male.

The research questions adequately served the purpose of data extrapolation for report creation and subsequent submission to the owning school within the university. For deeper analysis, this paper used the data elicited from these questions, organised and analysed within NVivo qualitative data software, to allow themes to emerge that the authors aligned to Glazer's (2012) blended learning characteristics.

University ethics clearance was gained prior to data collection. Codes are used in this paper to protect confidentiality while differentiating participants. Student codes are S1-S4 for individual interviews, SG1-SG2 for groups, SQ for student questionnaire; teachers T1-T5 for individual interviews, TW for teacher workshop; and TS1 for technology support staff interviewed.

Table 1: Data collection range (note: it = pedagogy; IT = educational technology)

Participant group	Data collection methods and participant numbers	View from/of Me. Us. it/IT
Students (*n* = 24)	Online questionnaire (*n*=14) (primarily qualitative)	Me. it
	Interactive interviews (*n*=10) • Individual (incl. demonstration) (*n*=4) • Group (2: *n*=2; *n*=4)	Me. it/IT Us. it
Teachers (*n*=7)	Interactive interviews • Individual (incl. demonstration) (*n*=5*)	Me. it/IT
	• Teaching team workshop (*n*=6*) *(*4 teachers participated in both)*	Us. it
Technical support (*n*=1)	Interactive interview (*n*=1) • Individual *(1 teacher also had a partial technical support role)*	Me. IT

Findings

It was clear from the teacher interviews and workshop (and reinforced in some student interviews) that the teachers shared at least one objective: facilitate student learning and progression toward their future careers. It was universally recognised that the model needed improvement.

This section presents selected data from the study that relate to Glazer's (2012) characteristics of blended learning, described in the literature review of this paper. This includes pedagogical approach (G1), active learning (G2), time expansion (G3), student voice (G4), valuable face-to-face time (G5), learning responsibility and knowledge organisation (G6), and subject layering (G7).

Pedagogical model (G1)

Descriptions of the Building blended learning model across the data mainly relied on structural elements, which were in turn represented inconsistently by participants. A composite representation, based on the most similar descriptions across the data, is that the students participate in (1) lecture; (2) online learning comprising: a) recorded lecture, b) worksheet and c) online session including d) quiz; and then (3) tutorial/workshop. Overall, there was little on the pedagogical reasoning provided for the blended learning model. First intended as a flipped classroom, the model was compromised when lectures were introduced to students who hadn't previously experienced this format, by vocational teachers who hadn't previously lectured. At some point teachers became aware of this anomaly and changed their terminology to blended learning, without further adjustment to the pedagogical design, and with occasional terminology slippage. One teacher explained, "Flip is a component of the blended model, as blended has a lot of things in it: lecture, online, workshop or tutorial as it's called. Therefore, flip doesn't completely describe what we do" (T1).

A student pair interviewed (SG1) identified structural variation between courses. They expected the weekly format to be a lecture, followed by online activities including a quiz, followed by a tutorial. They agreed "That's what they said is meant to happen. It has not happened like that at all, not once." The two students experienced the iterations of all four blended learning subjects (including when first titled as 'flipped'). These students highlighted that the timetabling of large cohort lecture theatres negatively constrained one subject (ASP) to a lecture-online-lecture model, while another (LCT) always timetabled in a computer lab or classroom meant they experienced tutorial-online-tutorial. This was coupled with constraints for one cohort's timetabled attendance on Monday and Tuesday, resulting in Monday night being the only time available to complete the online learning.

A student interviewed from a newer cohort referred generically to 'classes', where "we have two classes in a week.... the first one it's, it's a bit theoretical, you basically learn the framing members and stuff. And the second one… goes to the math part of it… the second class is I think more important to me. The first one is just the introduction I would say. In the middle we have this online lecture where you learn more about more detailed things" (S2; several filler words removed).

Active learning (G2)

Student descriptions of their actions in the Building blended learning model indicate that the tutorials/workshops are the most interactive element, compared to less interactive learning demands in the lecture and the online elements.

Half the student questionnaire respondents said that they only passively view the online resources before attending class, and others were strategic in minimising viewing if at all (see Table 2). A minority of activities were conveyed, relating to note-taking, completing the quiz, and assessment-related work.

Table 2: Student questionnaire responses to actions with online resources

Theme	No.	Example response (verbatim)
Watch video/online session before class	7	• *Watch the necessary recordings before class* • *Viewed the online content including the videos and presentations.*
Watch video/online session before class PLUS an action	2	• *Watched a video, sometimes took notes.* • *watch the video on the train, or after our lecture… to complete the portfolio associated with that video... go over past videos to make sure you haven't left out any information in your assignment*
Minimise effort related to watching pre-class video/online session	2	• *Skip through the video and do the quiz 5 minutes before workshop class. didn't take note of information just sourced the information required for quiz* • *Used the videos as a reference*
Sometimes / Did not complete pre-class video/online session	3	• *I do not have a computer or laptop at home. I don't access the lecture material until they are presented in the classes* • *I used them when I needed to*
Total responses:	**14**	

During individual student interviews, strategies nominated by students to process information and check understanding included:

- *doing the online lesson… It's like the homework for us to have done before to go to class so that we have the brief understanding about the content or topic that we're going to talk about. (S1)*
- *the online content is more or less a lecture for you, so you're able to take notes… replay stuff if you didn't understand it… I do it [online work] before the lecture… and then if I have any questions I'll ask… the teacher, either in the lecture or the tutorial, depending on where I can (S3)*
- *you go to the lecture, and then the online session goes up… [you go] over the stuff that happened in the lecture, so you understand it even more. And then you need to do the online session before the class, because there's a quiz, which… tests your understanding of what you've learned. (SG2)*

Some teachers expressed disappointment that the online sessions are not more interactive, as did the technology support person who discussed production limitations including tight timelines and limited software. He conceded "the quality has dropped off a little bit this year… we seem to be getting less and less time… trying to turn stuff around in a week" (TS1). One teacher expressed: "I was advised about this, it would be very interactive... These slides are just text supported by a few images [and audio narration]" (T4). The teacher opened an online session to demonstrate how a complex scenario-based question necessitating detailed discussion is presented on one slide, moving immediately on to another slide with another complex question. This teacher compensated by showing the online sessions in class and initiating classroom discussion.

Time expansion (G3)

Flexibility in regards to 'when', and ability to spend more time with the online resources, was appreciated by almost all student participants. For example, the questionnaire asked if the online resources were easy to use; 13 respondents agreed (one didn't), with four of 12 comments noting:

- *They [online resources] can be accessed and re-watched any time*
- *They are good if you can't attend the class*
- *Can watch over and over again if I don't understand it.*
- *You can watch them at your leisure and are able to re visit the lesson when needed.*

Apart from the Monday-Tuesday cohort who were constrained to complete the online activities on Monday night, appreciation for the flexibility of the online learning was supported across student interviews with comments such as:

- *[the online learning is] basically the repetition of what's happening in the first class. It's basically helped me understand if I missed something in the class that I can repeat it, like I can watch a video, like heaps of times. Which is helpful. (S2)*
- *the first time [viewing] is just mainly getting an idea of how it's set up… and then knowing where that is for when I see a question, I can jump back to it. (S4)*
- *It provides a lot of information about the subject which you can go over it over and over if you don't understand it, which in a lecture or class you might miss it or you might not understand it as much. Where at home, it's online, you can go over and over. (SG2)*
- *I just feel it gives you more time to actually do more things or, if you need to spend more time on it, you're able to. But it's up to you… you set your own pace (SG2).*

A dissenting comment in the student questionnaire noted:

- *The nature of the lectures is that we are over-worked to learn the flip-Resources before lectures. I attend the Lectures and then go to the Flip Material to understand the lectures better. (SQ)*

All students have a voice (G4)

The findings suggest that the student voice is more isolated in the online compared to the face-to-face learning elements. For example, when students were asked in the questionnaire how they communicate with their student peers and teachers during the online learning activities and before they attend classes, a majority said there was no or limited communication with peers or teachers during their online learning (see table 3).

Table 3: Student questionnaire responses regarding communication during online activities

Theme	No.	Example response (verbatim)
No or limited communication with peers or teachers during online learning component	10	• *I communicate with my fellow students only in the classes* • *Usually during workshop/tutorial classes.* • *Not much communication* • *Don't / I don't / You don't (x5)*
Email communication or other means	3	• *i talk with my classmates in the flip course frequently.* • *Mainly email* • *Just communicate using … [university] emails.*
Total responses:	**13**	

Face-to-face time is valuable (G5)

The Building students place different value on the face-to-face elements of the blended learning model, most placing more value on the tutorial/workshop compared to the lecture. When asked in the questionnaire what they do generally in the on-campus or face-to-face classroom, several responses reflected teacher-directed activities (see Table 4).

Table 4: Student questionnaire responses to actions in the classroom

Theme	No.	Example response (verbatim)
Listen and take notes	3	•*… listen to teacher use real world examples to reinforce information. Take notes on critical information* • *I just listened and take down notes. and if ever i forgot something with the topics i'll just jump on the Blackboard* [online classroom]
Listen and discuss, +/- work on other activities (e.g. assessment tasks)	4	• *I listen to lectures. Asking questions and working on Class Activities* • *Discuss what was mentioned in the videos, what questions are on the portfolio and their answers. We then continue to work on our assignments and have the freedom to ask our teacher any questions*
Follow directions from teacher	2	• *Most of the learning occurs here with direction from the teacher.* • *Using the teacher as a reference point to do work and asking question to ensure that what I am doing is correct*
Miscellaneous	4	• *How to work in a team setting*
Total responses:	**13**	

Example quotes from interviews with teachers and students illustrate appreciation of the tutorials:

- *the first couple of workshops we'll use all that time establishing foundation, but then… to go through the analytics [problematic areas identified in online quizzes], any additional things we want to touch on in the first hour, and then the second hour we will reserve it to do assessment… [where] they can talk about anything they want. (T2).*
- *I'd keep the tutorials the way they are going because I think they're really good. It gives them the opportunity, because it's informal, they can have that feedback across [their learning.] (T3)*
- *So we'll talk for an hour, and the last hour-and-a-half everyone will be working on their assignment. Or people who haven't done online quiz will do online quizzes, it's just whatever you want to do, you do. And then we've got that whole time to ask questions. (S4)*
- *A lot of the time it's working on assignments [in tutorials] or again, if we have any questions from the lecture or the online lesson [the teacher]'s more than happy to go over stuff. (S3)*

This compares to more critical feedback for the lectures, for example, advice from students:

- *[improve] the lectures… I think they should make that more interactive... I look around in class, most people are sleeping... They should be different, they should get people from the industry and … incorporate… Kahoot's tests [student quiz/polling tool] into the lecture (SG1)*
- *Lecture unnecessary. (SQ)*
- *[time wasted when] in class lecture[r] plays the online lesson that you have already watched. (SQ)*
- *Add 1 hour to workshop class and cancel lecture. (SQ)*

Most of the teachers interviewed were critical of the lectures. However, even a supportive teacher referred to the lectures as of "no other value than to introduce the topic and create interest… it's not a classroom session, it is a lecture session" (T2). Other teachers referred to the lectures as, e.g.:

- *[students] switch off… the weekly lectures sometimes you're sort of grasping at information to give to them because it doesn't really fit to the lecture model. (T3)*
- *The lectures are not working, there are too many students in the room, there is too much noise, and only a few students sitting in the front rows are interacting. Or engaging. With the teaching material. It's not working. We need more time with the students in smaller groups. (T5)*
- *I've been told that the purpose of the lecture is to talk to them about what they'll be learning this week... I'm not going to stand in front of a group of… 50 students or whatever, and tell them what they're going to do… [So I show these online] audio supported Power Points in the lecture. [First adopted as a work-around for the Monday-Tuesday cohort who had limited online time]. (T4)*

In the culminating team workshop, the teachers were presented with aggregate views of participants. The lecture data inspired overt disagreement. Some teachers reacted with "lectures might not be best suited for every single subject"; "reduce lectures"; and have "guest speakers… [to make] lectures more meaningful to the students" (TW). A single voice counteracted with various comments on preserving the model, such as "[they] aren't being delivered as lectures. If they were… they would be doing what they're designed to do"; "The flip [sic.] program requires the lecture because it's part of what's being delivered"; and "the current lecture scenario is worked on the higher education system… students leave the VE sector, and they articulate into the higher education system, they need to be ready for higher education… 49% of them go over" (TW). A final 'agree to disagree' comment came from a 'no-lecture' stance, "we're definitely split… been split on this for a while, haven't we?" (TW).

Learning responsibility and knowledge organization (G6)

Some students responded positively to the increased responsibility for learning required in blended learning subjects, while others not so. Some of the more positive student views include, for example:

- *you get sent all the information as a lecture and you go over it, and when, say, you don't understand something there's your chance to… work out what you don't understand and you have the chance to come in and ask it in that tutorial later in the week. (S3)*
- *The best thing about it [is] that the teacher allows us to do our own research… so then when we graduate… we're independent in our own work. (S1)*

Not all students held such positive views, for example:

- *other students take advantage of video learning and dont [sic.] even take the time to watch it at home because of distractions which can cause a lot of downfall in a student's learning. (SQ)*
- *I know the aim of the vocational program is to… do it in class and learn it in classes... But… instead of showing us how to do that, they are basically, expecting us to figure it out… I am basically having a problem with that. (S2)*
- *in class you're shown… [But] unless you've spent a long time going through someone's previous assignment, then you don't know… where to begin. (S4)*
- *he'd [teacher] be stuck on something simple, the kids [straight] from high school weren't studying… [or] reading the plans and it held us back from progressing… So he stuck on one subject because fifty people in the class didn't understand it, majority of the other people understood it but he can't keep going until they catch up… when he should have just moved on and if you don't understand it do more study or seek help afterwards. (SG2)*

One of the teachers interviewed explained his aim to increase student responsibility for deep learning:

- *we're trying to teach people to think. That's what Building's about, is problem solving, yeah? So if you use this blended process correctly, what you're doing is teaching people not just to accept the material, but to think on the material. (T2)*

Subject layering and constructive alignment (G7)

The student questionnaire (SQ) indicates some support for adequate layering of content in the Building blended learning model. When asked how the online resources help toward classroom learning, a majority of students nominated that they either do help (6/14) or sometimes help (5/14), while a minority said they make no difference (3/14). When asked if they liked the learning experience of the combination of online activities and scheduled classes, 12 students responded that they liked the experience, while two did not. Three of the positive responses related to constructive alignment:

- *When I have used the online lessons they have helped me understand components in the course.*
- *The flip resources explain the lectures much more clearly. When I don't understand a particular matter, I keep coming back to the segment.*
- *When I have used the online lessons they have helped me understand components in the course.*

Within other questions (SQ), two students stated:

- *We went over the topic/contents and analyses [sic.] the content, find out the right answers. This is only useful when I watched the online session beforehand. If I don't I am stuck!*
- *a lot of the information needed for the manual we were producing could be sourced from the online videos. This is very helpful as you have the convenience to go over and watch past videos.*

In contrast, some responses to other questions (SQ) suggest an incomplete constructive alignment. For example, when asked if they would recommend the model or suggest any improvements:

- *You learn much less. Good for people who work and can't attend class. [N]ot downloadable for future reference. In person you learn more rather than watching a video. Lecture is timetabled wrong and we just watch the video anyway*
- *Have portfolio activities from the online video that you actually need to complete and it is to be graded so that students don't just skip the video, do a quiz.*

- *The lessons sometimes say different things to the online lessons which causes confusion.*

Some teachers, while demonstrating the online resources during interviews, acknowledged broad constructive alignment between elements of the blended learning model. For example:

- *the online session and the tutorial… definitely work well hand-in-hand especially when you can say alright so you've learnt this information from your online session now let's apply it in the tutorial… The lectures can serve as a bit of an introduction… I think the whole formula works really great… it comes down to whoever's designing the course to make sure that happens. (T6)*
- *online lesson supports what they should be doing in the tutorial, which is really the work… if they keep up to speed then they won't be behind. (T4)*
- *The worksheet becomes… the driver for the blended session... So lecture, take home the worksheet, do the online, then we break it all down in the workshop… Every week… [the worksheet] task will always have something to do with compiling their assessment… So you do the work, you get the benefit... they either do it or they've got problems. (T2)*

In the culminating workshop (TW), a teacher noted that the blended learning subjects form a part of the overall Building course, and that further evaluations could look across the whole program rather than just focusing on the blended learning subjects.

Discussion

The Building blended learning initiative was organically developed by the teaching team, none of whom were particularly well-versed in blended learning theory. Their reflections on practice revealed successes and challenges which we have analysed via the work of Glazer (2012).

Glazer's (2012) seven characteristics of blended learning provide a robust framework with which to evaluate the intervention in the Building program. Overall, the Building model most readily aligns to Glazer's characteristics of time expansion (G3) and learning responsibility and knowledge organisation (G6). However, not all vocational students were ready to take on the responsibility of self-directed learning that the model required. The more self-directed students were only negatively affected if the teacher used some of their face-to-face time to bring the lagging students up to speed.

The active learning characteristic (G2) was best met in the tutorial/workshop elements of the model where students tended to most value their face-to-face time (G5), while the lecture was viewed as relatively passive and least valued by the students. There was disagreement among the teachers as to the value of the lectures. Introducing lectures into a VE setting misaligns to a contemporary shift in HE blended learning away from transmission-styled lectures (e.g. Garrison & Vaughan, 2008).

Student descriptions of their actions in the online learning element tended to illustrate relatively passive learning demands (G2). While Glazer reminds us that asynchronous online learning need not be passive, Laurillard (2012) acknowledges that learning through acquisition still has a place in formal learning, albeit the challenge is to promote active engagement with content, e.g. via interaction and learner control. This aligns with studies on blended learning that call for more online interaction and collaboration (Callan et al, 2015; Güzer & Caner, 2014; Toto & Nguyen, 2009). The Building students appreciated the flexibility to access, review, and revisit the online resources as often as they needed, hence a strong alignment to the time expansion ability (G3), and affording some learner control (G6). Designing more active engagement opportunities with the online learning resources may assist the less self-directed students to better prepare for class.

Participant comments suggest that interdependence of content between learning modes, or subject layering (G7), was achieved in the main. Some students indicated a lack of confidence in using the online resources to prepare for classes or assessments. Glazer included teacher presence in the subject layering characteristic of blended learning, indicating that teacher moderation and feedback should be present in both physical and online settings. In the Building model the teacher presence was more active in the physical environment. In the online environment it was only evident through the teacher narration of presentations. The student voice (G4) was not well represented online; student communications with teachers and student peers was almost non-existent, relying more on face-to-face or email contact. Garrison, Anderson and Archer (2000) advocate the need to establish and sustain teaching presence in the online learning environment as a key component to foster a community of inquiry. They add that online teacher presence can model behaviour and influence student behaviour, manage expectations, and supplement face-to-face learning. The authors of this study recommend emphasis on teacher presence, to draw it out as a discrete or eighth characteristic, to ensure explicit attention to both:

G7. Subject layering: an interdependence between the learning environments so students experience layers of content by attending to both online and face-to-face learning.

G8. Teacher presence: visible teacher presence in each of the learning environments, including interaction, moderation and feedback, modelling the supplementary value of each setting, and managing student expectations regarding amount of online teacher presence and interaction (reinforcing Garrison et al (2000) emphasis on teacher presence).

The pedagogical approach overall (G1), while missing explicit and articulable theorising to underpin the design, was processed by the teachers in an action-research style of implementation and improvement cycles. The teachers, both in individual interviews and their collective team workshop, identified areas for improvement such as more interactivity in the online learning elements and revision of the role of the lecture in the blended learning model.

Conclusion

The authors of this paper consider that a blended learning subject design seamlessly and complementarily utilises the best attributes of both face-to-face and online teaching and learning environments. What constitutes the 'best attributes' of each environment depends upon subject-specific context, intended objectives, and access to technology and resources.

This paper explored a blended learning case via the interrelationships between the individual, team, and pedagogy enhanced by technology in the tertiary education context of a diploma in building and construction. This exploration was supported by capturing the views of the 'me' or individual student, teacher and technologist (via individual interviews and a student survey); the views of the 'us' or group (via group interviews with students and a teaching team workshop); and views of 'it' (pedagogy) and 'IT' (technology), that is, the blended learning pedagogical approach supported by technology.

The Building model was analysed in this paper via Glazer's (2012) seven characteristics of blended learning. Several characteristics were largely met; however, in the online learning environment the areas of active learning and communication require further attention. This study endorsed Glazer's characteristics as a framework to evaluate blended learning in tertiary education, while recommending the separation of teacher presence as a characteristic of its own.

A report was delivered to the owning school of the university listing recommendations for improvements to the model, as refined with the teaching team in the workshop-styled collective interview. At the time of writing no decision has been received regarding follow-up action. A perspective that remains to be explored is to situate this study on blended learning in the overall Diploma of Building and Construction in which the remaining 60% of courses are delivered using a traditional face-to-face pedagogy. Such an evaluation may illuminate a wider view of how pedagogical layering occurs within and between blended and traditional subject areas.

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References

Al-Zahrani, A.M. (2015). From passive to active: The impact of the flipped classroom through social learning platforms on higher education students' creative thinking. *British Journal of Educational Technology, 46*(6), 113-1148. http://dx.doi.org/10.1111/bjet.12353

Bliuc, A-M, Casey, G, Bachfischer, A, Goodyear, P. & Ellis, R.A. (2012). Blended learning in vocational education: Teachers' conceptions of blended learning and their approaches to teaching and design. *The Australian Educational Researcher, 39*, 237–257. http://dx.doi.org/10.1007/s13384-012-0053-0

Callan, V.J., Johnston, M.A. & Poulsen, A.L. (2015). How organisations are using blended e-learning to deliver more flexible approaches to trade training, *Journal of Vocational Education & Training, 67*(3), 294-309. http://dx.doi.org/10.1080/13636820.2015.1050445

Cross, J. (2006). Foreword. In C.J. Bonk & C.R. Graham (Eds.), *Handbook of blended learning: Global perspectives, local designs* (pp.30-39). San Francisco: Pfeiffer.

De Leng, B, Dolmans, D., Donkers, H. Muijtjens, A. & van der Vleuten, C. (2010). Instruments to explore blended learning: Modifying a method to analyse online communication for the analysis of face-to-face communication, *Computers & Education, 55*(2), 644-651. http://dx.doi.org/10.1016/j.compedu.2010.02.024

Douglas, K., Lang, J. & Colasante, M. (2014). The challenges of blended learning using a media annotation tool. *Journal of University Teaching & Learning Practice, 11*(2), 1-19.

Engeström, Y. (2001). Expansive Learning at Work: Toward an activity theoretical reconceptualization. *Journal of Education and Work, 14*(1), 133-156. http://dx.doi.org/10.1080/13639080020028747

Garrison, D.R., Anderson, T. & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and*

Higher Education, 2(2-3), 87-105. http://dx.doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D.R. & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education, 7*(2), 95-105. http://dx.doi.org/10.1016/j.iheduc.2004.02.001

Garrison, D.R. & Vaughan, N.D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. San Francisco, CA: Jossey-Bass.

Glazer, F.S. (2012). Introduction. In Glazer, F.S. (Ed.), *Blended learning; Across the disciplines, across the academy* (pp.1-12). Sterling, VA: Stylus Publishing, LLC.

Graham, C.R. (2006). Blended learning system: Definition, current trends, and future directions. In C.J. Bonk & C.R. Graham (Eds.), *Handbook of blended learning: Global perspectives, local designs* (pp.63-95). San Francisco: Pfeiffer.

Güzer, B. & Caner, H. (2014). The past, present and future of blended learning: an in depth analysis of literature. *Procedia - Social and Behavioral Sciences, 116*(2014), 4596-4603.

Lage, M.J., Platt, G.J. & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment, *Journal of Economic Education, 31*(1), 30-43.

Laurillard, D. (2012). *Teaching as a design science; Building pedagogical patterns for learning and technology*. New York, NY: Routledge.

Littlejohn, A. & Pegler, C. (2007). *Preparing for Blended e-learning*. Abingdon, UK: Routledge.

Phillips, R., McNaught. C. & Kennedy, G. (2012). *Evaluating e-learning; Guiding research and practice*. Routledge: New York

Toto, R. & Nguyen, H. (2009). Flipping the work design in an industrial engineering course. *Proceedings 39th ASEE/IEEE Frontiers in Education Conference*. (pp.1-4). San Antonio, TX.

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Student-generated multimedia for supporting learning in an undergraduate physiotherapy course

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Outside the university, rapid authoring tools and ubiquitous technologies have fuelled a rise in user-generated multimedia and participatory culture. The educational equivalent, digital student-generated content, has been heralded as one approach for supporting active and student-centered learning. This is especially relevant in tertiary education, where multimedia is mainly used as a method for transmission of content. Though student-generated multimedia may seem pedagogically ideal, especially for applied areas such as Health Sciences, the diversity of adoptions and limited evidence in the area make broad claims to its efficacy difficult to support. This study uses mixed methods to assess the outcomes of a student-generated multimedia assignment within a third-year university physiotherapy subject. This study found that all students were able to complete the assessment task in a way that demonstrated key disciplinary learning and professional communication skills despite many not having prior experience of this kind of assessment. Student survey data demonstrated that students were able to navigate between new tools and methods to achieve a complex task. While multimedia gave students new and creative ways through which to engage with practitioners, patients and the profession, attitudes varied in accordance with student self-efficacy and confidence. The self-directed nature of the task appears to be both an opportunity and a challenge. These findings further contribute to our understanding of implementing student-generated multimedia projects and extend this knowledge to the health sciences' discipline.

Introduction

The rise of ubiquitous technologies and Web 2.0 has given rise to user-generated content and participatory culture (Jenkins, Purushotma, Weigel, Clinton, & Robison, 2009). Despite this, topographies between higher education and students' own social-technical worlds remain markedly different. Higher education has, with notable exceptions, primarily adopted video as a vehicle for furthering the transmission of content from instructor to student. Alternative approaches, where students generate this multimedia, place the student at the centre of their own learning (Dyson, Frawley, Tyler, & Wakefield, 2015). The creation and participation that students undertake in using Web 2.0 technologies can be an important part of student learning (Merchant, 2009). Early research on student-generated multimedia assignments suggests that they may afford experiential learning (Dyson, Litchfield, Lawrence, Raban, & Leijdekkers, 2009), graduate attribute development (Frawley et al., 2015), increased engagement (Wakefield, Frawley, Dyson, Tyler, & Litchfield, 2011) and new ways of representing and creating knowledge.

Web 2.0 tools that allow students a voice in online spaces has had some uptake in higher education. For example, discussion boards are now a standard feature in most major Learning Management Systems (LMS). Studies show these kinds of tools can promote social learning via collaboration (Boulos & Wheeler, 2007; Boulos, Maramba, & Wheeler 2006). Currently, as technologies and cultures shift towards placing a greater emphasis on digital multimedia and video, there is an opportunity to extend previous text-centric forms of online participation.

Documented uses of student-generated video content have been found in a wide range of disciplines in higher education. Empirical studies of student-generated multimedia have been found in physiology (Ernst, McGahan, & Harrison, 2015) science education (Hoban & Nielsen, 2012), accounting (Frawley et al., 2015; Wakefield et al., 2011) and information technology (Dyson, 2014; Litchfield, Dyson, Wright, Pradhan, & Courtille, 2010). Like most fields of educational technology, there is also likely to be wider adoption than that which is documented in formal research and evaluation studies (Liu, 2016a, 2016b). Although there is evidence of increased uptake, there remains a need for further empirical studies of how student-generated multimedia projects can be effectively implemented, especially within new disciplinary contexts of use.

To date, there has been no published study of digital student-generated multimedia in supporting clinical health sciences students. The authors address this gap through a study of a student video project within a third-year Physiotherapy subject. This paper addresses the gap and contributes to emergent understandings of the role of student-generated multimedia for learning and teaching. The authors begin with an overview of the background literature before describing the learning and teaching context and research methodology. Findings and discussion are presented in tandem. The paper concludes with a summary of the main contributions for researchers and practitioners and suggestions for future work.

Background

From user to student-generated content

Much has been written about the socio-technical landscape that today's students inhabit. This world is described as a networked society (Castells, 2000; Castells, Fernández-Ardèvol, Qiu, & Sey, 2007) characterised by new media (Kress, 2003) new literacies (Knobel & Lankshear, 2007; Kress, 2003) and participatory culture (Jenkins et al., 2009). Into this context, screens replace pages (Snyder, 1998) technologies are disruptive (Christensen & Bower, 1995) and old and new media collide (Jenkins, 2006). Such tools and cultures have allowed for the publication and amplification of previously unheard voices. There is now an abundance of opportunity for new media creation and consumption, and a great diversity in how people engage in such cultures. Despite this, evidence has shown that while some individuals may publish blogs, tweets and other forms of user-generated content, the majority may prefer to "like", "comment" or "view" (Nielsen, 2006). The unequal online participation is further exacerbated by the ways in which content, once generated by the user, is placed, diffused and consumed. While problematic, participatory culture and user-generated content cannot be reversed or undone. This world of digital disruption and multiple voices is one that all students have to navigate, whether as active content creators or as purely as readers, listeners or viewers.

In attempting to bridge the gulf between higher education and students' lived experiences, current research has often focused on 'student identity'. Concepts of students as being the 'net generation' (Tapscott, 1998) and 'digital natives' (Prensky, 2001, 2010) presume that students, imbued with technology from an early age, are proficient and sophisticated in its use. Although there is an intuitive appeal to such explanations, it cannot be assumed that the interests, practices and skills of an entire generation will be uniform. Bennett, Maton and Kervin (2008) suggest that claims of the digital natives constitute an academic form of 'moral panic', while research outside the education sphere problematizes generational stereotypes (e.g. Kowske, Rasch, & Wiley, 2010) and uniform use of participatory technologies (e.g. Nielsen, 2006). There remain grounds for meaningfully considering how parallel forms of existing technology could be adopted within a students' tertiary studies. The authors argue that it is not the disparity between students' identities, inside and outside the university but rather the digital environment that needs to be considered. By shifting our learning and teaching to include student-generated content, educators may increase engagement with this educational paradigm for the 21st century (Dyson, 2012).

Student-generated multimedia in higher education

While there has been a shift towards the use of video and other forms of multimedia within higher education, this has, with notable exception, been largely used as a vehicle for transmission of content from instructor to student, despite the prevalence of interactive tools and participatory culture outside the class. Approaches where students, instead of lecturers, create the content are rare. Student-generated multimedia is 'highly engaging and motivational', offers the possibility of contextualization in real life settings, provides common externalized representations to support learning conversations and peer-learning, and has an affordance for multiple meaning-making and deep learning' (Dyson, 2012, p. 18). The creation and participation that students undertake with Web 2.0 technologies can be an important part of student learning (Merchant, 2009). Early research on student-generated multimedia assignments in higher education which have used videos (Litchfield et al., 2010), screencasts (Frawley et al., 2015; Wakefield et al., 2011) and slowmation (Hoban & Nielsen, 2012' suggests that this approach may support active and experiential learning (Dyson et al., 2009), graduate attribute development (Frawley et al., 2015), increased engagement (Wakefield et al., 2011) and new ways of representing and creating knowledge. In placing the student and their work at the centre of the learning (Dyson et al., 2015), student-generated multimedia activities align pedagogically with constructive and student-centred approaches.

Despite evidence that such approaches can be gainfully used to support student learning, there remains a shortage of research into this area. Though student digital media align and afford student-centred pedagogies and learning, questions remain as to their wider educational design and implementation. The diversity of modes, media, tools, platforms and genres, coupled with the equally broad contexts for learning within the university mean that educational design and implementation are especially challenging. Though earlier studies of student-generated projects demonstrated increased student engagement (Dyson, 2014; Wakefield et al., 2011) recent research comparing traditional written assignments with a new digital multimedia alternative has shown implementation to the be the area of greatest challenge (Ernst et al., 2015; McGahan, Ernst, & Dyson, 2016). In this case, measures of student performance and satisfaction ratings both declined following the introduction of a mandatory digital multimedia assignment, however improved when the written assignment was re-introduced and students were allowed to choose which form of assignment to undertake (Ernst et al., 2015; McGahan et al., 2016). Studies such as these highlight the need for further research that explore how student-generated multimedia projects are implemented within in range of contexts.

The role of the digital multimedia within tertiary health sciences education

Hand-drawn or hand-rendered illustration, as well as digital methods have long been a key way of communicating and teaching medical knowledge, with new technologies allowing different image types to be produced (Corl, Garland & Fishman, 2000). Images not only assist in the learning and teaching of medical and clinical knowledge, but are essential to the construction, identity and shape that knowledge in the discipline takes. Due to the physical and tangible nature of disciplines within the health sciences, there has been a long history of using images and video within both the profession and education. With reference to static image, “use of medical illustration is probably as old as medicine itself” (Corl, Garland & Fishman, 2000, p.1519).

Whilst the properties of a static image afford one kind of knowledge representation, the moving images in video can afford different kinds of clinical and educational uses. As video has become more affordable and ubiquitous, educational videos that illustrate a specific aspect of healthcare management have become a core part of health sciences’ education (Olson, Bidewell, Dune, Lessey, 2016). More recently, the profession has also turned to using digital resources to communicate with patients and other stakeholders (Majid, Schumann, Doswell, Sutherland, Golden, Stewart, Hill-Briggs, 2012). Within the physiotherapy context, where demonstrations often involve assessment, treatment, patient education and an exercise prescription as part of a home program, there is often a need to support patients doing repeated exercises as part of their rehabilitation. There is an opportunity, therefore, for students in health sciences to create videos as a way of communicating to patients and other stakeholders. To date, documented cases of student-generated multimedia within physiotherapy education has utilised the student sharing of videos within the wider context of a student-generated wiki activity (see Snodgrass, 2011). The authors of this paper argue that video and multimedia production can be further extended to provide a project that aligns authentically with both the knowledge of the discipline and the direction of the profession.

Summary

In summary, student-generated multimedia provides opportunities for health sciences education. However, as prior literature demonstrates, though student-generated multimedia affords and aligns with experiential, constructivist and student-cantered pedagogies, its educational design and implementation is context dependent. Only with further research and evaluation studies will it be possible to gather a greater body of knowledge on how this might best work.

Context and implementation

This paper focuses on an implementation of a digital multimedia assignment within a third-year undergraduate physiotherapy unit. This compulsory second semester subject has an average enrolment of 75-90 students per year. The student cohort is predominantly comprised of undergraduate students wishing to enter into the healthcare services as practicing physiotherapists. This unit aims to educate students about multidisciplinary approaches to multisystem disorders, such as management of the aged care sector, amputees, burns, diabetes and facial nerve disorders. The digital multimedia assignment was designed as a group work task in which students planned and produced a resource to educate members of the lay public about the physiotherapy management of a multisystem disorder. Learning and teaching challenges in this subject are that physiotherapy students are not normally examined in this manner, as they are they are generally given practical and written assessment tasks. Therefore, it was a novel way of being assessed for most students, and therefore many had to develop a new skill-base to complete the task, including negotiating the challenges of working as part of a group.

Digital video assignment

The digital video assignment is a compulsory assessment undertaken by groups of 4-5 students and it was worth 30% of student’s final marks. As part of this assignment students attend a showcase event, where their videos are screened to other students, faculty members and those who have mentored students in creating their digital video. The assignment components and marking are illustrated in Figure 1 (Appendix 1).

Methodology

This paper contributes applied and research based understandings of the use student-generated digital multimedia assignment within a third-year university physiotherapy subject. As research in this area is new, and the specific variables largely unknown, this study adopts open qualitative methods to facilitate descriptive and exploratory work. Gaps in the literature and questions within praxis are combined and operationalised into the following research question:

> **RQ:** What are students' perceptions and attitudes to digital student-generated assignments in learning physiotherapy within a higher education context?

This question was addressed through an anonymous student-survey of a single cohort of students that have experienced this assignment within the semester. The survey was administered at the end of semester and designed to balance the need for open qualitative responses with the problem of managing participant's cognitive load. Categorical data from closed 'tick-box' questions was combined with open 'free-text' responses. Categorical data is summarized through count data, while text responses were be thematically coded (see Saldaña, 2009) using QSR Nvivo software. Analysis of student survey data was further supported with metadata on the video artefacts produced, the number and the technical accuracy of these, as well as instructor reflections. The University of Sydney's Human Research Ethics Committee approved this research in 2016.

Findings and discussion

Of the 79 students enrolled in the subject, 59 completed the end of semester survey, giving a response rate of 74.7%.

Student satisfaction

Within the cohort were 17 groups, each comprised of 4-5 students, each group producing a video of their work. Despite 48% of students having never previously created a digital multimedia assignment, the student group, in response to a 10 point Likert scale that ranged from 1 extremely dissatisfied to 10 extremely satisfied, students mean response to the question "How satisfied were you with the final presentation?" was 7.5, just over the 'moderately satisfied' indicator. Out of the total number of respondents, 9 students did not respond to this question. Students written reasons for their degree of satisfaction were largely tied to perceptions about either the process (13 thematic expressions: e.g. "Not enough time to get it good or better") or the final outcome (26 thematic expressions: e.g. "Achieved the intended effect"). While the average response to the question suggests moderate satisfaction, qualitative rationales were found to vary dependent on student interpretation of what satisfaction with such an assignment ought to look like. Generally, students who ranked their satisfaction as <6 typically provided a rationale for dissatisfaction, while those who register >8 provided a rationale for satisfaction. However, this was not always uniform with some students rating themselves as extremely satisfied (9) only to say that they were not content with the volume. As video assessments are projects are new within clinical education, further research is needed to understand student expectations about video content and how they judge such products.

Physiotherapy knowledge and the ability to communicate to a lay audience

Due to the anonymous survey design, the authors were unable to tie each video back to the individual student. Despite this shortcoming it is, nevertheless, possible to gauge understandings of the project from the video artefacts themselves. Despite 85% of student videos demonstrating creative ways to communicate physiotherapy knowledge, 25% of all submissions contained either slight or major technical errors in physiotherapy knowledge. What this means is that while the student video project, as a process supports students in learning communication skills and physiotherapy knowledge, that only about half of the final video products could be used as peer learning resources in the future.

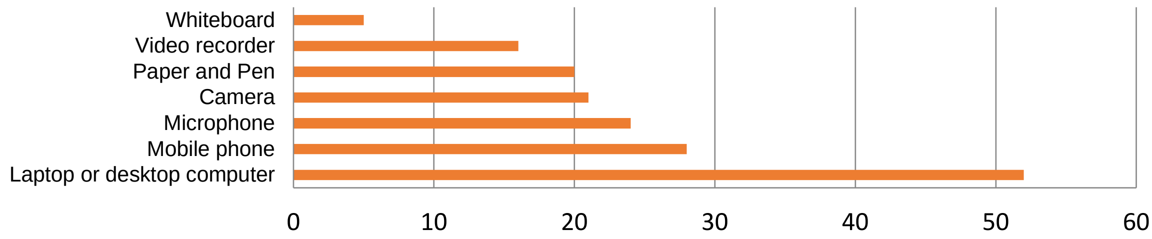
Technology use and multimedia experience of students

Prior experience

In response to the question 'Prior to this subject have you ever done a digital multimedia assignment?' 52% (n=30) of the 58 responses claimed to have created a digital multimedia assignment. This figure is higher than earlier studies that have asked similar questions (e.g. Wakefield et al., 2011). Though certainly not a high percentage, reasons why almost half of students had created a digital multimedia assignment may be due to both the third-year subject that is the investigation of this study and perhaps the increased popularity of this kind of assignment within higher education. However, within the bounds of this study it is not possible to know where and when those 30 students experienced a digital multimedia assignment within their prior curriculum without any additional follow-up research.

Technology use on the project

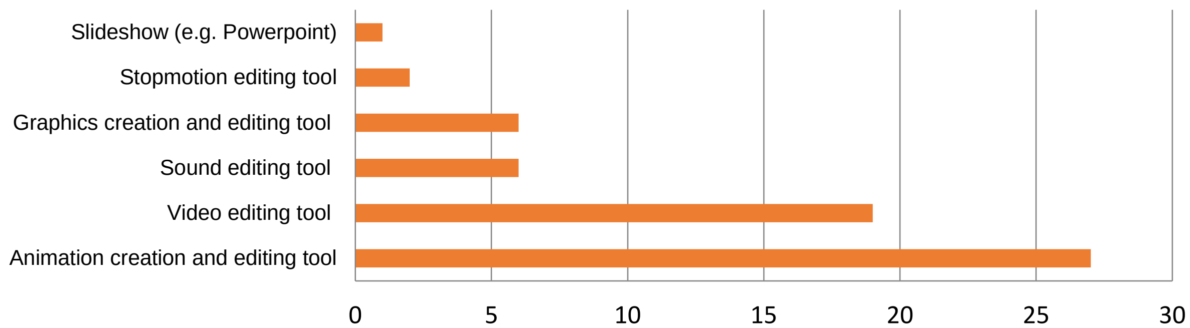
There was a diversity of technical approaches as reflected in the 57 student responses to the closed 'tick-box' question: "What tools or technologies did you use?" (Figure 2.) From this number, the majority of students used their own convergent devices (either laptops or mobile phones), with less prevalent use of specialist external devices such as microphones and devoted video recorders. (Figure 2). Students used an average of 2.9 (mean) devices per person in the creation of the one video. Only 10% (n=6) of respondents used a single device. Within this sub-group, it is possible to see that in 4 out of 6 of those respondents were using animation software, and so not needing peripheral video recording devices. 2 out of 6 were using editing software such as iMovie – so presumably took up editorial responsibilities for the entire group.



	Laptop or desktop computer	Mobile phone	Microphone	Camera	Paper and Pen	Video recorder	Whiteboard
Series1	52	28	24	21	20	16	5

Figure 2: Hardware and tools: What tools or technologies did you use?

In addition to navigating between a range of devices and tools, students were also found to use a variety of different software. This was gauged with the open text-response question: 'What software did you use?'. Text responses were thematically coded in two ways. The first sought to understand how the software was accessed and run, either as software ran as a native application on either mobile or desktop such as MS Office, iMovie, Windows Movie Maker or Adobe Creative Suite (31 instances) or that within a web browser (25 instances), these were largely for tools that supported animation: Powtoon, Toondoon, Videoscribe, Moovly. Of those students who responded to this question (n=46) 78% (36) largely stuck to *either* native or web based applications (n=36). Ten students (22%) navigated between both kinds of application, for example by using both an online tool such as Moovly as well as iMovie, or Photoshop and Powtoon. In addition to understanding the different kinds of applications being used, the data was also coded (Figure 3).



	Animation creation and editing tool	Video editing tool	Sound editing tool	Graphics creation and editing tool	Stopmotion editing tool	Slideshow (e.g. Powerpoint)
Series1	27	19	6	6	2	1

Figure 3: Software use: What software did you use?

Findings from this demonstrate that simple 'drag and drop' animation software such as Powtoon were the most popular approach (27), while traditional video editing technologies such as iMovie and Windows Movie Maker followed (19). Advanced specialist tools for editing specific parts of the video, such as the sound (6) and the graphics (6) were less common. These kinds of specialist editing tools (e.g. Audacity, Adobe Photoshop) require specialist knowledge; though not commonly used such specialist tool use demonstrates that a small number of students who are *not* enrolled in graphic design or computer science have skills in advanced and specialist software. Stopmotion was used as an approach by only two individuals, while Powerpoint was used by only one respondent.

Rationale for the approach used

Perhaps more interesting than the diversity of approaches taken is the rationale that students provided for this. In summary what this data tells us is that students navigate a complex suite of available tools, software and approaches in a way that accounts for both their beliefs about the purpose of the video artefact for the intended audience as well as their beliefs about what they perceive themselves to be capable of doing. These themes are illustrated in the Table 1 below.

Table 1: Rationale for technology use – Why did you choose this approach?

Thematic category	*Theme*	*No.*	*Exemplar student response*
Beliefs and attitudes about the purpose of the video (44 instances)	Engaging the audience	15	"We chose this approach as another way of engaging the audience. We came up with a melody from scratch and wrote the lyrics for it."
	Best suited the topic	10	"Because our condition was not easy to portray through live footage. So we chose different media to make brief Slowmation"
	Format properties	9	"Best materials to make our topic"
Beliefs and attitudes about the student or the group's own interests and capabilities (44 instances)	Ease of use	12	"Relatively easy to use given the time we have"
	Confidence with tools	8	"Most confident with these tools" "weren't educated or confident in software"
	Access to tools	6	"[…] accessible to us" "Free variety of techniques available"
	Personal preference or interest	6	"[…] we didn't want to be in a video recording" "[…] allowing us to present in a much more interesting manner" "Convenient, rich source of animation and interesting"
	Aims or vision	6	"allows incorporation of animation and attractive presentation"
	Strengths or weaknesses of the group	5	"Group members knew how to use these mediums"
	To be creative	1	"To try to be more creative"

What is visible from the data is that, given the open nature of the assignment that allowed students to pick *any* format for their video that students navigated a complex terrain of hardware, software, genre and formats based so as to design an experience appropriate for their audience, their topic and drawing upon the properties of the media and modes that were used. This suggests that students were engaged in quite complex audio-visual design choices in this assignment while factoring in pragmatic considerations as to what they believed they or their group could do.

Students' motivations and assessment criteria

In university assessment tasks, the majority of students are motivated by the desire to gain the highest mark they can, therefore close attention is paid to the assessment criteria. Most groups addressed assessment criteria, although there was variation in the marks awarded depending on the quality and thoroughness of the responses. The videos that stood out as being superior were those that incorporated an empathic, patient-centred approach to management, making the viewer's experience a more personal one.

Students' likes and dislikes

In answer to the question "What did you like about this assignment?" 46 out of 57 students responded. In answer to the question "What did you dislike about this assignment?" 52 out of 57 students responded. These responses were coded for themes that are illustrated below in Table 2. As is evidenced within the exemplar comments, student comments touched on a range of themes.

Table 2: Dominant reasons for liking and disliking the assignment

Thematic category	***Theme***	***No.***	***Exemplar student response***
Likes	Teamwork, group-work and collaboration	14	**"It is a group work allowed us to discuss and interact with others"**
	Fun or interesting	10	"Is an interesting assignment"
	Creativity	9	"The group work, **the artistic aspects,** ability to share ideas"
	Access to mentors	7	**Getting mentored** and visiting RNSH
	Different or novel kind of assignment	7	**"Project was something different and we could channel our creative side.** It was fun and enriching as we learnt lots about our condition as well"
	Access to external areas of the profession	6	"It provided us a choice in **site visits that we did not have many chance to touch with"**
	Digital or multimedia skills	6	**Interesting learning to use technology.** The variety of topics.
	Learning about the topic	4	"Teaches you about the **topic given"**
	Misc.	<3/ theme	*e.g. useful, authentic, autonomy and choice
Dislikes	Issues related to time	23	**Time restraints was difficult** to source resources in time especially if communicating with outside personnel
	Issues related to the assignment structure (including group-work)	25	"**Weighting of the rationale**" "**Group project**" "**assignment guidelines"**
	Feelings and emotional responses	19	"**fiddly**" | "**stressed**"
	Technology and media use	13	Time consuming, a lot of effort, **didn't know anything about video editing** **"limited resources i.e. programs, recording devices**, money for programs and music"

Student response to the assignment was mixed, with both positive and negative feedback relating to both the affordances of a multimedia assignment, as well as aspects relating to the wider implementation, such as: teamwork, mentor support, on site visits, and technology use. Despite this being a 'video' assignment, students' dislikes focused more on the assignment design and the time requirements of this, rather than the technology. Collectively, this reinforces what we already know, that the assignment design and implementation may be just as, if not more, important than issues relating specifically to the technology. This feedback also emphasises the need for the assignment guidelines to offer technical support and better recognition of the time and scope relating to video- based assessments. Based on this student feedback, both the power and the risk of the assignment comes from the allowance for creative agency, the challenge for educators will be knowing how to keep such video assignments open to allow for creative practice while sufficiently structured for those students with lower self-efficacy relating to this kind of assignment.

Conclusions and future work

To date, this particular use of digital multimedia within physiotherapy education is unique. Findings from this study demonstrate that while students produced a highly sophisticated and diverse range of digital video content, that student expectation and interpretation of what counted as a satisfactory varied. In a new non-text medium, where tools and skills may more greatly distinguish one student from another, students may express anxiety over what the standard is and equity concerns regarding access to technology or group members with technical skills. Though this open structure has affordances for learning, it is not without significant hurdles. In differing to typical written assignments, students' self-efficacy and belief systems alter their perception of whether the autonomy, authenticity and choice afforded in the video assignment were a positively or negatively perceived challenge. This in itself is nothing new, and has long been understood by those practicing similarly unstructured assessments such as problem based learning, however it is especially relevant within the continued discourse and narratives around students as 'digital natives'. There is a legitimate issue as to whether we can really assess students in a skill that is not formally taught but assumed of their generation. Based on this concern, the authors reflect that greater choice and support is needed for students who may be anxious or experiencing lower levels of self-efficacy relating to video production. Alternative approaches that extend student choice further may make the *entire* assignment optional (Frawley et al. 2015, Wakefield et al., 2011), offer a traditional written alternative (Ernst et al. 2015) or allow for a choice of either group or individual work (Wakefield et al. 2011). These approaches may be one way of scaffolding support of learners who are less confident while retaining the open and autonomous nature of the assignment, seen to be both empowering and enjoyable to other students. Future iterations of this assignment and this study will need to work on the balance between the freedom for creative pursuit and the scaffolding needed for less confident learners. Issues remain about how to accurately measure the impact of the activity on the viewing audience, and the impact of group dynamics on the final product. In this study, we relied on students' attitudes towards the video activity and academics assessment of learning outcomes and critical reflections. Future studies of this will need to build on understanding the relationship the assignment has across a broader range of variables.

References

Bennett, S., Maton, K. A., & Kervin, L. (2008). The 'digital native' debate: a critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775-786.

Boulos, M. K. & Wheeler, S. (2007). The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and healthcare education. *Health Informatics and Libraries Journal*, *24*(1), doi:10.1111/j.1471-1842.2007.00701.x

Boulos, M. K., Maramba, I. & Wheeler, S. (2006) Wikis, blogs and podcasts: a new generation of web-based tools for virtual collaborative clinical practice and education. *BMC Medical Education*, *6*(41), doi:10.1186/1472-6920-6-41.

Castells, M. (2000). *The Rise of the Network Society* (2nd ed.). Malden, MA: Blackwell Publishing.

Castells, M., Fernández-Ardèvol, M., Qiu, J. L., & Sey, A. (2007). *Mobile Communication and Society: A Global Perspective*. Cambridge, Massachusetts: MIT Press.

Christensen, C. M., & Bower, J. L. (1995). Disruptive technologies: catching the wave. *Harvard Business Review, 73*(31), 45-53.

Corl, F.M., Garland, M.R., & Fishman, E. K. (2000). Computers in radiology: role of computer technology in medical illustration, *American Journal of Roentgenology*, *175*, 1519-24. doi:10.2214/ajr.175.6.1751519.

Dyson, L. E. (2012). Student-generated mobile learning: A shift in the educational paradigm for the 21st century. *Transactions on Mobile Learning, 2*, 15-19.

Dyson, L. E. (2014). A vodcast project in the workplace: understanding students' learning processes outside the classroom. In M. Kalz, Y. Bayyurt, Y. & M. Specht (Eds.). *Mobile as Mainstream – Towards Future Challenges in Mobile Learning, 13th World Conference on Mobile and Contextual Learning (mLearn 2014),* 258-71.

Dyson, L. E., Frawley, J. K., Tyler, J., & Wakefield, J. (2015). Introducing an iPad innovation into accounting tutorials. In T. H. Brown & H. J. van der Merwe (Eds.), *The Mobile Learning Voyage - From Small Ripples to Massive Open Waters, 14th World Conference on Mobile and Contextual* Springer Switzerland. doi:10.1007/978-3-319-25684-9_16.

Dyson, L. E., Litchfield, A., Lawrence, E., Raban, R., & Leijdekkers, P. (2009). Advancing the m-learning research agenda for active, experiential learning: four case studies. *Australasian Journal of Educational Technology, 25*(2), 250-267.

Ernst, H., McGahan, W. T., & Harrison, J. (2015). Questionable benefit of visual and peer mediated learning on overall learning outcomes of a first-year physiology course. *International Journal of Mobile and Blended Learning, 7*(1), 25-40. doi:10.4018/ijmbl.2015010103.

Frawley, J. K., Dyson, L. E., Tyler, J., & Wakefield, J. (2015). Building graduate attributes using student-generated screencasts. *Proceedings of ASCILITE 2015: Globally connected, digitally enabled, Perth, WA, Australia*.100-111.

Hoban, G., & Nielsen, W. (2012). Learning Science through Creating a 'Slowmation': A case study of preservice primary teachers. *International Journal of Science Education, Communication & Information*, *35*(1), 1-28. doi:http://dx.doi.org/10.1080/09500693.2012.670286

Jenkins, H. (2006). *Convergence culture: where old and new media collide*. New York: New York University Press.

Jenkins, H., Purushotma, R., Weigel, M., Clinton, K., & Robison, A. J. (2009). *Confronting the challenges of participatory culture: Media education for the 21st Century*. Cambridge, Massachusetts: The MIT Press.

Knobel, M., & Lankshear, C. (2007). *A new literacies sampler*. New York: P. Lang.

Kowske, B. J., Rasch, R., & Wiley, J. (2010). Millennials' (lack of) attitude problem: An empirical examination of generational effects on work attitudes. *Journal of Business Psychology, 25*(265). doi:10.1007/s10869-010-9171-8.

Kress, G. R. (2003). *Literacy in the new media age*. London: Routledge.

Litchfield, A., Dyson, L. E., Wright, M., Pradhan, S., & Courtille, B. (2010). *Student Produced Vodcasts as Active Meta-Cognitive Learning*. Paper presented at the 10th IEEE International Conference on Advanced Learning Technologies, Sousse, Tunisia.

Liu, D. (2016a). Encouraging Pre-Reading Using Student-Generated Videos. Retrieved from https://sydney.edu.au/education-portfolio/ei/teaching@sydney/encouraging-pre-reading-using-student-generated-videos/

Liu, D. (2016b). Let your students surprise you: Making a unit relevant and engaging. *Teaching@Sydney*. Retrieved from https://sydney.edu.au/education-portfolio/ei/teaching@sydney/let-students-surprise-making-unit-relevant-engaging/

McGahan, W., Ernst, H., & Dyson, L. E. (2016). Individual learning strategies and choice in student-generated multimedia. *International Journal of Mobile and Blended Learning, 8*(3), 1-18.

Majid, H. M., Schumann, K.P., Doswell, A., Sutherland, J., Golden, SH., Stewart, KJ., Hill-Briggs, F. (2012) Development and evaluation of the DECIDE to Move! physical activity educational video. *The Diabetes Educator*. 38(6), 855-859.

Merchant, G. (2009). Web 2.0, new literacies, and the idea of learning through participation. *English Teaching: Practice & Critique, 8*(3), 107-122.

Nielsen, J. (2006). The 90-9-1 rule for participation inequality in social media and online communities. retrieved from http://www.nngroup.com/articles/participation-inequality/

Olson, R., Bidewell, J., Dune, T., Lessey, N. (2016). Developing cultural competence through self-reflection in interprofessional education: Findings from an Australian university. *Journal of Interprofessional Care*, *30*(3), 347-54.

Prensky, M. (2001). Digital natives, digital immigrants Part 2: Do they really think differently?, *On the horizon, 9*(6), 1-6.

Prensky, M. (2010). *Teaching digital natives: partnering for real learning*. Thousand Oaks: Corwin.

Saldaña, J. (2009). *The Coding Manual for Qualitative Researchers*. Thousand Oaks, California: Sage.

Sheridan, M. P., & Roswell, J. (2010). *Design literacies: learning and innovation in the digital age*. London: Routledge.

Snodgrass, S. (2011). Wiki activities in blended learning for health professional students: Enhancing critical thinking and clinical reasoning skills, *Australasian Journal of Educational Technology (AJET)* 27(4), 563-580.

Snyder, I. (1998). Page to screen. In I. Snyder (Ed.), *Page to screen: taking literacy into the electronic era* (pp. xx-xxxvi). London: Routledge.

Tapscott, D. (1998). *Growing up digital: the rise of the net generation*. New York, NY: McGraw-Hill.

Wakefield, J., Frawley, J., Dyson, L. E., Tyler, J., & Litchfield, A. J. (2011). *Increasing student engagement and performance in introductory accounting through student-generated screencasts.* Paper presented at the 2011 AFAANZ Conference, Darwin, Australia.

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Note: All published papers are refereed, having undergone a double-blind peer-review process.

Appendix 1

Title: Creating a Digital Explanation of the Physiotherapy Management of a Multisystem Problem

Weighting: 30%

Length: 3.5-4.5 minute Blended Digital Media

Construct a minute blended digital media presentation that is between 3.5-4.5 minutes long to explain **THE PHYSIOTHERAPY MANAGEMENT OF ONE MULTISYSTEM PROBLEM** that you will be allocated from the PT in Multisystems syllabus. The media enables a digital explanation of the management of this problem and can be used as and is as a learning resource. It needs to be at least 50% original material. The digital explanation can be made using Windows Movie Maker (PC) or iMovie (Mac) and should be submitted on a USB drive. Provide a one-page rationale per group (250 words) explaining the design of your resource as well as a storyboard that helps you to plan your resource. See below for examples and resources. Each student will also submit an individual reflection of this blended media assignment.

Criteria for assessment: Students will be assessed on these criteria:

<u>A group mark</u> /23 will be awarded for the following

- Rationale (one A4 page to justify the design/media, 250 words)
- Storyboard
- Content Accuracy
- Communication/ Explanation
- Presentation / Visual Impact / Professionalism / Technical

<u>An individual mark</u> /7 will be awarded to each student for the following

- Individual Student Reflection. Each student will be required to submit a one A4 page individual reflection (300-350 words). Your reflection should include (but is not limited to)

1) brief outline of the management your multisystem problem
2) reflection on what you learnt about the process of communicating a physiotherapy management message (multisystem problem) to educated members of the public.
3) reflection on how this new knowledge can impact on your future professional practice
4) reflection on the process of producing a multimedia product (and what would you do differently next time)
5) reflection on team work within your group

Figure 1: Assignment design, requirements and weighted marks

By design: Facing the academic challenges of implementing technology enhanced learning in higher education and the example of a third year biology unit

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This paper takes a design research approach to the challenge of transforming learning and teaching in higher education (HE) as it is experienced at the level of an interdisciplinary team composed of content matter experts and specialists in education. It is based on the reflections of members of the team working collaboratively to transform an undergraduate biology unit, delivered in intensive mode in parallel with a standard teaching semester to improve both student engagement and teaching staff satisfaction. The unit learning design tests 21st century active learning pedagogies in the context preparing students for their professional lives.

Using semi-structured interviews and reflective inquiry the authors attempt to uncover the salient features of the process of implementing technology enhanced learning, and generate constructive design solutions. The work is situated in the scholarship of learning and teaching as it encourages "reflection-in-action" and a commitment to sharing what works in STEM teaching and learning in contemporary environments. The teaching team focus on the complex problems of preparation, attendance, and engagement in a series of intensive labs, whilst the professional staff focus on the complex problems of innovation and student engagement in higher education.

A number of known and hypothetical learning design principles are integrated with the affordances of the chosen learning environment (OneNote) and used to propose plausible solutions. These solutions are used to iteratively refine the learning environment and reveal new design principles. The data shows improved staff engagement with the unit and the students through an enhanced role in the application and development of modern pedagogies. The paper emphasises the benefits of providing for and supporting the emergence of *microcultures*, and suggest strategies for those that wish to emulate the approach taken.

Introduction

This research reports on an innovative design and delivery of a third-year animal biology unit offered for the first time as a response to a need of improving student engagement and reverse declining attendance at lectures, tutorials and laboratory practicals.

Student (dis-)engagement is a well observed and researched phenomenon (Kahn, 2014; Kahu, 2013), that can have strong impact on the teaching team. However, the nature of the impact should not be defined too hastily. It certainly can cause academic frustration and staff demotivation, but on a positive side, it can also provide impetus for innovative solutions. Nowadays, this means implementing digital technologies, looking more closely at task design to make skillful use of the technological tools and adopting a more holistic approach to development of student learning experiences.

One of the important questions within the discipline of learning design relates to the role teachers and learning designers/developers play in the process of designing and developing technology-enhanced learning experiences (Kali, McKenney, & Sagy, 2015; Kirschner, 2015). An opportunity to explore this question more closely was seized by a group of academics and learning development team members tasked with addressing the issue of low student satisfaction rates and steady disengagement in a third-year animal biology unit offered at a large, metropolitan university.

In praxis (Freire, 2000), a workgroup, or *microculture* (Roxå & Mårtensson, 2015) an interdisciplinary team of specialists representing their relevant disciplines (i.e. biology and education/ learning design) emerged, located within what Trowler (2008) refers to as a meso-level of higher education (i.e. unit/subject/discipline level) and as such are not necessarily represented on organizational hierarchies (Heinrich, 2017). The unit teaching team was encouraged to look for sensitive interdisciplinary solutions that would encourage student engagement, increase the use of digital technologies in the unit, improve student satisfaction and positively influence teaching team motivation.

The current research reflected on the enablers, roadblocks and challenges encountered by the members of this *microculture* while designing and developing an innovative delivery of the above-mentioned unit. To this end, the authors identified two objectives of the research.

First, the authors investigated how the opportunities for learning offered by the freshly introduced OneNote Class Notebook were perceived and enacted by the teaching team. These opportunities took form of educational, technological and social affordances, made salient to the teaching team by the authors whose intention was to create a "world of learning" (Kirschner, Strijbos, & Kreijns, 2004). The leading idea behind the concept is to encourage learners' agency by offering them an educational environment filled with multiple and diverse opportunities for learning within which learners are responsible for their learning by acting, making choices, and taking opportunities.

Second, the authors looked deeper into the collaboration between the members of the *microculture*. This consisted on reflecting on the ways the collaboration took place and describing a model emerging from the analysis. The model combined an institutional support facilitated through formal meetings with more informal, organically evolved form of collaboration based on a subtle net of connections operationalized through informal catch-ups between the members of the two teams.

The development of the model prompted investigation of the effectiveness of such model, especially from the perspective of raising awareness of the potential offered by close collaboration within a *microculture* of an interdisciplinary team. In effect, such a collaboration can serve the higher purpose of enhancing scholarship of learning and teaching and ensuring a focus on the quality of teaching practice (Mårtensson, Roxå, & Olsson, 2011; Trigwell & Shale, 2004).

Bain and McNaught (2006) argue that teachers' beliefs impact on the use of technology in their practice. However, teachers' beliefs are not necessarily fixed constructs, and may change over the years (Goodyear, Markauskaite, & Kali, 2010). The authors are mindful of the difficulties associated with changing academic teaching practices. Mårtensson, Roxå and Olsson (2011) make the point that "despite attempts made by both internal stakeholders … and external stakeholders … to influence practices in higher education, teaching mostly remains unaffected". Seven years later the difficulties remain.

To investigate closer the potential for enhancing scholarship of learning and teaching offered by *microculture* of a small, interdisciplinary team, the authors of the current research made an effort to apply the following principles of the scholarship of learning and teaching, as outlined by Mårtensson, Roxå and Olsson (2011):

- Teachers must own sustainable change.
- Informed discussion and documentation is paramount for achieving a quality culture in relation to teaching and learning.
- The driving force for change is peer review among teachers.
- Clarity in vision and careful timing while taking structural measures is a crucial part of leadership.

The authors were interested in finding out to what extent the collaboration within the emergent *microculture* influenced academics' beliefs, their pedagogic content knowledge and teaching practices. A hypothesis has been put forward that through the collaboration within the *microculture*, the members of the workgroup raised their awareness of the learning and teaching potential offered by the proposed innovations and broadened their perspectives on learning and teaching.

To explore the above-outlined objectives, the following research questions were formulated:

1. What was the overall experience for academics implementing OneNote in the unit?
2. Did academic collaboration within the *microculture* impact on the scholarship of learning and teaching. If so, how?

Context of the study

The unit under investigation is a third-year Animal Biology taken by 92 students coming from diverse disciplines, predominantly Science (n=67), but also Education (n=9), Health (n=5) and a mix of double degrees with Business (n=11). The unit was offered for the first time in semester

1 2015, using traditional delivery modes such as lectorial and laboratory practicals, spread over 13 weeklong semester. The approaches to learning and teaching privileged inquiry-based learning with hands-on activities during laboratory practicals and interactive lectorials. At the end of the semester, a field trip was planned, however due to low student engagement it was cancelled. The disappointment of cancelling the field trip, combined with decreasing attendance not only at lectorials but also at the laboratory practicals that required the purchase of expensive laboratory materials caused a lot of staff concern. This resulted in a tendency of staff to over-assess, in an effort to force attendance and participation. Student evaluation surveys conducted in mid-semester and at the end of the semester were 2.8 out of 5.0, which also indicated low student satisfaction with the proposed format. In conclusion, the unit was ripe for redevelopment and a fresh approach.

The redesign team decided to approach the problem holistically, going beyond the constraints of traditional unit delivery normally limited by timetabling 13-week long semesters, and the associated procedures and processes operating on a pre-determined schedule. The new teaching model, trialled in semester 1, 2016, was based loosely on an Intensive Mode of Delivery (IMD) model, widely used in distance education, with modularisation and a significant online component as a structural frame supporting the learning design.

There is no one, overarching definition of the IMD. It could be described as an umbrella term containing a broad variety of models, all characterised by intensive delivery over a shortened period in relation to the traditional semester (Harvey, Power, & Wilson, 2016; Hesterman, 2015; Male et al., 2016). The proposed model was composed of four modules, supported by fewer, but more intensive face-to-face sessions, all directly connected to the assessment.

This frame served multiple objectives defined by the workgroup, or a *microculture*. These included testing IMD as a way of increasing student engagement, improving student satisfaction and progression rates, and emphasising more blended learning.

The unit content was organised in four thematic modules, with each module comprising a self-managed online learning component, followed by one intensive day of face-to-face delivery involving lectorials, workshops and laboratory practicals. The intensive day finished with an assessment task.

All online resources and activities were provided using the OneNote Class Notebook, which was made accessible through the university Learning Management System (LMS), according to the university standard operating procedures.

Microculture

The authors will use the term *microculture* to describe an environment encompassing all specialists involved in design, development, delivery and evaluation of the unit. Heinrich (2017) observes that "microcultures are not necessarily aligned to organizational structures. Looking at groups instead of individuals or whole organizations situates the work on microcultures at the meso level" (2017, p.704). Thus, the unit is at the meso-level of analysis (as opposed to macro levels such as course or program, or micro levels such as the individual or interpersonal).

Looking at this meso-level of analysis, a team led by a Unit Coordinator and composed of academics teaching the modules, learning and teaching development team members and technical staff was established. The total number of the involved specialists fluctuated between 9 and 12. From the beginning, the challenge of managing such a diverse group became evident. The difficulty resided not only with logistics (e.g. handling conflicting priorities and busy schedules), but also with the diverse nature of the team of specialists representing different pedagogical perspectives. Formal, meeting-driven approach was not effective for managing the complexity of problems to solve, issues to investigate and questions to answer within a tight timeline. Thus, there was a need for a more sensitive, network-like approach characterised by frequent and informal interactions. Such a structure fluctuated between organic development and conscious creation by the team members. After the initial discussion of the principles underpinning the design facilitated through formal meeting, the rest of the collaboration was based on intensive, frequent and informal catch-ups inside particular sub-teams.

That is, four sub-teams were formed, according to modules to be developed and delivered. Each sub-team was composed of teaching academics, supported by their tutors and technical staff, one learning designer and one research/ evaluation specialist. The authors note here that the informal nature of activities does not imply an absence of planning (Eraut, 2004; Rienties & Hosein, 2015), quite the opposite. The frequent and meaningful discussions allowed flexibility in planning and in reacting to encountered problems. Roxå & Mårtensson (2015, p. 195) contend "academics have more frequent, sincere, and emotionally dense personal conversations with a small number of trusted and significant colleagues". Such *significant conversations,* build on mutual trust and professional respect enable formation of *strong ties* inside the *microculture.*

Literature also stipulates that for learning developers/ designers the ability of creating *strong ties* with academics and supporting staff has far-reaching consequences (Roxå & Mårtensson, 2015; Roxå, Mårtensson, & Alveteg, 2011). The authors made an important effort to interweave strong ties with all members of the sub-teams, which required creating an environment underpinned by three heuristics: *trust*, *shared responsibility* and *developmental agenda* (Roxå & Mårtensson, 2015, p. 198) within which *significant conversations* took place. In this case, the content of significant conversations shifted from changing logistical details related to unit delivery to creating the learning environment, and creating a compelling experience for the students.

The *significant conversations*, carried over the duration of the delivery enabled deep reflection within both, the individual sub-teams and the *microculture*, and facilitated targeted adjustments to be made after each module. These reflections were prompted by a careful evaluation strategy that sought student opinion at the end of each module through short questionnaires administered at the end of each intensive teaching day. Collected data were analysed immediately and findings were used as a platform for new (and more) *significant conversations*. There was a commitment from the teaching team to act on student evaluations in each of the four modules of the unit.

Research methodology

The data collection included post intensive questionnaires of the students, in-depth interviews with the teaching team by the evaluation specialist, and a debriefing activity organised by the Unit Coordinator conducted at the end of the experiment. Student satisfaction surveys that form part of the centrally delivered unit evaluation process complemented the data collection strategy. For the purposes of the current research, only data collected through in-depth interviews and the debriefing activity with the teaching team is used. Their comments can be found in indented quotes below in findings and discussion.

The qualitative data were analysed in two stages. First, the qualitative data were color-coded to identify emerging patterns which were next classified in categories using the theoretical framework of discursive psychology (Jørgensen & Phillips, 2002). Discursive psychology argues that categories are mental representations that allow an individual to create a meaning and the language used by people to describe the environment reveals the ways they perceive it. Once the categories were identified, the interpretation of the data was conducted from two perspectives: the academics' viewpoints and experiences in implementing OneNote Class Notebook (research question 1), and the effectiveness of the emergent *microculture* in promoting the scholarship of learning and teaching (research question 2). Finally, the categories were analysed according to the following the six characteristics of design research, as defined by Reeves, Herrington & Oliver (2005)

- " A focus on broad-based, complex problems critical to higher education,
- The integration of known and hypothetical design principles with technological affordances to render plausible solutions to these complex problems,
- Rigorous and reflective inquiry to test and refine innovative learning environments as well as to reveal new design principles,
- Long-term engagement involving continual refinement of protocols and questions,
- Intensive collaboration among researchers and practitioners, and
- A commitment to theory construction and explanation while solving real-world problems."

Findings and discussion

A focus on complex problems

The analysis revealed that the teaching team strongly supported the decision to shift IMD and to focus on experiential, authentic, situated learning in the lab. Although the teaching team was initially focused on student engagement, the opportunity to create a more personalised learning experience was perceived and welcomed by all within the *microculture*. One member of the teaching team noted:

> "OneNote is really like a personalised notebook for the students. It allows us to produce content and place it in front of them, but it allows them some flexibility for how they use that material. So they can have online notebooks, they can have online reflections where they can record that material. If there is a particular part of the content that they don't understand then they can take that out and highlight it to us, particularly through the use of collaboration space as well. So it's a method for us to deliver but it also gives them some flexibility to consume that information in a much better way."

This observation reveals deep thinking about both the teaching practice, the learning environment and a growing awareness of the scholarship of learning and teaching, which ultimately increases the quality of learning experience for students.

The technology enhanced learning approach was facilitated by the use of OneNote Class Notebook, which constituted a departure from the standard university LMS. Students were directed through the university LMS and via email to access the Class Notebook. Due to the university regulations, the university LMS continued to play a central role in enrolment, assessment and feedback. OneNote would be the main delivery mechanism for the unit content, and the central communication and collaboration tool.

There was an imperative to shift the focus from mere content consumption to a more active delivery, such that students could tailor to their own needs as learners. With the content delivery conducted entirely through OneNote it was envisaged that students would have access to their own notes whenever the need arose to study. Other benefits included the ability to work through the material and reshape it according to their interests and abilities. The *microculture* purposefully took advantage of these affordances in designing the content and the flexible learning activities that came with it. These opportunities were also perceived by the teaching team who made an effort to explore them more deeply.

Integration of design principles with affordances

The following five broad opportunities for learning offered by OneNote Class Notebook were identified:

1. Distribution: content delivered directly into the student's personal notebooks.
2. Flexibility of an ongoing availability: content available at any time on multiple devices.
3. Contextualisation: the design of interaction guides and summaries to assist students in developing their own note taking skills in the context of preparing for the intensive days. This included hyperlinks to relevant content, guiding questions, tagged activities defining by mode of interaction.
4. Real-time collaboration: the ability to share and comment on each other's work in real time, and the sense of connection with the teaching team in the weeks between face to face intensive days.
5. Orchestration: The ability of the teaching team to manage in real time multiple activities in a multi-layered and constrained system (Dillenbourg, 2013).

The learning environment was designed to take advantage of the known theories of learning to emphasise certain learning behaviours such as repetition, chunking and retelling. Accordingly, the learning designers felt that it was a good match for these activities with a wide range of affordances, to support self-directed learning. The challenges to implementation would be found mostly in bringing the teaching team along on the journey to transition from a content delivery mindset into an experiential guide mindset. One respondent noted:

> "I'd never used OneNote prior to this, so it was really a baptism of fire for me."

The inherent difficulties in managing a transition like this can hardly be overstated, and they often mirror those that are felt by the student body. Wanner and Palmer (2016) analysed risks associated with flipping the classroom and found that perceptions of the time required to develop flipped approaches, along pressures to innovate often have a demotivating effect on teachers, particularly where there is a lack of institutional support. To address the learning design team staged the design and development of the learning modules in OneNote and modelled effective learning behaviors for the teaching team.

There were things that the teaching team continued to do after the implementation of OneNote that highlighted the persistence of recurrent practices (Trowler & Cooper, 2002), even when opportunities for new ways of teaching and learning were afforded. With a focus on the wholesale transformation of the unit, many of these recurrent practices are perhaps understated. The following comment supports this hypothesis:

> "Well, everything has changed, so we've changed; The way we've presented the material, the timetable, the way we interact with students. We've gone online, as well as doing intensive face to face practicals. There's pretty much nothing that we haven't changed this semester, apart from the basic learning outcomes that we are trying to achieve."

The teaching team took care to prepare students for the intensive days with the necessary content knowledge and to spark enquiry through the technological affordances of OneNote. The data analysis suggests that despite the new possibilities for interaction between students, the content and the teaching team, the One Note was still perceived as a delivery platform, as evidenced by the following comment:

> "The first version of the unit last year didn't have any online component at all, and this unit, basically we've put all of the content online. It is a mixed mode so we have online eLearning that goes for two or three weeks leading up to an intensive face-to-face residential school type day. So the students use OneNote as the main platform. They look at videos, they look at lecture notes, they look at readings we've put up there and do activities that we've put up there for them."

As opposed to the online component, the opportunities for learning and student engagement offered by the face-to-face, intensive day were immediately perceived and taken up by the teaching team. OneNote provided the opportunity for greater engagement for students even with the reduction in frequency of contact with the teaching team with the shift to four intensive days from the standard 13-week pattern. The reduction of frequency resulted in dynamic and engaging experiences during the intensives as evidenced by this comment from a teaching team member:

> "The intensive day was fantastic; it is a long day, for the teaching team and for the students. The structure for the second intensive days was that the students would show up at 9o'clock in the morning and a 2-hour lecture/lectorial took place then. So that was really an interactive session at the start of the day just to sense where they were at with the material and ensure that they were understanding what was going on. … They were amazing. The whole day they kept going. It's a long day and they kept the enthusiasm up and they made it through, and I think they actually enjoyed the experience. "

It seems that technological affordances for learning require more effort to be realised and enacted. This responsibility would normally fall to learning designers in this particular context, although it could be argued that teaching teams would benefit from encouragement to take on this task within the context of similar *microcultures* elsewhere. Direct involvement of academics in the design of the learning environment and the creation of content allowed the learning designers and developers the opportunity to expose the teaching team to new ways of interacting with student via OneNote.

Inquiry to refine the learning environment and reveal new design principles

The interview responses uncover how the teaching team refined the approach and the online environment, seeking feedback from students and undertaking reflective observations after each of the four intensives.

> "There is a general lack of experience with online teaching environments (within the teaching team). We are shifting towards blended learning, and not many teachers understand the composition, how much, how often, how to design and execute activities. What does a good online environment look like?"

It is this uncertainty that may contribute to demotivation of academics asked to flip the classroom without any real guidance on what or how that may work (Wanner & Palmer, 2016). The *microculture* worked to counter these apprehensions, to ensure that the technological hurdles for adoption were minimal, and there were clear suggestions for action built into the initial delivery.

Content was prepared directly in OneNote, using a development area that only the teaching team had access to. The *microculture* was encouraged to be familiar with the editing conventions within OneNote. The continued success of delivering the unit in this way is reliant on staff becoming more confident in working directly within OneNote, just as their students do. Modelling of this process of working in OneNote was seen as an essential design principle.

The *microculture* saw the opportunity to separate the design phases into four iterations coinciding with the four modules, and learned from each iteration how best to respond to the demands of the students. In the first module, it became apparent that the teaching team was not explicit enough with the ways in which they wanted students to interact with the material, so an interaction guide was created with explicit instructions on how to interact with the content. This design principle of contextualization and orchestration only became apparent through the reflections of the teaching team and their work within the *microculture*.

The *microculture* monitored page edit activity as the first module went live and saw a variety of ways in which the instructions were being interpreted. Being able to view page edit history and individual student activity was use one method of gauging the response of students to tasks within each module. In some instances, students responded in ways that were unexpected, such as using the collaboration space within the Class Notebook to produce how-to guides for their peers on aspects of the unit and the technology. Supporting and encouraging a diversity of collaborative responses to the learning activities was seen by the *microculture* as a design principle.

Long-term engagement and refinement of research method

The unit is available once a year, and each year the teaching team reconvenes to learn from previous offering, and improve the unit based on student and teacher feedback. The initial effort to set up the unit anew each year would be unsustainable, without the long-term engagement of the learning and teaching development team. Through a repeated critical reflection upon the development and implementation, there exists the possibility for the continual refinement of the research method.

The multiple cycles of iteration within the semester, and over the year enables teaching staff to learn from their engagement in the process. Gradually the learning design team intends to scale back their involvement in the unit to allow the academics time to carry on with the work. It is hoped that growth in the capabilities of the teaching team will allow them to maintain and extend upon the initial delivery. Key to this approach is building in opportunities for feedback and reflection:

> "One of the key aspects of the first delivery of this new method or learning situation is that we've been constantly seeking the feedback of students. After each online module or each intensive day is delivered we've gone to students and asked them what they think. And we actually change between each intensive day how we've been delivering based on the feedback the students have given us. And we've seen, how the students are working with us, how they're enjoying the material, and improve steadily through the unit as it is delivered because of that feedback. "

Student surveys at the end of each intensive allowed the *microculture* carefully negotiate the refinements in the unit delivery at each iteration. Student feedback was guiding the *microculture* in making changes to the unit as it progressed, and informing the development process for future iterations. The teaching team were allowing the students to guide the evolution of the unit for themselves and future cohorts.

> "Make sure that you are always assessing for knowledge gaps, because there will be students that don't get what is going on and don't feel confident in speaking up in the collaboration spaces as they are at the moment, or may not have the peer groups that are able to support them through that. "

Intensive collaboration

The *microculture* consisted of various mid-career academics working in collaboration with the learning designer, instructional multimedia developer and the evaluation specialist. The future success of this unit is dependent upon staff having the trust, professional confidence and the technical ability to create and deliver their own learning experiences through this particular mechanism.

> "We couldn't do this on our own because we are not learning designers, we are not experts in these areas, and so we have worked with (the learning design team)… and they bring the expertise in the delivery of the material, the expertise in OneNote, the expertise in terms of the pedagogy of how we deliver it as well."

The learning design team were interested in supporting the change processes involved in making this project a success, given the inherent challenges. This particular experiment had begun even before the software platform had been distributed widely across campus. There was a lack of technical know-how, and certainly no guidance on how best to implement as a teaching tool. Even now, the resources that were developed during the experiment are not widely disseminated, and largely inaccessible to the academic staff. Henderson, Beach, & Finkelstein (2011) in their analysis of change strategies in undergraduate STEM practice found that “Effective change strategies: are aligned with or seek to change the beliefs of the individuals involved; involve long-term interventions, lasting at least one semester; require understanding a college or university as a complex system and designing a strategy that is compatible with this system."

Theory construction and real-world problem solution

In addressing the complex problems of attendance, preparation and engagement, the observations of the teaching team are indicative of the benefits of the approach. With respect to attendance;

> "We are no longer standing in front of empty classrooms, as we are now averaging 99% student attendance on the face-to-face intensive days."

Blending online and face-to-face learning experiences seems to have had an effect on encouraging deeper learning through better preparation for the intensives according to one teaching team member:

> "I've never encountered a group of students in 30 years of teaching that were so on top of the subject material. Their ability to answer questions and ask questions was phenomenal compared to the sort of response you get when you ask questions at the end of a 2 hour lecture."

Another positive change noted by the teaching team was increase in student engagement.

> "The students are so much more engaged, and are understanding the unit material better now. They appear more independent, involved and have taken ownership of their own learning. They were enthusiastic and appeared to enjoy the experience."

In designing the unit, the teaching team was taking a calculated risk. They accepted the challenge of finding time to get up to speed on a new software platform, and develop content for the new learning environment. The main challenge was time in preparation and formatting of the online resources, but once they were created, they could be kept and modified for future iterations of the unit. Facing some of these challenges as a team can actually be seen as a positive for the team learning.

> "So I guess my advice is give it a go, don't underestimate how long it will take to prepare the materials"
>
> "I'd say get a good head start if you're going to go down this path. We decided to do it late last year and really only had a few weeks to get on top of using OneNote and so on."
>
> "Developing flipped content is never easy, and doing the first was difficult, we were using new tools (OneNote) and so we were all at risk of underestimating how much time it was going to take."

Making a change like this is a big task, and getting help from experts in learning design, ensuring the whole teaching team is involved and 'on board' is essential to its success.

> "You can't do it on your own, you actually have to get experts to come in and help you, we had the use and the collaboration of three experts in the area and that made this possible. It wouldn't be what it is without them."
>
> "We've turned the whole unit upside down in one go, if things had been different I would have chosen maybe to deliver part of the unit this way and part of it the more traditional way just to ease into it and get the students used to it."

Based on the experience of conducting this experiment we hypothesise that the modern higher education environment would benefit from the creation of models and frameworks that acknowledge the autonomy of *microcultures* that exist outside of the normal structures of the organisation. Such models would involve a reconceptualization of academic work as practice (Boud & Brew, 2013), and an emphasis on supporting the social networks that spring up around it. These models would also involve such *microcultures* taking strong ownership, having decisive power, creating strong ties internally and with strategic alliances, and focus on independent work done in partnership.

According to social network theory, key nodes in the network would be academics, smaller nodes would be peripheral actors, and the density of the network and the frequency of interactions would be defined by each particular node. In this particular model there is no need for boundaries, and in a very natural way taking ownership of one's own work requires drawing on the collaborative support of others when the need is there. Consequently, the problem of overstepping boundaries is negated by the creation of the network.

Summary of findings and some suggestions

For those wishing to emulate this approach it is important to emphasise that *microcultures* are an emergent property of the social climate that gives rise to them. It is therefore more productive to promote and support the conditions necessary for their emergence than to attempt to 'recreate' them. Recognition of the individual strengths of the members of any team is always a good place to start. Then the identification of a significant issue or problem to solve provides an important catalyst around which the team can form. It is beyond the scope of this paper to suggest ways to avoid the formal boundaries that often take shape within organisations around a particular project, suffice to say that organisations need to become more aware of the ways in which their hierarchies are often circumvented. This is not to discourage creative circumvention, but to the contrary, support a culture in which people involved in academic practice are encouraged to take risks.

In this case, the problem was flagging attendance and disengagement. The motivation to change came from within the team, and there was a commitment from all involved to make significant to change, not only to the unit, but also to the way in which the process of unit redevelopment was undertaken. Shared inquiry into improving the delivery of the unit, and how the students received this directly fed into the improvements made from module to module.

Conclusion

This paper reported on an experiment conducted as a response to declining attendance, preparation and engagement in a third-year science unit. The data analysis focused on two broad questions, first what were the experiences of the members of the *microculture* with the new technologies and second, to what extent did they enhance the scholarship of learning and teaching. The data revealed an underexplored and yet potentially rich area for developing a shared understanding of the potential for *microcultures* to emerge as the locus for professional development, transformational change and the enhancement of teaching and learning in higher education.

The reported experiences of the academic and professional staff involved indicate an environment of mutual trust and respect, which resulted in the opportunity to conduct significant conversations that benefit the learning environment. The nature of this project was dependent on the ability of people to see their part and play it well. The three conditions: *trust*, *shared responsibility* and *developmental agenda* (Roxå & Mårtensson, 2015, p. 198) was the climate within which *significant conversations* took place. The effect of focussing the attention of the *microculture* on solving complex problems, such as attendance and engagement that lead to reflective dialogue that elevated the scholarship of teaching and learning.

Many questions remain however, such as whether the change in practices survive the disbanding of teaching teams, or changes to the unit. Is it possible to provide the necessary conditions for *microcultures* to emerge or is this simply a "luxury" model, difficult and expensive to replicate? The authors consider that this research has the potential to produce readily applicable design knowledge (Reeves, Herrington, & Oliver, 2005).

References

Bain, J. D., & McNaught, C. (2006). How academics use technology in teaching and learning: understanding the relationship between beliefs and practice. *Journal of Computer Assisted Learning*, *22*(2), 99–113. https://doi.org/10.1111/j.1365-2729.2006.00163.x

Boud, D., & Brew, A. (2013). Reconceptualising academic work as professional practice: implications for academic development. *International Journal for Academic Development*, *18*(3), 208–221. https://doi.org/10.1080/1360144X.2012.671771

Dillenbourg, P. (2013). Design for classroom orchestration. *Computers & Education*, 69, 485–492. https://doi.org/10.1016/j.compedu.2013.04.013

Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, *26*(2), 247–273.

Freire, P. (2000). *Pedagogy of the oppressed*. Bloomsbury Publishing.

Goodyear, P., Markauskaite, L., & Kali, Y. (2010). Learning design, design contexts and pedagogical knowledge-in-pieces. In *The Future of Learning Design Conference* (p. 2).

Harvey, M., Power, M., & Wilson, M. (2016). A review of intensive mode of delivery and science subjects in Australian universities. *Journal of Biological Education*, 1–11.

Heinrich, E. (2017). Teaching groups as midlevel sociocultural contexts for developing teaching and learning: a case study and comparison to microcultures. *Higher Education Research & Development*, *36*(4), 702–715. https://doi.org/10.1080/07294360.2016.1208641

Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching*, *48*(8), 952–984. https://doi.org/10.1002/tea.20439

Hesterman, D. (2015). Intensive mode delivery of courses in engineering, computer science and mathematics. *Faculty of Engineering, Computer & Mathematics: The University of Western Australia*. Retrieved from http://www.ecm.uwa.edu.au/__data/assets/pdf_file/0009/2700846/Hesterman-2015-UWA-ECM-Report-on-intensive-mode-delivery.pdf

Jørgensen, M. W., & Phillips, L. J. (2002). *Discourse analysis as theory and method*. Sage.

Kahn, P. E. (2014). Theorising student engagement in higher education. *British Educational Research Journal*, *40*(6), 1005–1018.

Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education*, *38*(5), 758–773. https://doi.org/10.1080/03075079.2011.598505

Kali, Y., McKenney, S., & Sagy, O. (2015). Teachers as designers of technology enhanced learning. *Instructional Science*, *43*(2), 173–179.

Kirschner, P., Strijbos, J.-W., & Kreijns, K. (2004). Designing integrated collaborative e-learning. *Integrated E-Learning: Implications for Pedagogy, Technology and Organization*, 24–38.

Male, S., Alam, F., Baillie, C., Crispin, S., Hancock, P., Leggoe, J., Ranmuthugala, D. (2016). Students' experiences of threshold capability development with intensive mode teaching. In *HERDSA 2016: The Shape of Higher Education* (Vol. 39, pp. 192–201). Retrieved from http://ecite.utas.edu.au/114968

Mårtensson, K., Roxå, T., & Olsson, T. (2011). Developing a quality culture through the Scholarship of Teaching and Learning. *Higher Education Research & Development*, *30*(1), 51–62. https://doi.org/10.1080/07294360.2011.536972

Kirschner, P.A. (2015). Do we need teachers as designers of technology enhanced learning? *Instructional Science*, *43*(2), 309–322.

Reeves, T. C., Herrington, J., & Oliver, R. (2005). Design research: A socially responsible approach to instructional technology research in higher education. *Journal of Computing in Higher Education*, *16*(2), 96–115.

Rienties, B., & Hosein, A. (2015). Unpacking (in)formal learning in an academic development programme: a mixed-method social network perspective. *International Journal for Academic Development*, *20*(2), 163–177. https://doi.org/10.1080/1360144X.2015.1029928

Roxå, T., & Mårtensson, K. (2015). Microcultures and informal learning: a heuristic guiding analysis of conditions for informal learning in local higher education workplaces. *International Journal for Academic Development*, *20*(2), 193–205.

Roxå, T., Mårtensson, K., & Alveteg, M. (2011). Understanding and influencing teaching and learning cultures at university: a network approach. *Higher Education*, *62*(1), 99–111. https://doi.org/10.1007/s10734-010-9368-9

Trigwell, K., & Shale, S. (2004). Student learning and the scholarship of university teaching. *Studies in Higher Education*, *29*(4), 523–536. https://doi.org/10.1080/0307507042000236407

Trowler, P. (2008). *Cultures and change in higher education: Theories and practices*. Palgrave Macmillan.

Trowler, P., & Cooper, A. (2002). Teaching and Learning Regimes: Implicit theories and recurrent practices in the enhancement of teaching and learning through educational development programmes. *Higher Education Research & Development*, *21*(3), 221–240. https://doi.org/10.1080/0729436022000020742

Wanner, T., & Palmer, E. (2016). From Flipped to Flopped to Flexible classrooms in Higher Education?–Critical Reflections from Australia. Retrieved from http://2016conference.ascilite.org/wp-content/uploads/ascilite2016_wanner_concise.pdf

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The role of IT in prisoner education: A global view

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Studies have consistently found that prisoners who undertake education while in prison are less likely to reoffend, and return to prison. However, in an environment where post-secondary education is increasingly being offered via online delivery, prisoners with no access to the internet are experiencing barriers to education offered by non-prison providers. This study examines the Australian prison environment, the education needs of prisoners, and their current access to education, information technology and the internet. Recent and future Australian and international developments in delivering online education to prisoners are examined.

Introduction

Studies have consistently found that prisoners who undertake education while in prison are less likely to reoffend, and return to prison (Coates, 2016; Farley & Pike, 2016; Davis, Bozick, Steele, Saunders & Miles, 2013). However, in an environment where post-secondary education is increasingly being offered via online delivery, prisoners with no access to the internet are experiencing barriers to education offered by non-prison providers. This study examines the Australian prison environment, the education needs of prisoners, and their current access to education, information technology and the internet. Recent and future international developments in delivering online education to prisoners are examined.

The Australian prison environment

Adult prisoners, aged over 18 years of age, are incarcerated in one of ninety-eight correctional facilities in Australia. As of 30 June 2016, there were 38, 845 adults in our prisons, an eight per cent increase from the past twelve months (Australian Bureau of Statistics, 2016). The Australian prison system is comprised of eighty-five government-operated prisons, nine privately-operated prisons and four transition centres (Institute for Criminal Policy Research, 2015). The operation of each of these prisons is guided by a 2012 publication, *Standard Guidelines for Corrections in Australia* (referred to as the *Guidelines),* published by senior members of state and territory governments responsible for corrections, known as the Australian Correctional Administrators. The *Guidelines* advise individuals and companies who are responsible for the operation and management of Australian prisons on the broad outcomes and goals to be achieved within and by their prisons (Australian Correctional Administrators, 2012).

The *Guidelines* recognise the link between education and recidivism, stating that one of the guiding principles by which prisoners are managed, is that they should be actively engaged in making positive behaviour changes, and that education is one means of achieving this (Australian Correctional Administrators, 2012). The *Guidelines* indicate that education programs, including vocational education, should be made available to prisoners, and that prisoners undertaking full-time study should be remunerated equally to prisoners undertaking full-time work. The *Guidelines* make it clear that educating prisoners is important and supported by prisons. There is also a recognition that prisoners have some unique education needs.

Prisoners’ education needs

Some of the educational needs of Australian prisoners can be identified by a study of their educational attainment and literacy levels. The Australian Institute of Health and Welfare (2015) provides information about prisoners’ education levels. Thirty-two per cent of adults entering Australian prisons had completed only Year 9 studies or below. Only 16 per cent had completed year 12 studies (Australian Institute of Health and Welfare, 2015). The Victorian Ombudsman (2014) identified that in Victorian prisons in 2013, 59.5 per cent of prisoners had literacy levels that required intensive support. At a national level, the National Centre for Vocational Education Research (Dawe, 2007) identified that 62 per cent of Australian prisoners had literacy levels that are classified as less than functional. The Victorian Ombudsman’s report (2014) states that education and skills training, along with work opportunities, are essential elements of the rehabilitation package that should be offered by prisons.

The link between education and recidivism is also well documented. A British study by Hopkins (2012) found that prisoners who had achieved a qualification whilst in prison were 15 per cent less likely to be reconvicted in the year after release than those who had gained no qualification. Callan & Gardner (2007) provide similar data in an Australian context. They found that in the two years following release from prison, 32 per cent of prisoners who did not undertake VET training during their time in prison were reconvicted and returned to prison, while only 23 per cent of prisoners who undertook VET training were reconvicted. A more recent Australian study by Giles (2016) also found that the more classes taken while in prison, the less likely it was that people would re-offend upon release.

Current access to education in Australian prisons

Prisoners can choose to enrol, or to not enrol, in education programs within prison. All Australian prisoners have their training needs assessed when entering the prison system (A future beyond the wall: improving post-release employment outcomes for people leaving prison ARC Linkage Project LP140100329, 2016), but prisoners do not have to undertake the training that is recommended to them. Prisoners who do choose to study have limited options available. Education and training that is typically offered in prison includes a Certificate I in General Education for Adults, which aims to develop basic skills in reading, writing and numeracy. Other vocational education opportunities such as entry level certificates are offered in areas such as hospitality, asset maintenance, horticulture and construction. In addition, prisoners can train for a licence in forklift driving and other construction-related licences (Victoria State Government, 2017a). These training opportunities are generally outsourced to local Tertiary and Further Education organisations, private Registered Training Organisations, or are offered by in-house teaching staff.

Prisoners wishing to study beyond 'in-house' offerings can receive some support from prison staff to do so, however, there are many barriers to succeeding in education offered outside the prison. Prisons in all states and territories state that they support distance education for prisoners, by providing access to education support staff (A future beyond the wall: improving post-release employment outcomes for people leaving prison ARC Linkage Project LP140100329, 2016). In addition, in some prisons, inmates are allowed to receive printed information and readings from family members. In other prisons, education officers are available for short periods each week to work with individual prisoners who are enrolled in external education programs. Education officers are able to download course work from education providers and to upload completed student assessments. Some students are able to pay to enrol in university courses through distance education and receive their coursework through the postal service. Some university libraries will lend books and print journal articles to be posted to the prisoner, upon request. Despite these services, the increasing emphasis on learning online and the online delivery of content, even to on-campus students, places a barrier between prisoners who have poor, or no access to information technology and the internet, and educational opportunities.

Current access to IT in Australian prisons

Access to information technology tools and services is highly restricted in Australian prisons. Prisons in New South Wales, Queensland and the Australian Capital Territory will allow prisoners to purchase desktop computers for their cells if they can demonstrate they need this for their education (A future beyond the wall: improving post-release employment outcomes for people leaving prison ARC Linkage Project LP140100329, 2016). Other prisoners can have access to PC computers within education training rooms during their lessons. These rooms are not accessible to prisoners outside of class hours. In the majority of Australian prisons, none of the computers described have access to the internet, but do offer basic word processing software. There are limited exceptions to these arrangements. For example, in the Alexander Maconochie Centre in the Australian Capital Territory, prisoners may visit the prison library to access computers and may send and receive emails from five approved addresses (personal communication, January 15, 2015). All email traffic is monitored. New South Wales, Western Australia and Tasmania allow limited and supervised access to the internet, either within a classroom, or on a one-on-one basis with a prison officer beside them (A future beyond the wall: improving post-release employment outcomes for people leaving prison ARC Linkage Project LP140100329, 2016).

Although prisoner education is supported through the provision of classroom computers and a tolerance of computers within cells in some states and territories, the lack of easy access to computers and the internet for education, places barriers between prisoners and online educational opportunities. Although these barriers are significant, developments in tablet and cloud technology have created opportunities to reduce barriers to online education faced by prisoners.

An Australian IT-based solution

Farley and Pike (2016) describe the *Making the Connection* project established by the University of Southern Queensland, as one solution to reducing the barriers to education placed on prisoners, due to their lack of access to the internet and other IT-based tools. The project introduced notebook computers that have no internet connectivity, but have access to a server containing educational materials, via an offline collection of study modules. The project allows digital learning, without needing to provide internet access. Through this mechanism, training has been delivered at the diploma and associate degree level in the areas of Business and Commerce, Science, and the Arts. As of March, 2017, there are 30 sites delivering the program within Queensland, the Northern Territory, Western Australia and Tasmania, with the possibility of expansion being currently explored (University of Southern Queensland, 2017).

International examples

There are some international examples of controlled access to information and communication technology tools being introduced into prisons. For example, the Colorado Department of Corrections has provided access to tablet computers to 8,000 inmates (Mitchell, 2017). The tablets have been designed for the prison environment and allow email and phone calls. They also enable access to a database of games, recorded music and ebooks. A similar program has been introduced into the prison system in South Dakota (Hult, 2017). Here prisoners are assigned a PIN that they can use to 'check out' a tablet for 24 hours. The tablets can be taken into prisoners' cells and provide access to music, ebooks and six websites. Links embedded within those sites are not active, so the user cannot move beyond the six sites. The tablets connect to a wireless internet service, but are only able to connect to the internet when they are within the grounds of the prison.

Having access to hardware, such as tablets and notebooks is also seen as valuable and educational, independent of the content they enable prisoners to access (Nabers, 2017). Many prisoners will have had limited or no exposure to electronic devices in their lives before prison. California correctional administrators have identified prisoners' lack of familiarity with information technology as a barrier to gaining employment after prison. By providing prisoners with tablet technology that enables electronic messaging and access to games and music, they hope to develop the basic computer literacy skills prisoners will need to find work after their release (Nabers, 2017).

Upston (2017) describes a New Zealand initiative where educational content is stored on a prison intranet within 'educational suites', creating a secure online environment. The 'suites' can be accessed within prison classrooms, by a limited number of pre-approved prisoners at the one time, providing them with content that supports their education and development of life skills. Twelve selected, educational websites are able to be accessed as a means of providing online learning opportunities.

The use of fixed screens on cell walls to deliver educational content has been investigated by Wayland Prison in Norfolk, England (Anon, 2016). Most prisoners at Wayland have a television in their cells where they have access to only one channel, produced by the prison. The Prison Channel currently delivers pre-programmed educational materials, but the prison plans to extend this idea with screens that will allow prisoners to Skype with external tutors and family members. Such an approach would solve a common problem within prisons, where many teaching hours are lost when prisoners are unable to attend classes. This can occur when the prison goes into lockdown, or other security measures are in place, and a lack of available prison officers to accompany prisoners from their cells to classrooms.

Despite the potential for such solutions to reduce barriers to education for prisoners, it should be noted that these services often come at a cost to the prisoner. The Colorado (Mitchell, 2017) and the South Dakota (Hult, 2017) examples mentioned earlier, both require prisoners to pay to gain access to the hardware, and also for the content they use. This is despite the fact that it is cheaper for prisons to provide access to external education opportunities, delivered online, than it is to educate prisoners in the prison class rooms (Sellers, 2016). The Australian prisons that allow prisoners to keep computers in their cells, require the prisoners to buy or rent them and any software required. Although prisoners do get paid for studying and may receive some money from family, the amount they receive from either source is very limited. Money earned needs to be used to buy items that are not supplied by the prison. Such items that need to be purchased include any additional food required, access to phone calls, and personal items such as newspapers, art or hobby materials and educational materials (Queensland Government, 2014). In addition, not all the money they earn in prison is made available to them. Prisoners in Victoria, for example, have 20 percent of their earnings withheld as savings to be used upon release (Victoria State Government, 2017b). Having to pay for access to hardware and content creates further barriers to participating in the educational opportunities delivered through these tools.

The future of prisoner education?

The use of virtual reality (VR) in education and training has the potential to place prisoners in immersive educational environments that would offer them tailored training opportunities. Bindi (2016) describes an American company that is developing VR technology for prisoner education. They plan to create VR learning environments where prisoners can learn how to perform car maintenance tasks, such as replacing batteries. Their product will include haptic feedback technology that enables the student to feel what they are holding, as well as see it. They also plan to develop VR scenarios, such as scenes of domestic violence, where they can be immersed to practice appropriate physical and emotional responses (Bindi, 2016).

Zoukis (2016) also discusses opportunities for prisoner education through the use of VR. He describes training through immersive experiences, where prisoners can be placed in virtual building sites, or kitchens and taught how to operate machinery and tools. He also envisages the possibility of prisoners experiencing virtual 'field trips' to museums, art galleries and libraries. He makes the point that such educational experiences can be self-paced and would have benefits to prisoners who struggle with literacy, as the educational experience would be visual, rather than text-based.

Conclusion

The benefits to prisoners in being able to study online, from within their cells are many. Learning in this way does not preclude prisoners from undertaking paid work during the day, is not dependant on the availability of prison staff to move prisoners to and from classrooms, allows prisoners a greater number of choices of courses to study, and caters for prisoners who wish to move beyond the very basic in-house education options. The increasing use of online delivery of educational content to students, has the potential to benefit prisoners who cannot attend classes on campus. However, prisoners who have little or no access to the internet, information technology, or computer hardware, face barriers in accessing such educational opportunities, particularly those offered by institutions outside prisons. In an environment where it is recognised that improving educational outcomes is one of the keys to reducing recidivism, efforts must be made to reduce these barriers. IT-based projects underway, and in development, have the potential to reduce these barriers and bring educational opportunities to prisoners. However, caution must be taken to ensure new barriers are not placed between prisoners and education by restricting these opportunities to only those who can pay.

References

A future beyond the wall: improving post-release employment outcomes for people leaving prison ARC Linkage Project LP140100329 (2016). *Adult prisoner participation in education, training and employment in Australia 2008-15*. Retrieved from New South Wales: https://socialsciences.arts.unsw.edu.au/media/SOSSFile/Audit_prisoner_participation_in_industries_and_education_20082015_FINAL_.pdf

Anon. (2016). Technology in prisons: screens behind bars. *The Economist, June 11, 2016.*

Australian Bureau of Statistics (2016). *4517.0 - Prisoners in Australia - 2016*. Canberra: Australian Bureau of Statistics.

Australian Institute of Health and Welfare (2015). The health of Australia's prisoners 2015. Canberra: Australian Institute of Health and Welfare.

Bindi, T. (2016). New York startup to use VR tech to rehabilitate prisoners: New York-based startup is looking to bring virtual reality technology into prisons to educate and rehabilitate inmates globally. *ZDNet, November 25*.

Callan, V., & Gardner, J. (2007). The role of VET in recidivism in Australia. In S. Dawe (Ed.), *Vocational education and training for adult prisoners and offenders in Australia: research readings* (pp. 27-36). Adelaide: NCVER.

Davis, L. M., Bozick, R., Steele, J. L., Saunders, J. & Miles, J. N. V. (2013). Evaluating the effectiveness of correctional education: a meta-analysis of programs that provide education to incarcerated adults. Santa Monica, California: RAND Corporation.

Dawe, S. E. (2007). Vocational education and training for adult prisoners and offenders in Australia: research readings. Adelaide: National Centre for Vocational Education Research.

Farley, H., & Pike, A. (2016). Engaging prisoners in education: reducing risk and recidivism. *Advancing corrections: journal of the International Corrections and Prisons Association, 1*, 65-73.

Giles, M. (2016). Study in prison reduces recidivism and welfare dependence: a case study from Western Australia 2005-2010. *Trends & Issues in Crime and Criminal Justice* (415).

Hopkins, K. (2012). The pre-custody employment, training and education status of newly sentenced prisoners. *Results from the Surveying Prisoner Crime Reduction (SPCR) longitudinal cohort study of prisoners. Ministry of Justice Analytical Services, Ministry of Justice Research Series*.

Hult, J. (2017). Tablets coming for SD inmates. *Argus Leader*. Retrieved from http://www.argusleader.com/story/news/2017/05/10/tablets-coming-sd-inmates/314747001/

Institute for Criminal Policy Research. (2015). *World Prison Brief - Australia* [Online]. London: University of London. Available: http://www.prisonstudies.org/country/australia [Accessed 22 November 2016].

Mitchell, K. (2017). 8,000 Colorado inmates have free computer tablets — but cost of texts, calls and streaming media adds up. *The Denver Post*.

Retrieved from http://www.denverpost.com/2017/05/09/colorado-prison-inmate-free-tablets/

Nabers, M. S. (2017). Tablet technology - now being found in strange places. Retrieved from http://www.corrections.com/news/article/45542-tablet-technology-now-being-found-in-strange-places-

Queensland Government. (2014). Daily life in prison. *Prisons and detention centres.* Retrieved from https://www.qld.gov.au/law/sentencing-prisons-and-probation/prisons-and-detention-centres/daily-life-in-prison/

Sellers, M. P. (2016). Online learning and recidivism rates. *International Journal of Leadership in Education, 19*(5), 632-636.

University of Southern Queensland. (2017). What we have achieved. Retrieved from https://www.usq.edu.au/research/research-programs/education-digital-learning/making-the-connection/about/achievements

Upston, L. (2017, 4 May, 2017). Secure Online Learning now at all prisons. Retrieved from https://beehive.govt.nz/release/secure-online-learning-now-all-prisons.

Victoria State Government (2017a). Work, education and training. Retrieved from http://www.corrections.vic.gov.au/home/prison/going+to+prison/work+education+and+training/

Victoria State Government. (2017b). Money. *Going to prison.* Retrieved from http://www.corrections.vic.gov.au/home/prison/going+to+prison/money/

Victorian Ombudsman (2015). Investigation into the rehabilitation and reintegration of prisoners in Victoria. Melbourne.

Zoukis, C. (2016). Virtual reality behind bars for real change. Retrieved from http://www.prisoneducation.com/prison-education-news//virtual-reality-behind-bars-for-real-change.

Contact author: Jane Garner, jane.garner@rmit.edu.au
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Me, us and IT: Insiders views of the complex technical, organisational and personal elements in using virtual worlds in education

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The adoption and pedagogical use of technologies such as virtual worlds to support teaching and learning, and research in higher education involves a complex interplay of technical, organisational and personal factors. In this paper, eighteen educators and researchers provide an overview of how they perceive a virtual world can be used in education from the perspective of themselves as individuals ‘me’, their educational organisations and as members of the Australian and New Zealand Virtual Worlds Working Group (VWWG) community of practice ‘us’, as well as the complex technology that underpins this learning environment ‘IT’. Drawing on Linstone’s (1981, 1984) Technical, Organisational and Personal (TOP) multiple perspective concept as the framework for analysis, the authors discuss their perspectives of how the personal, organisational and technical aspects of teaching through the use of virtual worlds have impacted on their teaching and research in higher education. The potential of employing the TOP framework to inform future research into the use of technologies such as virtual worlds in teaching and learning is explored.

Introduction

The Australian and New Zealand Virtual Worlds Working Group (VWWG) began in 2009 seeing a need to bring together researchers from Australia and New Zealand to discuss how virtual worlds could be utilised in higher education institutions across the two continents. This paper draws on Linstone’s (1981, 1984) multiple perspective approach to explore the experiences of Australian and New Zealand higher education academics in employing virtual worlds technologies in their teaching and learning. Using Linstone’s (1981, 1984) Technical, Organisational and Personal (TOP) multiple perspective concept as the framework for analysis, eighteen educators who are members of the VWWG explicate the complexities of employing virtual worlds in higher education. These experiences are viewed through the lens of TOP, which considers their personal perspectives as teachers, researchers and individuals with a social presence in virtual worlds ‘me’, the organisational context of the educational institutions in which they work, as educators within the virtual world social context, and as members of the VWWG community of practice ‘us’, and the technology of virtual worlds, referred for the purpose of the paper as Information Technology ‘IT’.

Literature review

The design, deployment and use of virtual words within educational institutions can be thought of as a messy (Courtney, 2001), ‘wicked’ problem (Rittel & Webber, 1973). In recent times, virtual words have had to deal with a decline in support within educational institutions, both in focus and financial resourcing as initial grant money has dried up. As the findings of a study conducted in 2013 suggest, organisational factors such as lack of available technology and institutional support in terms of technology, funding and teaching accounted for a majority of educators no longer teaching in virtual worlds (Gregory et al., 2015). Thus, initial fervour turned to disillusionment on the part of institutional leadership about unmet expectations that were based on more hype than fact. In the intervening time, lessons have been learnt about how to best apply the technology within educational settings as demonstrated by the work of researchers in the Australian and New Zealand Virtual Worlds Working Group (Gregory et al., 2016, Gregory et al., 2015, Gregory et al., 2014). As a result, virtual worlds have been rising up from the ‘slope of enlightenment’ and are now placed on the ‘Plateau of Productivity’ (Lowendahl, 2016, online).

Yet, across Australasia, particularly, Australia and New Zealand, many virtual word practitioners still face considerable barriers in developing, deploying and using virtual worlds in their institutions. Such problems can be described as having multiple, evolving facets, where technical elements are complex and interconnected, and where stakeholders have different and sometimes contradictory aims. The research undertaken by educators who have been striving for a long time to develop creative and holistic resources and best use deployments of virtual worlds, offer great insight into the nature of the problems faced by educators in using such tools. They have deep insight into the nature of the benefits that can accrue from carefully considering matching technology and desired educational outcomes. The authors of this paper, a diverse group of educators and researchers in virtual worlds within higher education, offer multiple perspectives on the problem from an insiders’ point of view. As experts, they offer insights from diverse perspectives and represent a range of educational institutions; from metropolitan research focused universities, to multi- and single-campus regional institutions from every part of Australia and New Zealand. The authors draw upon their personal insights and reactions to their struggles and hopes for virtual worlds in education in the broadly interpretative tradition as per Schwandt (1994). In the practical situation of using and thinking about virtual worlds occurring in a social context, Markus (1983) argues that in complex systems projects insiders such as a project team member, as an individual educator, as a system support person or learning designer, are aware of the role of the non-technical aspects of the job at hand and the desired outcomes of applying virtual worlds. Thus, we as insiders are considered as intelligent, thinking, creative and self-aware and more than capable of contributing in their own right to the research effort. By combining insights from multiple experts and contexts, we are able to build a richer understanding of the phenomena. In seeking to understand their diverse perspectives, the theme of ‘me’, ‘is’ and ‘IT’ is explored using Linstone’s (1981, 1984) TOP multiple perspective concept framework for analysis. Linstone’s ideas have been used in complex problem analysis for well over three decades. The approach recognises the limitations of focusing only on the technical aspects in complex real-life systems, arguing that the technical perspective needs to be augmented by the organisational/institutional and personal/individual perspectives to make sense of the complexity of systems operating with organisational contexts. For Linstone (1981, 1984) to understand the sociotechnical environment in which systems operate, we need to move beyond reductionism, which assumes that all problems can be solved from a technical perspective. The multiple perspective approach, therefore, requires consideration not only of the technical, but also organisational factors such as the dynamic processes that impact on systems as well as the individual actors within the system. Each individual brings with them personal characteristics such as their ability to learn and adapt, their power and influence within the organisation and how they utilise these characteristics as leaders or followers. We are also reminded by Avison and Myers (2002) who argue that ‘qualitative’ is not equivalent to ‘interpretive’. This means there is a role for some descriptive numerical analysis of the perspectives we have collected in the aid of understanding.

The TOP multiple perspective approach provides a useful lens through which to consider the complex technology that drives virtual worlds (T), the organisational context within educational institutions that employing virtual world technologies and the community of scholars surrounding virtual worlds (O) and the personal characteristics of educators and researchers who are employing virtual worlds in their learning and teaching (P). In the following sections, the authors apply the TOP multiple perspective approach as the theoretical foundation for understanding the ‘me’

(Personal/Individual), 'us' (Organisational), and IT (Technical) factors impacting on their experiences teaching and researching in virtual worlds and as the lens through which they share their experiences as a diverse group of virtual world insiders.

Me, Us, IT: a complex ecosystem

Like all learning environments, the elements and relationships that constitute the educational use of virtual worlds are multiple and complex. The prism of 'me', 'us', IT and the TOP multiple perspective conceptualisation provides a concise structure with which to unpack this dynamic complexity, as shown in Figure 1. As the diagram shows and the next sections describe, the complex ecosystem in which we teach and research constitutes three elements: the technology (IT, in this case 3D virtual worlds augmented with other learning technologies that offer particular pedagogical affordances); the organisation comprising our higher education institutions including our colleagues, learners and university service providers including technology services, as well as the VWWG community of practice 'us'; and the person 'me', who fulfils the role of educator, researcher and social individual.

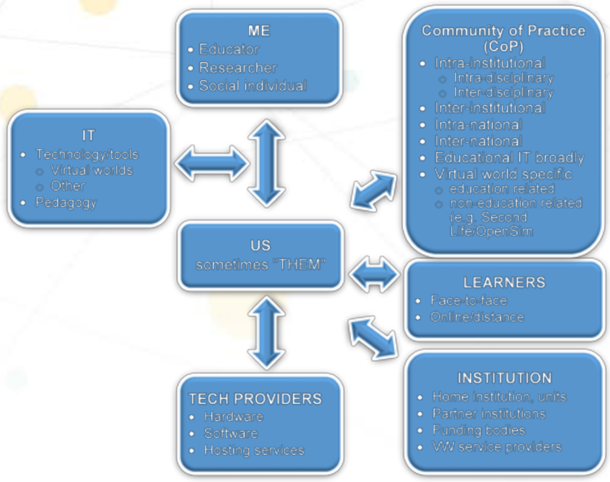

Figure 1: ME, US, IT: A complex ecosystem

Me (Personal/Individual)

Me represents the personal perspective. As practitioners, we engage with the combination of IT, virtual worlds and pedagogy in more than one role; we are educators, researchers, and individuals with a social presence in these environments. The role of 'social individual' is included in this category because many practitioners have a social presence within virtual worlds that, in addition to satisfying social needs, can also feed into their teaching and research. This could be through learning more about the intricacies of the platform by frequent use and experimentation, through direct mentoring from other users who are not educators, or simple observation of what others are doing in situations that have nothing to do with education. While not unique to virtual worlds, given that most virtual worlds were established primarily as social networking platforms, the social aspect of engagement in virtual worlds is an important element in understanding the ways in which individuals interact within virtual world environments.

Us (Organisational)

Us represents the organisational perspective of institutions and of the relational dynamic that occurs in a complex web of different players, both within and without the virtual world environment. Some of the members of this complex web include IT support, faculties and departments, university management and teaching support centres. Others, such as 'Tech Providers' are included separately because of the dialogue that frequently occurs between users of the various virtual world platforms and the platform providers and hosts that, at times, leads to mutual insights, growth, and development. While it could be argued that 'Tech Providers' should also be included in the community of practice (CoP) (Wenger, 1998), we would argue that, as they are primarily commercial providers of a service, they answer to a broader constituency and have a larger mission than just educators and education, with this segment of their constituency often being considered minor, yet, they are important, players.

When reflecting about 'us' two streams were evident: (a) the community of practice that the educator was able to be part of, and (b) the affordances of virtual worlds to provide educational experiences for students. The place of the VWWG within the community of practice has served as an important linking mechanism between geographically dispersed individuals and clusters and has itself become hub of an Australasian virtual worlds community of practice.

IT (Technical)

IT can represent literal 'IT', that is technology and the perspective of technology developers, support services and vendors. But, it can also represent other things through 'it', a crucial one being pedagogy. Indeed, it could be argued that IT (technology) on its own merely represents an opportunity waiting to be exploited. In the field of virtual worlds, platforms such as Second Life and

OpenSim exemplify this idea perfectly. In each case, users are provided with a blank slate, an empty, highly customisable, 3D environment, underpinned by a range of technological affordances. However, it is left up to the users to create the uses of the environment provided. For educational uses of virtual worlds, the most crucial factor is the combination of and intersection between, technology and pedagogy. The usability characteristics of the technology tools themselves, such as stability and cost and play an important part in the ability for individuals, 'me', and organisations, 'us', to viably adopt and adapt virtual words to their teaching practice.

Methodology: community of practice

Members of the VWWG were asked to provide their insights into 'me', 'us' and 'IT' in relation to their experiences of using a virtual world at their institutions. A request was distributed to all members of the VWWG inviting them to contribute to this publication by responding to a series of open and closed questions incorporated into an online survey. These questions included closed questions aimed at identifying the discipline in which they use virtual worlds for teaching and the sorts of activities undertaken through virtual worlds. Open questions focused on the themes, 'me', 'us' and 'IT', and also sought to identify any challenges they have experienced teaching and researching in virtual worlds.

A total of 19 VWWG members responded to the survey. Responses to closed questions provided background information for this paper, and responses to the open ended questions were thematically analysed to identify the experiences of the respondents in relation to the 'me', 'us' and 'IT' themes, drawing on the TOP multiple perspective approach. The findings from this study are reported in the following sections.

Respondents discuss the 'me' aspect of their virtual world experiences

Thirteen responses were received in regards to what virtual worlds meant to 'me'. The responses were categorised into five themes: frustration; less active; engagement, innovation and unrestrictive; and collaboration without borders as shown in Figure 2.

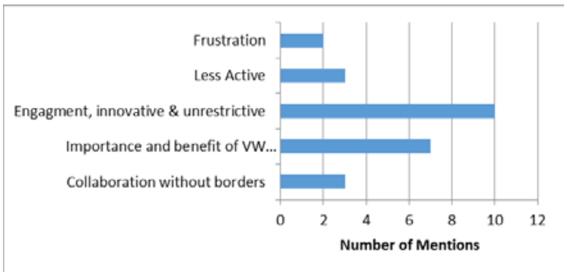

Figure 2: Five themes of 'me' in relation to virtual world education

Themes and individual responses in relation to 'me' are discussed further.

Frustration: Two of the responses outlined the frustration they felt in terms of the lack of support virtual worlds receive. This included the challenges in finding funding to support and maintain usage, and the isolation felt due to the lack of willingness to engage with virtual worlds.

Less Active: Three responses indicated that they had become less active with virtual worlds. This was due to workload, focussing only on educational use, and funding pressures as previously outlined. In all cases, the passion for virtual worlds remained and it was external forces that led to reduced usage and frustration.

Engagement, innovative and unrestrictive: The most common element with ten responses centred on the positive aspects of virtual worlds and the way they foster engagement, inspire innovation and removed many of the restrictions faced in the real world or two-dimensions (2D) communication technologies. This was expressed in two ways. Firstly, was in terms of the benefits to teaching and learning the individuals gained from applying virtual worlds in a teaching application. This was based on how virtual worlds increased engagement and allowed for solutions to problems currently unavailable or less effective via other means. Secondly, in terms of the benefit directly to the individual, for example, one response was, 'What I like about virtual worlds is that I can experience them as 'me' or even 'alternative me's'. I have about thirty avatars and which one I use depends on how or who I'm feeling like. Virtual worlds allow me to learn as 'me'.'

Importance and benefit of virtual world pedagogy: The importance in using virtual worlds with the appropriate pedagogy was raised by seven of the respondents. While many virtual worlds such as Second Life have large social networking aspects, comments outlined that their focus was centred on education. Using virtual worlds requires careful consideration of the correct pedagogy that integrates with their affordances.

Collaboration without borders: Three respondents outlined how the technology enabled communication and collaboration with users located across the world. The flexibility and scalability of virtual worlds enabled for more immersive conversations than can happen elsewhere. For example, a study by Lee, Nikolic, Vial, Ritz, Li and Goldfinch (2016) demonstrated how effective a virtual world could be when used to improve the broader aspects of project work with students and staff located across two continents with industry representatives located across the globe. The interaction with the offshore students and industry representatives helped reduce the confusion and frustration often faced in the initial, critical stages of open-ended, project-based learning. This led to a measured increase in learning and students becoming more confident and an improvement in their skills.

Some other comments from respondents in relation to 'me' were:

> Virtual worlds opened up my horizons. They can provide a perspective that cannot be experienced readily any other way. It is hoped that virtual worlds will offer a deep and rewarding immersive role play environment in which to foster empathy and regulatory fit. However, they still suffer from 'non-support fatigue'. The 'me' must keep finding funds and support to maintain the use of them.

Another respondent made the following comment:

> At a personal level, the 'me' level, the powerful combination of virtual worlds and communities of practice was revealed to me very early on. I believe I am a much better, and certainly much better informed, educator as a result of my participation in Second Life and the communities, both virtual and real world, it has exposed me to.
>
> In addition to this growth as an educator, working with the virtual environment of Second Life (and subsequently OpenSim) has forced me to learn a whole range of other skills that I may well not have learned otherwise. The use of virtual worlds has also, over the years, opened up many opportunities for collaboration, research, publication and obtaining research funding. Virtual worlds, task-based learning, simulation, immersive learning, etc., are still providing me with ongoing opportunities to do all of these things.

Us – In the virtual world

A strong voice came through about collegiality and a true sense of an authentic Community of Practice (CoP). This was evident regardless of the level of experience that the educator had in the virtual world as one new user claimed that the users of virtual words that they were fortunate to have interacted with, proved to be collaborative and dynamic educators. Other users had been extremely helpful when they encountered the many blocks that can occur initiating virtual worlds into the curriculum. This 'less than encouraging environment' meant that 'users band together to be supportive' and many have found that 'the CoP group inside virtual worlds, share more than any other group of colleagues with whom I have ever had the pleasure of dealing'.

Often educators are the only one within their institution using virtual worlds and as such the need to find a CoP outside of the physical space is extremely important. The VWWG has sought to provide this space and special interest groups have developed in tandem to the main group. One such group was the virtual worlds PhD group. This brought together higher degree research students who were using virtual worlds as part of their research. One participant described this as 'a truly authentic experience as we used the technology we were researching'. The meetings held by the VWWG and sub-groups enabled geographically dispersed individuals to come together with a true sense of presence, as though they were in the same space and sharing the same experience. This meant that 'we can share a table, a meeting, a laugh or a project as if we are actually meeting in the real world'. 'There is a sense of shared presence that you just don't get when using other technologies'. 'By sharing the virtual space with our colleagues, we become 'us'.'

As educators working in what is still a new technology in terms of uptake in the higher education community, the authors feel that it is important for 'us' to drive the process. This includes continuing to partake in research that includes virtual worlds and to set the goals and designs for how a virtual word will work if they are to have mainstream acceptance. It is the 'us' that are the leaders in these fields and should be assisting other teaching staff and institutions in how to deploy of virtual word as a turnkey educational technology.

As many of 'us' work in online and blended learning environments, the challenge of providing students with authentic experiences in which we develop relationships and provide parity of experiences is vitally important. Virtual worlds provide students located in different locations to participate in activities where they feel a sense of community, in which the activity is about 'us', as they interact via the avatar they have embodied. As educators using virtual worlds, we believe in the effectiveness of teaching and learning in a virtual environment having experienced the benefit to students through the presence we and they bring to the activities.

Thirteen responses received were in regards to what virtual worlds meant to 'us'. The respondents referred to the term 'us' in two different ways. This includes as a virtual world user community and as educators represented in Figure 3.

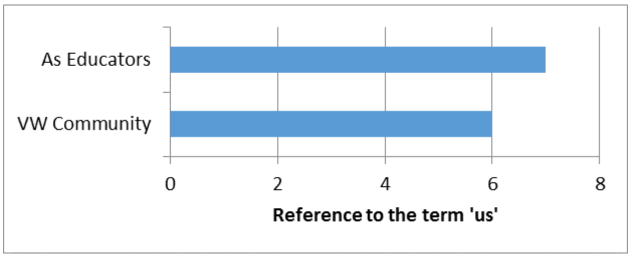

Figure 3: 'Us' in relation to virtual worlds (vw)

Most respondents considered the term 'us' as educators and discussed in two different contexts. The first, by only one respondent, was that as a virtual world supporter within a university the 'us' is small with little support to further develop the area. The other respondents described 'us' as the benefits that virtual worlds bring to the community of teachers, students and other participants that engage with it for teaching and learning. For example, statements included 'I can share virtual space with my colleagues and we become 'us'.' And, 'What's important about virtual worlds is the community it has the potential to build'.

The other six respondents consider 'us' in terms of the VWWG. A common theme across the responses was the collegial and supportive environment of the group with the sharing of experience and research, forging many friendships along the way. It was highlighted that members of the group were leaders and were responsible and needed to help others appreciate and adopt virtual world technologies.

From the point of view of the university as a group 'us', there appears to be scant support for further development in the area. It remains a niche enterprise taken on by passionate individuals. It has yet to become mainstream. Virtual worlds allow participants located in different locations to appreciate activities where they feel a sense of community in which the activity is about 'us', removing the lack of student engagement and that feeling of isolation found with typical online learning opportunities. The 'us' allows more people to participate in the learning journey, be it students, industry or teaching staff from around the country or world.

IT (Technical)

Ten responses received where in regards to what virtual worlds meant to 'IT'. The respondents referred to the term 'IT' in three different ways, with one respondent referring to two. 'IT' was discussed in terms of the user; technology infrastructure and support; and exploration and potential as shown in Figure 4.

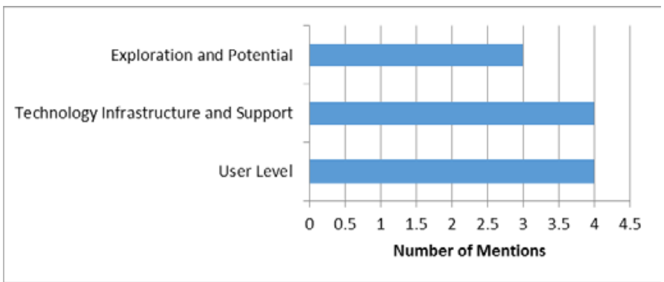

Figure 4: IT in relation to virtual worlds

Many respondents discussed the user component of IT referring to technical capability, adaptability and familiarity with the technology. This includes the way younger and older generations interact with the technology and how, by using the technology, we enable our students. Younger participants in particular tend to adapt to the technology very quickly, but in turn need some motivation to try new technologies to become aware and familiar with the application. Older participants less familiar with technology can need some assistance in understanding the fundamental concepts. A study by Nikolic, Lee, Goldfinch and Ritz (2016) assessed the implementation of a virtual world careers fair and found students would not necessarily engage with new technology without a motivator. Within the study, it also found that those not familiar with the technology can benefit from an in-world (in the virtual world) help desk prior to the beginning of events.

Similarly, just as many respondents outlined the impact that infrastructure and IT departments have on the experience. One respondent believed that IT is becoming invisible, while the other three respondents discussed the struggles implementing virtual world learning has with their interaction with IT support. They claim that 'IT support struggles with understanding what virtual worlds are and how they are used in teaching'.

The other three comments referred to 'IT' as a place to trial and use technology. It was important to explore technology, that it is always changing and there are always many new developments on the horizon for educators to explore. It was also noted that many of the new technologies on the horizon will merge with virtual worlds leading to new opportunities. The technology in virtual words remains a stumbling block for wider spread adoption. Their use in education still requires a level of technical skill that is beyond the average academic or the funding available.

A challenge in using virtual worlds is IT on two levels. First is in getting the technology to work (overcoming IT policies) and the non-standard computer setup of participants. Logistical management is key and is not for everyone. But, by getting people to participate in such events, the opportunities provided by technology gain greater familiarity and awareness which may provide some hope. Secondly, IT departments have been increasingly aware and helpful in supporting virtual world opportunities. However, there is still a lack of financial support in providing long term licenses and rolling out the technology across all users to help support the initiatives and increase greater take-up.

Conclusions

The findings reported in this paper provide greater understanding of educators and researchers' perceptions of how a virtual world is used by the individual 'me', the group 'us' and how 'IT' has impacted on its use. It is clear from the responses that virtual worlds are complex ecosystems and that their use in teaching and learning, and as sites for research, needs to be understood in the context of wider organisational considerations in which the individual educator and researcher plays a critical role in championing the use of virtual worlds for education, while also navigating the complexities and messiness that comes from working within an organisational context, which is itself complex and dynamic, and subject to limited resources and support. The complexities of the virtual worlds technology bring particular challenges that require the commitment and dedication of educators to resolve. The findings also show the benefits of educators and researchers collaborating through the VWWG community of practice as an element of the organisational context that can support educators in navigating the complexities of using virtual worlds.

The TOP multiple perspective approach helps to make sense of these complexities and provides a valuable framework for assisting educators and researchers to explicate the factors that make up the complex ecosystem in which they teach and research. The TOP multiple perspective conceptualisation has potential as a framework for analysis of other technological implementations within higher education.

Overall, the authors believe the value of virtual worlds in education is enormous and will continue to espouse their benefits to the wider community as they navigate and problem solve the challenges experienced in their teaching and researching in virtual worlds. They have individual stories to tell, but they also provide a group story, from across continents through their community of practice, the Australian and New Zealand Virtual Worlds Working Group. As the findings of this study show, the members of this group use virtual worlds as individual teachers, researchers and social beings 'me', and as members of an organisational context comprising their higher education institution and the VVWG community of practice 'us' to support their teaching and research enabled through the virtual worlds platform 'IT'.

References

Avison, D.E. & Myers, M. (2002) *Qualitative research in information systems: a reader*, Sage Publications, London, UK.

Courtney, J.F. (2001) Decision making and knowledge management in inquiring organizations: toward a new decision-making paradigm for DSS, *Decision Support Systems, 3*(1): 17–38.

Gregory, S., Scutter, S., Jacka, L. & Newman, C. (2015). Barriers and enablers to the use of virtual worlds in higher education: An exploration of educator perceptions, attitudes and experiences, *Educational Technology & Society, 18*(1), 3–1.

Gregory, S., Gregory, B., Grant, S., McDonald, M., Nikolic, S., Farley, H., O'Connell, J., Butler, D., Jacka, L., Jegathesan, J.J., McGrath, N., Rudra, A., Stokes-Thompson, F., Sukunesan, S., Zagami, J., Sim, J., Schutt, S., Gaukrodger, B., Hearns, M. & Irving, L. (2016). Exploring virtual world innovations and design through learner voices. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), *Show Me the Learning: Proceedings ASCILITE 2016 Adelaide* (pp. 245–254). Adelaide, Australia: University of South Australia. Retrieved from http://2016conference.ascilite.org/wp-content/uploads/ascilite2016_gregory_full.pdf

Gregory, S., Gregory, B., Wood, D., O'Connell, J., Grant, S., Hillier, M., Butler, D., Yvonne Masters, Y., Stokes-Thompson, F., McDonald, M., Nikolic, S., Ellis, D., Kerr, T., de Freitas, S., Farley, H., Schutt, S., Sim, J., Gaukrodger, B., Jacka, L., Doyle, D., Blyth, P., Corder, D., Reiners, T., Linegar, D., Hearns, H., Cox, R., Jegathesan, J.J., Sukunesan, S., Flintoff, K. & Irving, L. (2015). New applications, new global audiences: Educators repurposing and reusing 3D virtual and immersive learning resources. In T. Reiners, B. von Konsky R., D. Gibson, V. Chang, L. Irving & K. Clarke (Eds.), *Globally connected, digitally enabled. Proceedings ASCILITE 2015 in Perth (*FP:109–FP:121). Perth: WA. http://www.2015conference.ascilite.org/wp-content/uploads/2015/11/ascilite-2015-proceedings.pdf

Gregory, S., Gregory, B., Wood, D., Butler, D., Pasfield-Neofitou, S., Hearns, M., de Freitas, S., Farley, H., Warren, I., Jacka, L., Stokes-Thompson, F., Cox, R., Crowther, P., Atkins, C., McDonald, M., Reiners, T., Wood, L., Sim, J., Grant, S., Campbell, C., Hillier, M., Meredith, G., Steel, C., Jegathesan. J.J., Zagami, J.,Sukunesan, S., Gaukrodger, B.,Schutt, S., Le Rossignol, K., Hill, M., Rive, P., Wang, X. (2014). Rhetoric and Reality: critical perspectives on education in a 3D virtual world. In B. Hegarty, J. McDonald, & S.-K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology*. Proceedings ASCILITE Dunedin 2014 (pp. 279–289). https://app.box.com/s/016cdyv8dq1pp0yhp1vw/1/2704865198/23032570210/1

Lee, M. J. W., Nikolic, S., Vial, P. J., Ritz, C., Li, W., & Goldfinch, T. (2016). Enhancing project-based learning through student and industry engagement in a video-augmented 3D virtual trade fair. *IEEE Transactions on Education, 59*(4), 290–298. doi:10.1109/TE.2016.2546230

Lowendahl, J.-M. (2016). Hype Cycle for Education, 2016. Retrieved from https://www.gartner.com/doc/3364119/hype-cycle-education-

Linstone, H.A. (1981) The multiple perspective concept with applications to technology assessment and other decision areas, *Technological Forecasting and Social Change, 20*(4): 275–325.

Linstone, H.A. (1984) *Multiple perspectives for decision making - bridging the gap between analysis and action*, North Holland, New York, USA.

Markus, M. L. (1983) Power, politics, and MIS implementation, *Communications of the ACM, 26*(6): 430-444.

Nikolic, S., Lee, M. J. W., Goldfinch, T., & Ritz, C. H. (2016). Addressing misconceptions about engineering through student–industry interaction in a video-augmented 3D immersive virtual world. Paper presented at the I*EEE Frontiers in Education Conference* (FIE), PA, USA.

Rittel, H. & Webber, M.M. (1973) Dilemmas in a general theory of planning, *Policy Sciences, 4*(2): 155–169.

Rowe, J., P., McQuiggan, S., W., & Lester, J., C. (2007). Narrative presence in intelligent learning environments. In *AAAI Fall Symposium on Intelligent Narrative Technologies* (pp. 1–8). Washington DC. Retrieved from http://www4.ncsu.edu/~jprowe/papers/FS06RoweJ.pdf

Schwandt, T. A. (1994) *Constructivist, interpretivist approaches to human inquiry*, in Denzin N.K. & Lincoln Y.S. (eds) Strategies of qualitative inquiry, 2nd ed, Sage, Thousand Oaks, CA, USA, pp. 118–137.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

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Variations in the coherence and engagement in students' experience of blended learning

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We report a study which examines coherence of engagement of 344 first year engineering students' blended learning experience. Using self-report and observational data sources, we demonstrate that student perceptions of the blended learning environment, academic learning outcomes, and engagement with the online learning activities are logically related at the variable level as shown by correlation analyses; and at the level of student groupings of similar learning experience and behaviors, as revealed by cluster, ANOVA, and 2 x 2 contingency analyses. Using self-report data, we found that when students perceived the learning activities in the f2f and online environments were integrated, they were more likely to be engaged with the online learning and to perform relatively higher on the assessment tasks than students who perceived disintegration between f2f and online learning. Using the observational data, students who were more engaged with the online learning tended to perceive that the online learning was well integrated with the f2f learning, that the online contributions were valuable for the whole learning experience, and achieved relatively higher than less engaged students. A 2 x 2 contingency table revealed a logical relationship between the groupings of students based on the self-report and observational data: moderate and positive association was found between students with coherent perceptions and more engagement; and between students with fragmented perceptions and less engagement. The use of multiple data sources and methods enabled triangulation, strengthened analysis power, and offered a more comprehensive picture of students' blended learning experience.

Introduction

The last decade has witnessed the rapid development of learning analytic methods and tools in order to monitor, trace, and record students' learning behaviors (Baker & Seimens, 2014; Knight, Buckingham Shum, & Littleton, 2014; Lockyer, Heathcote, & Dawson, 2013). With the assistance of different data mining techniques, which use algorithms to derive knowledge and insight from log and trace data held in online learning systems, educational researchers and teachers use the results to uncover students' learning patterns in order to improve students' learning experience and to facilitate teaching (Antunes, 2010; Essa & Ayad, 2012 a, b; Romero, López, Luna, & Ventura, 2013). One risk of fully rely on learning analytics and educational data mining is that the analyses and identification of learning patterns is primarily based on empiricism without being theoretically informed (Long & Siemens, 2011). This can result in reduced insight into the patterns of learning; and limits their use to locate problems in learning, to offer ideas for pedagogy reform, and to provide guidance for better design of learning environments (Shum & Crick, 2012).

Not everyone agrees with the risks of atheoretical approaches to educational data mining. Some researchers suggest that the analyses and advancements of learning analytics as a matter of empiricism should be used to shed light on learning theories. Using observational data of actual use by students of online learning systems, such methods are sometimes referred to as the bottom-up approaches (Berland, Martin, Benton, Patrick Smiths, & Davis, 2013, Chen, 2015). In contrast, other researchers argue that theories from educational psychology, curriculum and pedagogy studies, educational assessment, or sociology in education should be explicitly adopted in the research design to guide the approach to educational data mining in order for learning analytics to be useful for decision-making about learning and teaching issues (Knight et al., 2014). Using self-report data from questionnaire completed by students, these methods are sometimes referred to as top-down approaches (Suthers & Verbert, 2013). In this paper, we present a study which discusses how top-down and bottom-up approaches are combined to reveal variations in the coherence and engagement in an experience of blended learning in a first year university engineering course.

Background

Relational student learning research

Relational student learning research seeks to demonstrate qualitative variations in students' learning outcomes and identify variables which explain differences in their academic achievement. Studies have shown that a number of interrelated factors, including the departmental factors, students' prior learning experience, their conceptions of learning the subject, their approaches to study, and their perceptions of teaching and learning, are closely related to the quality of student learning (Asikainen, Parpala, Lindblom-Ylänne, Vanthournout, & Coertjens, 2014; Edmunds & Richardson, 2009; Lonka, Olkinuora, & Mäkinen, 2004; Prosser & Trigwell, 1999). Past research has found that students' qualitative differences in learning outcomes relate to these variables across many different disciplines and cultures (Dolmans, Loyens, Marcq, & Gijbels, 2016; Ellis & Goodyear, 2013; Entwistle, 2009)

Relational student learning research has identified that student perception variables, such as clear goals and standards in teaching, appropriate assessment, and appropriate workload play important roles in students' learning experience (Ramsden, 1991, Richardson, 1994; Wilson, Lizzio, & Ramsden, 1997). Studies report that positive perceptions (that teaching is of a high quality, that assessment is suitable for the course, and that the course workload is appropriate), are related to cohesive conceptions of and deep approaches to learning, and relatively higher levels of academic achievement. In contrast, negative perceptions (unclear goals and low teaching quality, and inappropriate assessment and workload) are associated with fragmented conceptions of learning, surface approaches to study, and poorer academic performance (Ginns, Prosser, & Barrie, 2007; Lizzio, Wilson, & Simons, 2002; Wilson & Fowler, 2005).

Learning analytics research

In the last couple of decades, the advancement in learning analytic software systems and data mining techniques have been captured observational data of student use of the online environments with a view to understanding their learning processes and facilitate design of learning environment (Baker & Siemens, 2014; Martin et al., 2013). The rich and 'big data' sets captured with learning analytic technology have been used for many purposes. They have been used to track students' retention rate (Arnold, Hall, Street, Lafayette, & Pistilli, 2012), in providing professional advice on students' future career plans (Bramucci & Caston, 2012), in supporting students' collaborative learning (Kaendler, Wiedmann, Rummel, & Spada, 2015), in identifying learning patterns and strategies (Chen, Resendes, Chai, & Hong, 2017), in detecting students' affect (Ocumpaugh, Baker, Gowda, Heffernan, & Heffernan, 2014), and in predicting academic success (Antunes, 2010; Romero et al., 2013). Despite the usefulness of big data, researchers point out the danger of relying fully on learning analytics and advise combining educational theories and data mining techniques to inform research design, methodologies and interpretation (Buckingham Shum & Crick, 2012; Suthers & Vebert, 2013).

In this study, we use self-report data which assess students' perceptions of the blended learning environment as part of students' learning experience on the one hand, and the extent of students' engagement with online learning activities as revealed by learning analytics on the other. Using a top-down approach, we examined to what extent variations in students' learning experience are related to levels of engagement with online learning sessions. Using a bottom-up approach, we investigated how levels of engagement are related to students' qualitatively different learning experience. We then consider what the combined perspectives offer in terms of insights into learning experience.

Method

Participants and the research context

The research was conducted with 334 first year engineering undergraduates in one core semester-long course. According to the procedures stipulated by the university ethics committee, all the students were invited to participate in the research on a voluntary basis and we explained ways to ensure the anonymity of their identity. The course had four major teaching aims: (1) to provide students with a solid foundation on the concepts of computer architecture and digital logic design; (2) to equip students with engineering communicative abilities to accurately and concisely present specific information on issues related to design; (3) to familiarize students with professional and ethical conducts and practice to meet standards when working with hardware and software; and (4) to enable students to experience team-based design and cooperation in solving engineering problems.

The course is designed as a blended learning experience with a two-hour lecture, a two-hour tutorials, and a three-hour laboratory sessions each week; and a range of online learning activities and resources, including compulsory and supplementary readings in pdf format, URL links, and videos related to the course contents; course notes; problem solving sequences; multiple choice questions; and multiple choice questions embedded with videos. The students were expected to use the online activities and resources as preparation and follow up for each of their face-to-face (f2f) sessions. The online learning activities were hosted in a bespoke learning management system (LMS), which were able to capture the kinds of activities a student is engaged with, the starting and ending time for each type of activities, and the break time between the activities when a student logged into the LMS. The learning analytics are able to arrange student engagement with the activities in a sequence of events in a format which could be directly exported and downloaded for analyses.

Instruments

We collected information on students' perceptions of blended learning environment (i.e., self-report data), students' learning outcomes for the course, and the online learning sessions they were engaged in throughout the semester (i.e., observational data). Each of these is explained in turn.

Perceptions of blended learning environment.
A questionnaire was used to evaluate students' perceptions of blended learning environment in this course. The questionnaire was constructed using the literature of the relational research on student learning (Ramsden, 1991; Ellis, Ginns, & Piggott, 2007). The questionnaire had three scales: (1) perceptions of integration between f2f and online learning (7 items, α = .86; A sample item is: "I found it helpful to follow up ideas from class in the online environment in this course"); (2) perceptions of appropriateness of the online workload (6 items, α = .77; "A better balance between the online activities and the other tasks would help my workload" is an example item); and (3) perceptions of usefulness of the online contributions (6 items, α = .87; A sample item is: "Online contributions from others in this course prompted me to reflect more on the ideas in this course"). All the items in the questionnaire were on a 5-point Likert scale, with 1 representing strongly disagree, and 5 indicating strongly agree.

Learning outcomes. The learning outcomes were measured using the total mark for the course, which was made up of six different assessment tasks: (1) preparatory exercises for lectures (10%), (2) preparatory exercises for tutorials (10%), (3) laboratory performance (5%), (4) a report of a research project (15%), (5) the midterm examination (20%), and the final examination (40%). The total course mark was the aggregated score of the six tasks out of 100 points.

Engagement with online learning sessions. Students' engagement with online learning sessions was extracted using the criterion that a sequence of events comprised one or more online learning activities which had lags less than 30 minutes between activities. Using this criterion, the number of online learning sessions per week for each individual student was derived for 12 consecutive weeks. The 12-week online learning sessions were then averaged and used as indicators of students' engagement with online learning sessions.

Procedure

We distributed the questionnaire towards the end of the semester so that the students could reflect on their whole learning experience of the course. The questionnaire took approximately 10 minutes to complete. With the consent from the students, we retrieved the data representing their online learning sessions from the LMS and obtained the total marks upon completion of the course.

Data analysis

To investigate how students' learning experience and engagement with online learning sessions are related at the level of variables, we conducted correlation analyses. Then in order to investigate the distribution of the associations amongst the variables across the population sample, we used cluster analysis and Analysis of Variance (ANOVA) in two stages. In the first stage, we classified students based on their perceptions of learning environment and the learning outcomes of the course, and compared students' engagement of online learning sessions by their cluster membership using ANOVA. In this stage, the groupings of the students were derived from the relational perspectives (i.e., top-down approach), and the analyses were able to show how students' learning experience was closely related to their engagement with online learning sessions.

Subsequently, in the second stage, we grouped students using the *Mean (M)* scores of the engagement with numbers of online learning sessions, and conducted ANOVA to examine if students differed on the perceptions of blended learning environment and the learning outcomes by levels of engagement with online learning sessions. In the second stage, the groupings of the students came from the learning analytics data (i.e., bottom-up approach), and the analyses reflected how students' engagement with online learning sessions affected their perceptions and learning outcomes. Lastly, to examine how the grouping variable from the top-down approach is associated with the grouping variable from the bottom-up approach, we conducted a 2 x 2 contingency table. This analysis allowed us to see whether the top-down and the bottom-up approaches of groupings converges, that is the strength of association between variations in students' learning experience (i.e., coherent or fragmented learning experience) is associated with qualitatively different levels of online engagement (i.e., more or less engaged as reflected by *M* numbers of online learning sessions).

Results and discussion

Descriptive statistics

The descriptive statistics of the three perception scales, the learning outcomes, and engagement with online learning sessions, including means (*M*s), standard deviations (*SD*s), minimum (Min.) and maximum (Max.) values the variables are displayed in Table 1.

Table 1: Descriptive statistics

Variables	*M*	*SD*	Min.	Max.
Perceptions				
Integration of f2f and online learning activities	2.87	0.76	1.00	5.00
Appropriateness of online workload	3.74	0.72	1.00	5.00
Usefulness of online contributions	3.18	0.88	1.00	5.00
Academic achievement				
Course marks	67.28	14.43	25.00	98.00
Observational data				
Online learning sessions	3.25	0.71	1.58	5.00

Results at the variable level

The results of correlation analyses regarding the relationship between the learning experience and engagement with online learning sessions are presented in Table 2.

The correlation results in Table 2 shows that the students' perceptions of the integration of f2f and online learning was positively and weakly related to perceptions of the appropriateness of online workload (r = .15, p < .01) and the course marks (r = .14, p < .01). It had positive and moderate association with the perceptions of usefulness of online contributions (r = .43, p < .01). Students' perceptions of online workload was negatively and weakly related to the perceptions of online contributions (r = -.11, p < .05), but it had positive and weak relation with the course marks (r = .20, p < .01). Engagement with online learning sessions was positively and weakly related to the perceptions of usefulness of online contributions (r = .18, p < .01) and it was also positively and moderately correlated with the course marks (r = .51, p < .01). These correlation results show logic pairwise relations amongst variables of students' perceptions, course marks, and the engagement with online learning sessions: the positive appraisal of values of online contributions in the course is related to higher achievement in the course, and more engaged with online learning on average throughout the course.

Table 2: Results of correlation analyses

Variables	Appropriateness of online workload	Usefulness of online contributions	Course marks	Online learning sessions
Integration of f2f and online learning	.15**	.43**	.14**	.10
Appropriateness of online workload	---	-.11*	.20**	-.01
Usefulness of online contributions	---	---	-.01	.18**
Course marks	---	---	---	.51**
Online learning sessions	---	---	---	---

Notes: ** p < .01, * p < .05

Results of the top-down approach

Table 3 presents the cluster analysis using the students' learning experience variables (i.e., the three perceptions scales and the learning outcomes) and the ANOVA, which examined the contrast of these learning experience variables as well as the learning analytic data (i.e., engagement with online learning sessions) using the cluster membership derived from the learning experience variables. To facilitate interpretation, we converted all the raw scores into z-scores with a M of 0 and a SD of 1 in the analyses.

Table 3: ANOVA results of based on the learning experience variables

Variables	Coherent experience (N = 226)		Fragmented experience (N = 108)		F	p	η^2
	M	SD	M	SD			
			Perceptions				
Integration of f2f and online learning	0.44	0.70	-0.95	0.89	240.96	**.00**	.42
Appropriateness of online workload	0.13	0.96	-0.23	1.05	9.63	**.00**	.03
Usefulness of online contributions	0.29	0.92	-0.61	0.88	72.86	**.00**	.18
			Academic achievement				
Course marks	0.31	0.93	-0.64	0.83	83.29	**.00**	.20
			Observational data				
Online learning sessions	0.16	0.95	-0.34	1.03	20.01	**.00**	.06

Using the increasing value of the squared Euclidean distance between clusters, we retained a two-cluster solution. Table 3 shows that of 334 students, 226 students were classified as students who reported a coherent learning experience, consisting of positive perceptions of the blended learning environment and relatively higher academic achievement in the course;

whereas the rest of 108 students were those who had a fragmented learning experience with negative perceptions of the blended learning environment and relatively lower academic achievement. As shown by the ANOVA results, all the differences on the perceptions scales (integration between f2f and online learning: F (1, 333) = 240.96, p < .01, η^2 = .42; appropriateness of online workload: F (1, 333) = 9.63, p < .01, η^2 = .03, and usefulness of online contributions: F (1, 333) = 72.86, p < .01, η^2 = .18) and the course marks (F (1, 333) = 83.29, p < .01, η^2 = .20) between the two clusters of students were statistically significant. The students with coherent learning experience had higher ratings on the perceptions of integration between f2f and online learning (M = 0.44, SD = 0.70); felt the online workload was more appropriate (M = 0.13, SD = 0.96); considered the online contributions being more useful (M = 0.29, SD = 0.92), and performed relatively academically higher in the course (M = 0.31, SD = 0.93); than those with fragmented learning experience, who had lower ratings on all the perceptions scales (integration between f2f and online learning: M = -0.95, SD = 0.89; appropriateness of online workload: M = -0.23, SD = 1.95; and usefulness of online contributions: M = -0.61, SD = 0.88), and achieved relatively poorly (M = -0.64, SD = 0.83). On the basis of this cluster membership, the ANOVA also identified statistically difference of numbers of online learning sessions between the two clusters (F (1, 333) = 20.01, p < .01, η^2 = .06). It revealed that the students who reported a coherent learning experience were more engaged with online learning activities (M = 0.16, SD = 0.95) than their counterparts who reported a fragmented learning experience in the course (M = -0.34, SD = 1.03).

From the top-down approach, we found that at the levels of groups of students identified by maximising their similar learning experience, their learning experience were related to the level of engagement they displayed with the online learning sessions. Students who perceived that the f2f and online learning environments were integrated and valued the online learning in the courses, were more engaged with the online activities. Those students also tended to achieve relatively higher in academic assessment tasks. In contrast, students in the cluster of the fragmented blended learning experience did not perceive a connection between the f2f and online activities, did not appraise the online postings contributed by their peer classmates, considered the online learning workload was heavy, and obtained relatively lower course marks. Those students with the fragmented learning experience also tended to be relatively less engaged with using online learning activities.

Results of the bottom-up approach

To compare with the findings of the top-down method which clustered the population sample using the self-report data, in this stage we commenced with the learning analytic data in order to find grouping of students in the population sample. Table 4 presents the ANOVA results with the grouping variable 'online learning sessions'. Students are grouped based on their relative levels of engagement with online learning sessions in relation to the M of the online learning sessions for all the 334 students. Those above the M were classified as 'more engaged' and those below the M were classified as 'less engaged'.

Table 4: ANOVA results based on the online learning session

Variables	More engagement (N = 144)		Less engagement (N = 190)		F	p	η^2
	M	SD	M	SD			
Observational data							
Online learning sessions	0.92	0.59	-0.70	0.61	592.75	**.00**	.64
Perceptions							
Integration of f2f and online learning	0.14	1.01	-0.13	1.00	5.72	**.02**	.02
Appropriate-ness of online workload	0.09	1.00	-0.03	0.99	1.17	.28	.01
Usefulness of online contributions	0.27	0.87	-0.19	1.03	18.35	**.00**	.05
Academic achievement							
Course marks	0.46	0.87	-0.34	0.95	61.13	**.00**	.16

From Table 4, we can see that among 344 students, 144 students were relatively more engaged (M = 0.92, SD = 0.59) with the online learning activities and 190 students were relatively less engaged (M = -0.70, SD = 0.61), as reflected statistically by the ANOVA, F (1, 333) = 592.75, p < .01, η^2 = .64. Using this as a grouping variable, the ANOVA also showed that between the more and less engaged students, there were statistical differences on perceptions of integration between f2f and online learning, F (1, 333) = 5.72, p < .05, η^2 = .02, usefulness of online contributions, F (1, 333) = 18.35, p < .01, η^2 = .05, and course marks, F (1, 333) = 61.13, p < .01, η^2 = .16. We found that students who were more engaged with online learning tended to have positive perceptions about the integration between f2f and online learning (M = 0.14, SD = 1.01), had a positive perception of the value of online contributions (M = 0.27, SD = 0.87), , and achieved relatively higher learning outcomes (M = 0.46, SD = 0.87) than less engaged students, who felt that f2f and online learning was not well connected (M = -0.13, SD = 1.00), did not consider online postings were useful (M = -0.19, SD = 1.03), and obtained lower scores in the course (M = -0.34, SD = 0.95).

From a bottom-up approach using the observational data, it shows that when students were more engaged with the online learning activities, they felt online learning was well integrated with f2f learning, online contributions were valuable for the whole learning experience in the course. The more engaged students also tended to perform at a higher academic level than the less engaged students, who perceived the f2f and online learning as separate aspects and did not think they could learn from other students' online postings.

Results of association between top-down and bottom-up groupings

To look at the association amongst the top-down and bottom-up groupings of students, specifically, the extent of logical congruence amongst the groupings, we conducted a 2 x 2 contingency table to examine how students' membership based on types of learning experience and levels of engagement with online learning sessions was associated. We used the chi squared statistics to determine if the observed and expected frequencies of the groupings are significantly different, and used phi statistics to determine the strength of the association. Table 5 presents the 2 x 2 contingency table results.

Table 5: Frequency distributions and proportions by levels of learning experience and engagement with online learning

Groupings	More engagement		Less engagement		Total	
Coherent experience	116	34.7%	110	32.9%	226	67.7%
Fragmented experience	28	8.4%	80	24.0%	108	32.3%
Total	144	43.1%	190	56.9%	334	100.0%

$\chi^2 = 19.23^{**}$, $\phi = .24^{**}$, ** $p < .01$

The chi-squared statistics (χ^2 (1) = 19.23, $p < .01$) and phi ($\phi = .24$, $p < .01$) show that a 'coherent experience' is significantly and moderately associated with 'more engagement' with online learning sessions; and a 'fragmented experience' is related to 'less engagement' with the online learning activities.

Conclusion

The research is replete with studies which argue the merits of different categories of data as evidence of learning (Chan, 2009; Smith, 1993). Here we combined two sources of data as evidence of learning and investigated the congruency in outcomes when contrasting different sequence of methodologies. While we used the same methods (cluster and ANOVA with both data sets) in the two sequences of analyses, we partitioned the population sample in two ways using top-down (based on self-report quality of learning experience) and bottom-up approaches and (based on level of observed engagement with online activities). Using a 2 x 2 contingency table, we found the groupings in the two methodologies were logically and structurally coherent and consistent; that is reported coherent experiences of learning were found to be positively related to observed higher levels of online engagement; and reported fragmented experiences of learning were found to be negatively related to observed less levels of online engagement in both methods.

By using both categories of data and discovering similar findings, we not only confirmed the usefulness of using both types of data, but also revealed a more holistic understanding of the student experience of blended learning and the reasons why some learning experiences are more successful than others. Students who reported relatively more coherent experiences of learning as indicated by positive perceptions of the integration of the learning activities in class and online, who valued the postings of other students, and who perceived that the workload was appropriate, were observed to engage more often and for longer periods of time in the online environment and achieved relatively higher academically. In contrast, students who reported relatively more fragmented experiences of learning as indicated by negative perceptions of the integration of the learning activities in class and online, who did not value the postings of other students, and who considered the workload being heavy, were observed to engage less often and for shorter periods of time in the online environment and achieved relatively lower academically. In this study, we employed multiple analyses, including correlation, cluster and ANOVA, and a 2 x 2 contingency table, these methods triangulated with each other and strengthened the power of the analyses, presenting a more comprehensive picture of students' blended learning than a single method and approach can offer. The findings offer a number of implications for teaching.

For teaching and activity design, the results suggest that helping students to develop positive perceptions of the relatedness of the in-class and online activities is important for perceptions of workload, the online contributions of other students and overall achievement. This observation could be worked into the design of the activities, pointing backwards and forwards between the online and classroom contexts in the activity design to remind the students of the links between the ideas raised in both contexts and how they related to tasks and course outcomes. Equally important could be discussions in class that show how and why some students are relatively more engaged online with the activities. This could be achieved through peer learning activities in small groups or through plenary demonstrations in which active students demonstrate 'what they do' and 'why they do it' in the online environment to the whole class. In both examples, the results suggest that such strategies are likely to help students experience more coherent and engaged experiences of learning in blended contexts.

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References

Antunes, C. (2010). Anticipating student's failure as soon as possible. In Romero, C., Ventura, S., M. Pechenizkiy, M., & R. Baker, R. (Eds.), *Handbook of educational data mining* (pp. 353-262). New York: CRC Press.

Arnold, K. E., Hall, Y., Street, S. G., Lafayette, W., & Pistilli, M. D. (2012) Course signals at Purdue: Using learning analytics to increase student success. In S. Buckingham Shum, D. Gašević, & R. Ferguson (Eds.) *International conference on learning analytics and knowledge* (pp.267-270). New York: ACM Press.

Asikainen, H., Parpala, A., Lindblom-Ylänne, S., Vanthournout, G., & Coertjens, L. (2014). The development of approaches to learning and perceptions of the teaching-learning environment during Bachelor level studies and their relation to study success. *Higher Education Studies, 4*(4), 24-36.

Baker, R., & Siemens, G. 2014. Educational data mining and learning analytics. In Sawyer, R. K. (Ed.), *The Cambridge Handbook of the Learning Sciences* (pp. 253-274). Cambridge, Cambridge University Press.

Berland, M., Martin, T., Benton, T., Petrick Smith, C., & Davis, D. (2013). Using learning analytics to understand the learning pathways of novice programmers. *Journal of the Learning Sciences*, *22*(4), 564-599.

Bramucci, R., & Gaston, J. (2012). Sherpa: Increasing student success with a recommendation engine. In S. Buckingham Shum, D. Gašević, & R. Ferguson (Eds.) *International conference on learning analytics and knowledge* (pp. 82-83). New York: ACM Press.

Buckingham Shum, S., & Crick, R. D. (2012). Learning dispositions and transferable competencies: pedagogy, modelling and learning analytics. In the proceedings of *the 2nd International Conference on Learning Analytics and Knowledge* (pp. 92-101). New York, ACM Press.

Chan, D. (2009). So why ask me? Are self-report data really that bad. *Statistical and methodological myths and urban legends: Doctrine, verity and fable in the organizational and social sciences*, 309-336.

Chen, B. (2015). From theory use to theory building in learning analytics: A commentary on "Learning analytics to support teachers during synchronous CSCL". *Journal of Learning Analytics, 2*(2), 163-168.

Chen, B., Resendes, M., Chai, C. S., & Hong, H. Y. (2017). Two tales of time: uncovering the significance of sequential patterns among contribution types in knowledge-building discourse. *Interactive Learning Environments, 25*(2), 162-175.

Dolmans, D. H., Loyens, S. M., Marcq, H., & Gijbels, D. (2016). Deep and surface learning in problem-based learning: A review of the literature. *Advances in Health Sciences Education, 21*(5), 1087-1112.

Edmunds, R., & Richardson, J. T. (2009). Conceptions of learning, approaches to studying and personal development in UK higher education. *British Journal of Educational Psychology, 79*(2), 295-309.

Entwistle, N. J. (2009). *Teaching for understanding at university: Deep approaches and distinctive ways of thinking.* Basingstoke: Palgrave Macmillan.

Ellis, R., & Bliuc, A. (2016). An exploration into first-year university students' approaches to inquiry and online learning technologies in blended environments. *British Journal of Educational Technology, 47*(5), 970-980.

Ellis, R., Ginns, P., & Piggott, L. (2009). E-learning in higher education: some key aspects and their relationship to approaches to study. *Higher Education Research & Development,* 28(3), 303-318.

Ellis, R., & Goodyear, P. (2013). *Students' experiences of e-learning in higher education: The ecology of sustainable innovation*. London: Routledge.

Ellis, R. A., Pardo, A., & Han, F. (2016). Quality in blended learning environments – significant differences in how students approach learning collaborations. *Computers & Education, 102*, 90-102.

Essa, A., & Ayad, H. (2012a). Improving student success using predictive models and data visualisations. *Research in Learning Technology, 5*, 58-70.

Essa, A., & Ayad, H. (2012b). Student success system: Risk analytics and data visualization using Ensembles of Predictive Models. In the *proceedings of the 2nd International Conference on Learning Analytics and Knowledge.* New York, ACM Press.

Ginns, P., Prosser, M., & Barrie, S. (2007). Students' perceptions of teaching quality in higher education: The perspective of currently enrolled students. *Studies in Higher Education, 32*(5), 603-615.

Kaendler, C., Wiedmann, M., Rummel, N., & Spada, H. (2015). Teacher competencies for the implementation of collaborative learning in the classroom: A framework and research review. *Educational Psychology Review*, *27*(3), 505–536.

Knight, S., Buckingham Shum, S., & Littleton, K. (2014). Epistemology, assessment, pedagogy: Where learning meets analytics in the middle space. *Journal of Learning Analytics, 1*(2), 23-47.

Lizzio, A., K. Wilson, & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Studies in Higher Education, 27,* 27-52.

Lockyer, L., Heathcote, E., & Dawson, S. (2013). Informing pedagogical action: Aligning learning analytics with learning design. *American Behavioral Scientist, 57*(10), 1439-1459.

Lonka, K., Olkinuora, E., & Mäkinen, J. (2004). Aspects and prospects of measuring studying and learning in higher education. *Educational Psychology Review, 16*(4), 301-323.

Martin, T., Aghababyan, A., Pfaffman, J., Olsen, J., Baker, S., Janisiewicz, P., & Smith, C.P. (2013). Nanogenetic learning analytics: Illuminating student learning pathways in an online fraction game. In the *proceedings of the Third International Conference on Learning Analytics and Knowledge* (pp. 165-169). New York: ACM Press.

Ocumpaugh, J., Baker, R., Gowda, S., Heffernan, N., & Heffernan, C. (2014). Population validity for Educational Data Mining models: A case study in affect detection. *British Journal of Educational Technology*, *45*(3), 487-501.

Prosser, M., & Trigwell, K. (1999). *Understanding learning and teaching: The Experience in higher education.* Buckingham: SRHE and Open University Press.

Ramsden, P. (1991). A performance indicator of teaching quality in higher education: The Course Experience Questionnaire. *Higher Education, 16*, 129-150.

Richardson, J. T. E. (1994). A British evaluation of the Course Experience Questionnaire. *Studies in Higher Education, 19*, 59-68.

Romero, C., López, M.-I., Luna, J.-M., & Ventura, S. 2013. Predicting students' final performance from participation in on-line discussion forums. *Computers & Education, 68*, 458-472.

Smith, J. K. (1993). After the demise of empiricism: The problem of judging social and education inquiry.

Suthers, D., & Verbert, K. (2013). Learning analytics as a "middle space." In the *proceedings of the Third International Conference on Learning Analytics and Knowledge (LAK '13),* 1-4.

Wilson, K., & Fowler, J. (2005). Assessing the impact of learning environments on students' approaches to learning: Comparing conventional and action learning designs. *Assessment & Evaluation in Higher Education, 30*(1), 87-101.

Wilson, K. L., A. Lizzio, & Ramsden, P. (1997). The development, validation and application of the Course Experience Questionnaire. *Studies in Higher Education, 22,* 33-53.

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Framework for the analysis and comparison of e-assessment systems

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The use of technology within the education sector affects many aspects of the learning process, including assessment. Electronic assessment presents many advantages over traditional paper based methods and it is being widely used by teachers and educational institutions. The progressive acceptance and use of e-assessment has resulted in the development of a panoply of e-assessment systems. This paper aims to propose a framework for the analysis and comparison of e-assessment systems, to support the selection of the most suitable assessment instruments. The proposed framework is composed of eight criteria, variety of design options, scalability, security, access and usability, feedback features, personalisation, cost and interoperability, which were overall validated by the viewpoints of educational experts via an online questionnaire.

Introduction

The establishment of good assessment practices is crucial for the success of learning and teaching and the use of technology has been proven to enhance assessment at many levels (JISC, 2007). Generally speaking, e-assessment refers to the use of technology to assist the assessment process.

E-assessment presents a variety of benefits over paper based mechanisms, namely a decrease in cost (James, 2016), marking automation (Ras, Whitelock, & Kalz, 2015), adaptive testing (Fluck, Pullen, & Harper, 2009), increase of assessment frequency (Sclater, 2007) and the ability to assess higher number of learners (Jordan, 2009). As it happens with any technology, its implementation is not free from challenges: incapacity to evaluate high-order thinking competences (Fluck et al., 2009), lack of security in the delivery of e-exams (Miguel, Caballé, Xhafa, & Prieto, 2014) and the inappropriateness of technological infrastructures (James, 2016).

The design, delivery and evaluation of e-assessment activities are supported by a wide range of technologies and tools. Teachers have the possibility of using Web 2.0 platforms such as blogs or wikis, virtual environments like Second Life (Crisp, 2011), e-portfolios, computer based quizzes (Jordan, 2013) and e-assessment systems. The development of e-assessment systems began in the late 1990's to assist the accomplishment of regular assessment for a high number of students. Since then, these systems have become increasingly complex and they are being used not only as assessment instruments, but as tools for the enhancement of learning (Gusev & Armenski, 2014).

This paper begins with the description of the proposed framework for the evaluation of e-assessment systems and the theoretical foundation of each of its elements. It then discusses the methodological aspects of the empirical research and presents the results of the online questionnaires. A brief discussion of the findings and their implications concludes the paper.

Framework for the evaluation of e-assessment systems

The growing interest and investment in e-assessment draws attention to the systems that have been and are being designed to create, deliver and evaluate e-assessment activities. With the existing variety of e-assessment systems it is important to have parameters that can guide their selection. The framework that is proposed in this section aims to provide the criteria to analyse and compare e-assessment systems.

Despite the fact that "an e-assessment system… is only as good as the content on it and the vision and skill of its users." (JISC, 2007, p. 39), there are aspects that pertain to e-assessment systems themselves that are determinant for high quality e-assessment and prevent the detrimental impact of "straight jacket software systems" (Whitelock & Brasher, 2006, p. 500). This framework will be focusing solely on the characteristics that concern the systems themselves. Hence, it excludes aspects relating to the efficacy of the questions and assessment activities in general, the competences of the teachers and students, the appropriateness of the technological infrastructures of the institutions or any other aspects that are external to the systems.

The framework that this paper proposes derives from a review of existing research within the area of e-assessment and it combines contributions concerning e-assessment systems' characteristics and principles for effective assessment and e-assessment. This framework is composed of eight criteria (Figure 1): variety of design options, scalability, security, access and usability, feedback features, personalisation, cost and interoperability.

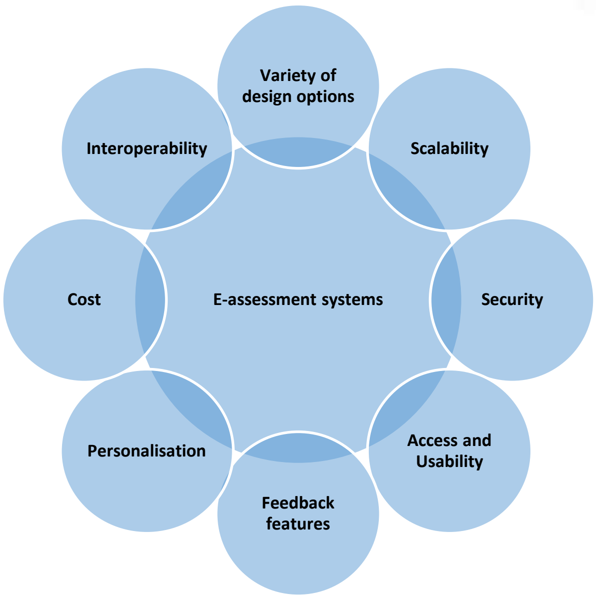

Figure 1: Framework for the evaluation of e-assessment systems

Variety of design options

When deciding what e-assessment system to use it is important to examine the type of assessments it supports (Oakleaf, Belanger, & Graham, 2013). Variety is a requirement of good quality assessment. Hence it is an added value to use several assessment instruments (surveys, portfolios, rubrics) (Buzzetto-More & Alade, 2006) and an assortment of techniques, namely self and peer assessment (Gaytan & McEwen, 2007).

It is crucial that they provide an ample selection of question types (Hillier & Fluck, 2013; Mackenzie, 2003), namely to widen the range of skills that can be evaluated (Usener, Majchrzak, & Kuchen, 2011). The possibilities that e-assessment provides in terms of designing assorted and authentic assignments, namely through e-portfolios, games and simulations, allow the evaluation of competences that would be more difficult when using other methods (Jordan, 2013). Furthermore, e-assessment systems should have several features for the edition of questions, namely grammar and spell checkers, offline design of questions and pretesting of the assessment (Singh & De Villiers, 2015).

Scalability

Scalability is one of the challenges commonly associated with e-assessment (Ristov, Gusev, Armenski, Bozinoski, & Velkoski, 2013). It is important that an assessment system has the scalability to support an institution-wide implementation (Leach, 2011). Scalability is also an important feature to account for higher number of students (Hillier & Fluck, 2013) and a mounting number of assessments (Gusev, Ristov, Arminski, Velkoski, & Bozinoski, 2013).

A system's scalability can derive from a certain degree of automation (Daly, Pachler, Mor, & Mellar, 2010). Scalability can also be obtained by resorting to cloud computing solutions for the development of e-assessment systems. The use of cloud computing represents a cost effective alternative to improving the systems' performance and scalability (Gusev et al., 2013).

Security

Security is a major concern in e-assessment (James, 2016). In general, it is necessary to enable the identification of unauthorised behaviour by the students; to ensure that the students can only access the e-test content at the designated time of the assessment; and to provide safe storage for the students' responses and personal information (QCA, 2007). The security of assessment systems can also be assured by restricting the access to grading data to those with authorisation and limiting the access to the test to certain IP addresses (Singh & De Villiers, 2015).

According to Miguel et al. (2014) the security of e-assessment is dependent on a multiplicity of factors, namely the student's integrity when completing the assessment and student identification and authentication. Resorting to question ordering and different versions of the same question (JISC Info Net, 2006) and to restrict or interdict access to the internet or the network (Hillier & Fluck, 2013) are some of the possible approaches for enhancing fairness. Moreover, for high stakes examinations remote monitoring can be used via video and biometrics for authentication, as well as the use of IP restrictions and the assignment of individual credentials (Crisp, 2011).

Access and Usability

The decision of adopting an assessment system is influenced by its ease of use (Oakleaf et al., 2013). The system's interface must be intuitive and offer help options (Singh & De Villiers, 2015). E-assessment systems should include features to promote access and usability, such as font size and colour edition tools, subtitled videos and transcription for audio resources (Hillier & Fluck, 2013). According to Mackenzie (2003) the ideal e-assessment system for e-learning should offer the learner pre-test and pre-question training resources if necessary.

E-assessment systems' software should have the capacity to run in the great majority of the operating systems (Hillier & Fluck, 2013) and devices (James, 2016). It is equally important that the system offers some type of support services. These services can vary from training assistance, to online help manuals, to telephone support (Oakleaf et al., 2013) and should have the ability to support a large number of users concurrently (Singh & De Villiers, 2015).

Feedback features

An assessment system must provide the student with detailed and instructive feedback and it should deliver information about the performance of the learner to the teacher in order to adjust tutorial help (Mackenzie, 2003). E-assessment systems should provide the students with access to the results of previous assessments and offer them the possibility to compare their grades with the average of their peers (Singh & De Villiers, 2015). Many assessment systems provide functionalities to manage assessment data, such as statistical analysis and offer the documentation of the students' assessments (Oakleaf et al., 2013).

The use of automatic grading is essential as it reduces the workload of the teacher (Ras et al., 2015). Certain aspects of marking need to be considered, namely misspelling and case sensitivity and there needs to be some flexibility in terms of the acceptance of answers (Walker, Topping, & Rodrigues, 2008). It is important to clarify this specific aspect of the feedback process, since in certain systems it could lead correct answers to be marked as incorrect based on errors related to misspelling (JISC, 2007).

Personalisation

E-assessment systems need to be adaptable (Armenski & Gusev, 2009). An adaptive e-assessment system uses the information it has about students' cognitive level to suggest their next assessment. Generally, these systems are constituted by an evidential module that works continuously throughout the learning process, processes the data that is collected from the students and decides what is pertinent to add to their profiles; and an adaptive module that adapts the assessment to the student and is solely employed at the time of the assessment tasks' creation (Baneres, Baró, Guerrero-Roldán, & Rodriguez, 2016). The capacity to deliver adaptive assessment activities is a central part of the system's capacity to offer personalisation features that the teacher can use to make the assessment more suitable to each individual student. Adaptive testing allows students to be presented with questions that are consonant with their knowledge level (Gusev & Armenski, 2014). Also, assessment systems should allow personalised configurations, so that the institutions can adapt the system to meet their needs (Hillier & Fluck, 2013).

Cost

E-assessment systems are required to be financially effective. When selecting which system to use for e-assessment one of the core concerns is the cost (Oakleaf et al., 2013). One of the aspects to consider when comparing systems is their availability as open source (Amelung, Krieger, & Rösner, 2011). When deciding what systems to use, institutions have to opt between a commercial solution, a system that they will develop themselves or a combination of both. Entities with more financial resources can recruit programmers and other personnel to design their own system, while entities with less financial resources often decide to use a commercial alternative (Sivakumaran, Holland, Wishart, Heynig, & Flowers-Gibson, 2010). From a financial perspective the provision of systems for e-assessment constitutes a substantial burden. Although some institutions have considerably invested in Virtual Learning Environments (VLE) and they do offer assessment functionalities, these are usually simple and insufficient to attain the institutions' assessment goals (Whitelock & Brasher, 2006). Similarly, many Learning Management Systems (LMS) do not offer a complete range of e-assessment features (Gusev & Armenski, 2014).

Interoperability

Accounting for interoperability adds credibility to the development of assessment tools (Sclater, 2007). Thus, the progress of e-assessment would benefit from the achievement of system interoperability (JISC, 2007; Whitelock & Brasher, 2006). One strategy for promoting it among systems is to develop common standards (JISC, 2007). The development of interoperability standards has the potential to foment the interinstitutional exchange of data (JISC, 2010). Moreover, e-assessment systems should have the capacity to use and share material and components with other similar systems and they should be effortlessly integrated into other educational applications (Armenski & Gusev, 2009). It is important not only that a system can be integrated with other institutional systems, but also that it has the capacity of assimilating active sources of data (Oakleaf et al., 2013). An important aspect of assessment systems is their capacity of integration with other systems (Amelung et al., 2011).

Methodology

This study is based on a quantitative descriptive research design that explores the viewpoints of educational experts about the fundamental characteristics of e-assessment systems. The sample was selected via a method of convenience and was composed of both higher education teachers and researchers working in education technology and e-assessment. Their opinions were collected via an online questionnaire, which as a data collection instrument has the advantage of reaching participants that are geographically scattered and allowing a swifter collection of data (Wright, 2005). The questionnaire was composed of two parts: the first intended to collect demographic data and determine the respondents' familiarity with e-assessment systems; and the second section aimed to identify the participants' opinions about the proposed framework for the analysis and comparison of e-assessment systems, using an adapted Likert scale ranging from totally disagree to totally agree (1-5).

Presentation and discussion of the findings

The online questionnaire received a total of 342 responses, from which 231 were deemed complete and valid. The male participants correspond to 55% of the sample, while the female respondents correspond to 45%. Their ages ranged from under 30 years old (3%) to over 70 (3%), being that the majority of the participants (63%) are between 41 and 60 years old. The questionnaire received responses from 37 countries, namely Australia, Brazil, Canada, Colombia, France, Germany, Japan, Mexico, Russia, Spain, Switzerland, UK and USA.

In terms of their current positions, over 74% of the respondents hold a teaching position, 14% are engaged in research and 11% have other academic positions. Before presenting the respondents with the several items concerning the framework, it was important to assess their level of familiarity with e-assessment systems. For the purpose of this questionnaire only people who had at least read about this type of systems were considered. This basic knowledge of the systems was reported by 24% of the participants who claimed to have read about them and 21% stated they have conducted research about them. In terms of the participants who currently use the system or have used them in the past they correspond to 28% and 22% respectively. The majority of those who currently use them have been doing so for over 5 years (69%). A smaller percentage has been using them from 2 to 5 years (26%) and only 3% for 1 year and 2% for 1 semester. The majority the participants who have used them in the past did so from 2 to 5 years (61%) and a more reduced percentage used them for over 5 years (24%), 1 year (4%) and 1 semester (10%). In brief, the sample can be characterised as being experienced with e-assessment systems, which can positively impact on their evaluation of the framework and validates their suitability to answer the questionnaire.

The eight criteria that constitute the framework were all validated by the respondents, but with varying levels of agreement and disagreement. To establish a comparison between the different criteria, the average of the ratings for each of their items was calculated. The agree and totally agree ratings were grouped to determine total agreement and the disagree and totally disagree ratings were joined to calculate total disagreement (Figure 2).

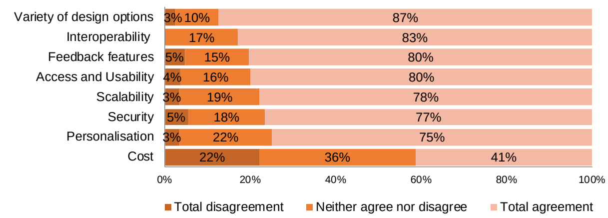

Figure 2: Levels of total agreement and disagreement for all the criteria

According to the participants, and in order of importance, e-assessment systems should have a variety of design options, interoperability, feedback features and they should account for access and usability, scalability, security, personalisation and cost. The criteria that gathered more agreement were a variety of design options (87%) and interoperability (83%). The remaining items also had high ratings of 75% or above, with the exception of cost that only 41% of the participants agreed with. In order to have a deeper understanding of the results, each of the criteria were individually analysed.

Diversity in design

The first element of the framework to be presented to the respondents was the variety of design options, with 5 essential items (Figure 3).

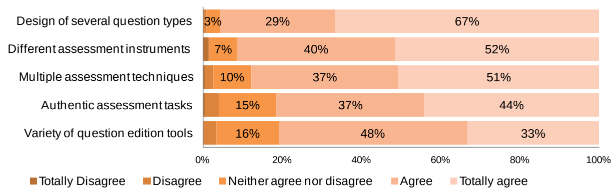

Figure 3: Agreement and disagreement levels for the variety of design options criterion

Overall the respondents reiterated the importance of all the items of this criterion. In particular the participants were in consonance with the literature (Buzzetto-More & Alade, 2006; Gaytan & McEwen, 2007; Hillier & Fluck, 2013; Mackenzie, 2003; Usener et al., 2011) and highlighted the importance of allowing the design of several question types (66.7 totally agreed and 29% agreed), different assessment instruments (51.5% totally agreed and 39.8% agreed) and multiple assessment techniques (50.6% totally agreed and 37.2% agreed). Despite a general acceptance there was a higher percentage of participants that were neutral to the inclusion of question edition tools (15.6%) and the incorporation of authentic assessment tasks (14.7%), when comparing with the other items. These aspects also had a small percentage (3.5 and 7.5 respectively) of respondents who disagreed or totally disagreed with their importance.

Interoperability for e-assessment

Interoperability was the element of the framework whose items scored the lowest disagreement levels among the participants (Figure 4).

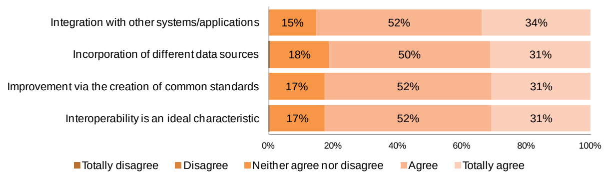

Figure 4: Interoperability's agreement and disagreement ratings

The percentage of viewpoints that disagreed or totally disagreed with the entirety of the items ranged from 0 to 0.4. The highest score for neutral opinions was 18.2 for the item related to the incorporation of different data sources, which also had the lowest score of responses stating they agreed and totally agreed (81.4%). These results corroborate the importance of interoperability to e-assessment systems as was concluded by previous research (JISC, 2007; Sclater, 2007; Whitelock & Brasher, 2006).

Provision of feedback

All the items related to feedback features proposed in the framework were validated by the respondents. The items concerning the delivery of feedback information to both students and teachers (59.7% totally agreed; 35.9% agreed) and the inclusion of options for the management of assessment data (57.1% totally agreed; 35.1% agreed) were selected by the respondents as the main feedback features that an e-assessment system should have and were also defended by previous studies (Mackenzie, 2003; Oakleaf et al., 2013). Despite Singh and De Villiers (2015) argument and the fact that a shy majority of the participants (58.4%) agreed or totally agreed that students should be provided with an overall depiction of their peers' results, 30% of the respondents were neutral to this item and 10.8% disagreed with it.

Accessible and usable systems

With regards to access and usability, most of the participants were in agreement with its importance for e-assessment systems (Figure 5).

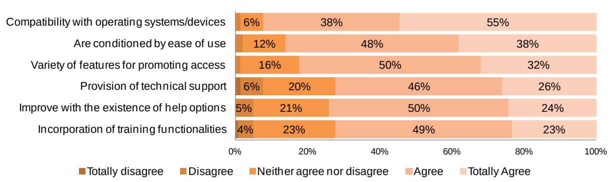

Figure 5: Agreement and disagreement levels for the access and usability criterion

The compatibility with most operating systems and devices, argued by previous studies (Fluck, 2013; Hillier & Fluck, 2013; James, 2016) was the item that gathered more consensus, with 92.2% of the participants stating that they agree or totally agree. Its score was even superior to the score received by the ease of use (86.1%), which has a solid support of existing literature (Oakleaf et al., 2013; Singh & De Villiers, 2015). On the other hand, the provision of technical support, the existence of help options and the incorporation of training functionalities had significant scores in terms of neutral viewpoints (19.9%, 21.2% and 22.9% respectively).

Scalable assessment

In terms of scalability the majority of the respondents agreed or totally agreed with the totality of the items (Figure 6).

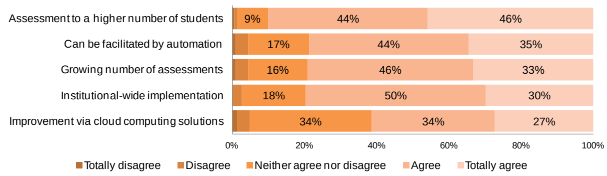

Figure 6: Scalability's levels of agreement and disagreement

The highest score was achieved by the capacity to deliver assessment to a higher number of students (45.9% totally agreed and 44.2% agreed), reiterating previous research (Hillier & Fluck, 2013). The contribution of scalability to a higher number of assessments and an institutional-wide implementation was still largely supported by the participants, but it was deemed only slightly less relevant than a higher number. The fact that a system's scalability can be improved by cloud computing solutions as argued by Gusev et al. (2013) was the item that generated more neutral responses 33.8%, which demands further scrutiny in the future research, to assess if the neutral responses can be explained by a lack of knowledge about this technology and its value for e-assessment.

Security options

The security criterion was also validated by the participants, but its items had differing levels of acceptance as is illustrated in Figure 7.

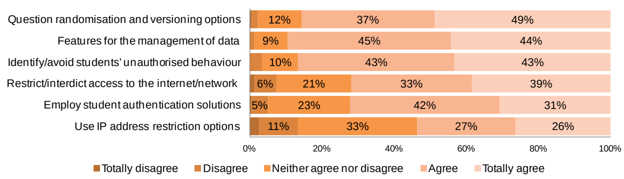

Figure 7: Levels of agreement and disagreement for the security criterion

A solid majority of the participants (86% and over of agreement) clearly believed that having features for question randomisation and versioning, the existence of features for data management and having options to identify and avoid students' unauthorised behaviour increase the security of e-assessment systems, which is in line with previous research (JISC Info Net, 2006; QCA, 2007). Although restricting/interdicting access to the internet/network during assessment activities, using student authentication solutions and IP address restriction options were also deemed as solutions for increasing security, by the majority of the participants and the literature (Crisp, 2011; Hillier & Fluck, 2013; Miguel et al., 2014; Singh & De Villiers, 2015), these items had a considerable number of neutral responses with 20.8%, 22.5% and 32.9% respectively. Also, 13.4% of the participants disagreed or totally disagreed with the restriction of IP addresses.

Personalised assessment

Personalisation was composed of 4 items, which were supported by the viewpoints of the participants. In accordance to the literature (Armenski & Gusev, 2009; Baneres et al., 2016; Gusev & Armenski, 2014), the majority of the participants (84.8%) agreed or totally agreed with the fact an e-assessment systems' capacity for personalisation can assist teachers to develop more suitable assessment activities via the incorporation of adaptive testing, making this the item with the highest score in the personalisation criterion. These systems' capacity for personalisation was deemed a fundamental requirement by 67.1% of the participants, but had 28.6% neutral responses.

Cost effectiveness

The financial cost of e-assessment systems was the element of the framework that created more disagreement among the participants as can be seen in Figure 8.

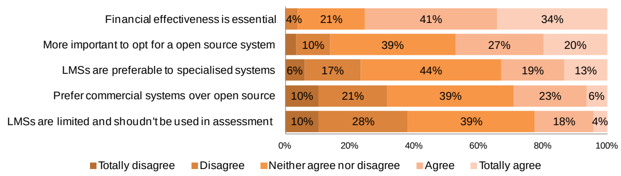

Figure 8: Agreement and disagreement ratings for cost

The only item that the majority of the participants (75.3%) agreed or totally agreed with referred to the fact that it is essential that e-assessment systems are financially effective, which is in line with previous research (Amelung et al., 2011; Oakleaf et al., 2013). The two items that referred to the use of LMSs for assessment generated high percentages of neutral opinions (39% and 44%), but in both items the respondents stated that LMS should be used for e-assessment (38%) and that LMSs rather than specialised e-assessment systems should be used for assessment (33%), even though the literature states that they have limited assessment functionalities (Gusev & Armenski, 2014).The biggest issue with this criterion of the framework concerns its items' high levels of neutral responses, ranging from 39% to 44%, which hinder their interpretation.

Conclusion

The growing importance of technology in the development of effective assessment activities has emphasised the importance of using high quality e-assessment systems. These systems assist teachers in the creation, delivery and evaluation of assessment tasks and can be determinant for the quality of assessment.

There are numerous factors involved in the successful implementation of e-assessment systems, namely human, technical and institutional, but the characteristics of the systems themselves are vital for their adoption. With a growing offer of systems in the market it is progressively more difficult to select a system that suits particular assessment needs. This paper proposed a framework of criteria to guide the selection of e-assessment systems and tested it via an online questionnaire with educational experts.

The sample of participants that completed the questionnaire reiterated the eight criteria that composed the framework that was proposed: variety of design options, scalability, security, access and usability, feedback features, personalisation, cost and interoperability. The criterion with the highest levels of agreement was variety of design features and the one with the highest levels of disagreement was cost. The five items with the highest scores in terms of agreement belong, in this order, to the criteria of variety of design features (enable different assessment instruments; several question types); feedback features (include options for the management of assessment data; deliver feedback information to both students and teachers); and interoperability (compatibility with most operating systems and devices). On the opposite side of the spectrum, the five items with the lowest scores in terms of agreement belong, in this order, to the criteria of cost (LMSs should not be used for e-assessment activities because the features they offer are limited; a commercial system is preferable to an open source alternative, if the assessment design options are more advanced; it is better to resort to LMSs for e-assessment than to use specialised e-assessment systems; it is more important to select a system that is open source) and security (use IP address restriction options).

Future research should further examine the aspects that caused a great percentage of neutral opinions and disagreement to identify the reasons behind the participants' responses. Also, it is important to include the other stakeholders in this discussion, namely the students and the educational institutions.

References

Amelung, M., Krieger, K., & Rösner, D. (2011). E-Assessment as a Service. I*EEE Transactions on Learning Technologies, 4*(2), 162-174.

Armenski, G., & Gusev, M. (2009). The Architecture of an 'Ultimate' e-Assessment System. Association for Information and Communication Technologies ICT-ACT.

Baneres, D., Baró, X., Guerrero-Roldán, A.-E., & Rodriguez, M. E. (2016). Adaptive e-Assessment System: A General Approach. *International Journal of Emerging Technologies in Learning (iJET), 11*(07), 16-23.

Buzzetto-More, N. A., & Alade, A. J. (2006). Best practices in e-assessment. *Journal of Information Technology Education, 5*(1), 251-269.

Crisp, G. (2011). *Teacher's Handbook on e-Assessment. Transforming Assessment.* Transforming Assessment – An Australian Learning and Teaching Council Fellowship Activity. Retrieved from http://www.bezaspeaks.com/eassessmentafrica/Handbook_for_teachers.pdf .

Daly, C., Pachler, N., Mor, Y., & Mellar, H. (2010). Exploring formative e-assessment: using case stories and design patterns. *Assessment & Evaluation in Higher Education, 35*(5), 619-636.

Fluck, A. (2013). Implementation of on-campus digital examination practices, Transforming Assessment in a Digital Era Revolutionising assessment approaches across Australian universities, 31 July - 1 August 2013, Melbourne, Australia, pp. 1-8. [Plenary Presentation].

Fluck, A., Pullen, D., & Harper, C. (2009). Case study of a computer based examination system. *Australasian Journal of Educational Technology, 25*(4), 509-523.

Gaytan, J., & McEwen, B. C. (2007). Effective online instructional and assessment strategies. *The American Journal of Distance Education, 21*(3), 117-132.

Gusev, M., & Armenski, G. (2014). E-Assessment Systems and Online Learning with Adaptive Testing. In M. Ivanović & L. C. Jain (Eds.), *E-Learning Paradigms and Applications: Agent-based Approach* (pp. 229-249). Berlin, Heidelberg: Springer Berlin Heidelberg.

Gusev, M., Ristov, S., Arminski, G., Velkoski, G., & Bozinoski, K. (2013). e-assessment cloud solution: Architecture organization and cost model. *International Journal of Emerging Technologies in Learning (iJET), 8*(S2), 55-64.

Hillier, M., & Fluck, A. (2013). Arguing again for e-exams in high stakes examinations. In M. G. J. H. H. Carter (Ed.), *Electric Dreams: Proceedings of the 30th ascilite conference* (pp. 385-396). Australia: Macquarie University.

James, R. (2016). Tertiary student attitudes to invigilated, online summative examinations. *International Journal of Educational Technology in Higher Education, 13*(1), 1-13.

JISC. (2007). Effective Practice with e-Assessment: An overview of technologies, policies and practice in further and higher education. Joint Information Systems Committee.

JISC. (2010). Effective assessment in a digital age: A guide to technology-enhanced assessment and feedback. Joint Information Systems Committee.

JISC Info Net. (2006). Effective Use of VLEs: e–Assessment. Joint Information Systems Committee.

Jordan, S. (2009). Assessment for learning: pushing the boundaries of computer-based assessment. *Practitioner Research in Higher Education, 3*(1), 11-19.

Jordan, S. (2013). E-assessment: Past, present and future. *New Directions, 9*(1), 87-106.

Leach, M. (2011). A Case Study in CAA System Migration: TRIADS to Blackboard. *International Journal of e-Assessment*, *2*(1)

Mackenzie, D. (2003). Assessment for E-Learning: What are the features of an ideal e-assessment system? *Proceedings of the 7th CAA Conference,* Loughborough: Loughborough University.

Miguel, J., Caballé, S., Xhafa, F., & Prieto, J. (2014). Security in online learning assessment towards an effective trustworthiness approach to support E-learning teams. *Proceedings of the 28th International Conference on Advanced Information Networking and Applications*. Victoria, Canada. IEEE.

Oakleaf, M., Belanger, J., & Graham, C. (2013). Choosing and using assessment management systems: What librarians need to know. Proceedings of the ACRL National Conference: "Imagine, Innovate, Inspire"(pp.97-106), Indianapolis, USA.

QCA. (2007). e-Assessment: Guide to effective practice. Qualifications and Curriculum Authority: London, UK.

Ras, E., Whitelock, D., & Kalz, M. (2015). The promise and potential of e-assessment for learning. In P. Reimann, S. Bull, M. Kickmeier-Rust, R. Vatrapu, & B. Wasson (Eds.), *Measuring and Visualizing Learning in the Information-Rich Classroom* (pp. 21-40). New York: Routledge.

Ristov, S., Gusev, M., Armenski, G., Bozinoski, K., & Velkoski, G. (2013). Architecture and organization of e-assessment cloud solution. *Proceedings of the IEEE Global Engineering Education Conference* (EDUCON). IEEE.

Sclater, N. (2007). The Demise of eAssessment Interoperability? In H. C. Davis, E. Duval, B. Muramatsu, S. White, and F. Van Assche (eds) *WWWrong*, Volume 317 of CEUR Workshop Proceedings.

Singh, U., & De Villiers, M. R. (2015). e-SEAT: an electronic framework for evaluating e-assessment systems. *Proceedings of the E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*. Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Sivakumaran, T., Holland, G., Wishart, W., Heynig, K., & Flowers-Gibson, B. (2010). Electronic assessment systems: implementation, maintenance and support. *FOCUS on Colleges, Universities, and Schools, 4*(1), 1-9.

Usener, C., Majchrzak, T., & Kuchen, H. (2011). Combining state of the art software engineering and E-assessment. In M. B. Nunes and P. Isaías (eds) *Proceedings IADIS International Conference e-Learning*. Lisbon, Portugal: IADIS Press.

Walker, D. J., Topping, K., & Rodrigues, S. (2008). Student reflections on formative e-assessment: expectations and perceptions. *Learning, Media and Technology, 33*(3), 221-234.

Whitelock, D. M., & Brasher, A. (2006). Developing a roadmap for e-assessment: which way now? *Proceedings of the 10th CAA International Computer Assisted Assessment Conference*. Loughborough University

Wright, K. B. (2005). Researching Internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of Computer-Mediated Communication, 10*(3), 00-00.

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Metaphors postgraduates use to depict their student experience: Individual, community and digital presence

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In an Australian national study into student constructions of postgraduate education, 38 students (masters and doctoral) were asked to draw literal or figurative pictures of their experience. Manual thematic analysis of interview transcripts revealed 33 metaphors. Metaphors were coded into individualistic, personal constructions (Me), relational community depictions (Us) and digital or information technology conceptualisations (IT) which were mapped to the Community of Inquiry (CoI) Framework's elements of Cognitive, Social and Teaching Presence. The highest proportion of metaphors were about personal gain and process. The next largest thematic category was relational, mostly depicting what students think others should give, rather than student contribution. Aligned with this theme, students also used metaphors of isolation and perceptions of a missing 'us' factor. There were few metaphors drawn from the language of information technology and/or digital presence, which seems to flag a domain of the postgraduate student experience that requires further development. The key takeaways from this paper are expanded information about digital presence in postgraduate student experience, as well as quality improvement recommendations for universities.

Introduction and context

A picture paints a thousand words. Applied to research, this means that metaphors can be revealing regarding personal conceptualisations of experience, as well as instrumental in improving the quality of these experiences (Lakoff, & Johnson, 1980). In the context of postgraduate education, metaphors can be used to inquire into the visual narratives used by students to conceptualise and evaluate their experiences. Postgraduate student experience describes the totality of students' involvement with, and engagement in, their higher education, and the prioritisation of learning within their broader contextual environment (Crane, et. al., 2016). The *NMC Horizon Report: 2017 Higher Education Edition* identifies themes that capture current and future trends. Key words across these themes include – cultural transformation, real-world skills, collaboration, technology access, personalisation, digital fluency, deep understanding, content co-creation, online, mobile, blended learning, learning ecosystems, incubation, and lifelong learning. It is incumbent upon universities to find creative ways to determine whether these experiential themes are included and apparent to the students themselves.

In the study described in this paper, metaphors were used as a window into postgraduates' depictions of their student experience through a secondary analysis of data from a larger study. The Australian government competitively commissioned research into student experience, and in 2016, the final report of a nation-wide study into postgraduate student experience was published (Crane, et. al., 2016). The full study posed five research questions:

- How do postgraduates rate their student experience?
- What matters most to them about this experience?
- How do perceptions of experience vary between those in coursework versus research degrees?
- Is there agreement or dissonance between the perceptions of postgraduate students and the staff who support them?

- How can postgraduate student experience be improved?

The overall goals of the full research project were to determine what Australian postgraduates think about their student experience and to recommend ameliorative actions to guide the strategies of higher education leaders. Engagement with 319 postgraduate students and 47 staff was conducted through student engagement breakfasts, face-to-face focus groups and face-to-face interviews. Students participated from 26 universities and 8 states/territories. Students were enrolled in doctoral and master's programs, and in both research-based and course-based programs.

For the purposes of the secondary analysis, described in this paper, transcripts of the 38 postgraduate students who participated in the face-to-face interviews were analysed. One of the interview questions was:

- *Could you please draw (or describe) a picture of your/the postgraduate student experience (through your university).*

Thirty-three metaphors resulted. This paper reports the thematic classification of these metaphors into individual (Me), community (Us) or digital (IT) conceptualisations to reveal the diversity of postgraduate student experiences. The *Me. Us. IT* framework, posed as the theme of the 2017 ASCILITE Conference, was selected as the thematic categories for the secondary analysis, because a trial analysis revealed a good fit. The metaphors articulated by the postgraduate students were easily sorted into these three categories without forcing the match. Furthermore, this categorisation theoretically aligns with the *Community of Inquiry (CoI) Framework* (Garrison, & Anderson, 2003; Garrison, Anderson, & Archer, 2000; Garrison, & Vaughan, 2008).

Literature review

Postgraduate education, encompassing research higher degree students and coursework students, is becoming an increasingly important part of the higher education sector. From 2005 – 2015 the number of students enrolled in postgraduate level courses in Australia almost tripled to 386,915 (Department of Education and Training, 2016). Together with this increase in numbers, universities acknowledge that student expectations are not static, and as educators reflect on the expectations of an increasingly diverse student population it is important that institutions adapt to contemporary needs, wants and affording technologies to ensure student engagement and learning for a whole-of-university experience (Crane, et. al., 2016). Despite acknowledgement of the increasing numbers and diversity of student expectations, it is widely recognised that research on satisfaction of postgraduate students is limited and that institutions and students would benefit by greater attention being devoted to this sector (Jancey & Burns, 2013; Morgan, 2014).

The diversity in the postgraduate student population extends across multiple dimensions; gender, age, previous experience, and reasons for study are all major contributors to variations in the postgraduate demographic profile. In the context of this work, it is also important to note that postgraduate students are also likely to rely a great deal on flexible course delivery, preferring online-only distance courses or blended delivery, with scheduled face-to-face *intensive* days supplemented with online components (Garrison, & Vaughan, 2008). Despite further distances and greater reliance on online course components, research has found that in the role of learners, students value integrated student-staff interactions achieving a relationship as *allies in learning* (Richardson & Radloff, 2014). This reinforces findings of an earlier study of both undergraduate and postgraduate students (Hill, Lomas, & MacGregor, 2003) which found that in focus groups probing the general question "What does quality education mean to you" very few students specifically mentioned library resources or IT as important factors, with lecturer quality and engagement with learning being most frequently mentioned.

The importance of blended delivery and personal contact is reinforced by limited studies that have explored students' perceptions of their efficacy in using IT and its role in their studies. In one study of coursework (taught) Master's students in a business course at a British university, students' initial competence in using IT was less than staff expected based on their age and prior experiences (Masterman & Shuyska, 2012). Diversity of experience was also true even in the context of another British course with an IT focus (records management) in which students worked in environments that utilised IT whilst they were studying (McCartan, 2010). These studies in the British context are reinforced by a study in an Australian university in which postgraduate Information Studies students' information literacy skills were not substantially improved in comparison to their undergraduate colleagues (Conway, 2011).

These results regarding digital skills are consistent with previous work on transition to postgraduate study that suggested postgraduate students' self-expressed identity tends towards the novice end of a spectrum of learner experience and contrasts with the tendency of institutions to frame them as more expert learners (Tobbell, O'Donnell, & Zammit, 2010). This research raises the question of how postgraduate students perceive their relationship with use of information technology in their studies/institution and how they might verbalise their views.

It has been postulated that a particularly powerful and pervasive way of expressing abstract thought is via the use of metaphors (Bager-Elsdorf & Greve, 2017; Billott & King, 2015). These authors described analysis of metaphors as a window into the way in which people think about and organise reflections into their experiences as well as their assumptions and values. These studies applied analysis of metaphors to academics' expressions of identity in relation to interactions with leaders and their teaching experiences. The methodology of the current study is ideally situated to extend the power of analysing conversations for requested and spontaneous use of metaphors to understanding postgraduate students' perceptions of the place of Information Technology and digital presence more generally in their broader experiences. This is possible as the study described in this paper deliberately engaged individuals in detailed discussion of abstract interpretations of their experiences and invited them to use metaphors if they so desired. It is intended that this additional perspective on students' stories will add to our institutional understandings of what postgraduate students value and thereby enable us to provide targeted and effective contextualised digital content and supports to facilitate student success.

Research questions and scope

This brief review of the literature on postgraduates' conceptualisations of information technology (and digital culture more broadly) within the context of their overall student experience reveals three apparent gaps:

1. There is a scarcity of research that collects and reports how university is experienced from postgraduate students' points of view;
2. Published research has not included a diverse range of postgraduate student experiences, including masters, doctoral, research-based and course-based; and
3. There is a need for further empirical data to support the improvement of the postgraduate student experience, particularly in the context of digital presence.

In order to contribute to resolving these research gaps, this research was designed such that:

1. Postgraduates were interviewed about their student experience and specifically asked to draw or describe pictures of this experience.
2. A full range of postgraduate students were intentionally included in the research.
3. The empirical findings were applied to derive recommended improvements to university supports of the postgraduate student experience, theorised through the Community of Inquiry (CoI) Framework.

The research questions that guided the secondary analysis reported in this paper were:

1. What metaphors do postgraduate students use to depict their student experience?
2. What is the balance between individual, community and digital conceptualisations?
3. Based on these metaphors, how can the postgraduate student experience be improved?

Methods

Each interview was scheduled for one hour and was completed face-to-face. Participants were identified / recruited through:

- Targeted contact with students facilitated by a member of the research team who was an office holder in the national postgraduate student association;
- Broad-based calls for student participants within the institutions in all eight states / territories; and
- Invitations issued through the team members' networks and professional associations.

Participants were targeted to ensure a diverse range of university experiences including course and research-based postgraduate degrees, on-campus, online and mixed-mode study, and professionally and non-professionally focused courses. Interviews were fully audio-recorded and transcribed, with the transcriptions subsequently analysed by team members and research assistants until concordance of theme identification was reached.

Within the full project and applying the manual narrative methodology approach of Shaddock (2014), each transcript was independently analysed by three full-project team members, inserting interpretive data onto a thematic proforma. Serving as a Research Consultant, one full team member collated, aggregated and validated the three independent analyses. If there was less than 80 per cent agreement, the Project Manager sought subsequent analyses until 80 per cent agreement was reached. SPSS software was used to derive demographic statistics and to analyse comparison of responses between groupings of research participants. The overall methodology for this stage of the project was comparative case study, using the approach of Dowell and Bach (2012) and Yin (2014). The study also fits the classification as design-based research, as the team collected and described naturalistic higher education experiences (Kelly, Lesh, & Baek, 2008).

For the secondary analysis, metaphors identified in the full project analysis were copied and pasted into a collated document. The original interpretive notes from the initial analysis were included alongside the student quotes. Key descriptive words from the direct quotes and interpretive notes were bolded. For example, in the metaphor about the 'Lone Ranger,' this term was bolded within the full quote. Four members from the full research team conducted the secondary analysis and authored this paper. One member collated and assembled the quotes and interpretive notes. Another classified the metaphors into the three categories of individual (Me), community (Us) and digital (IT). The other authors added additional metaphors and checked and confirmed the classification.

Results

Among the 38 interviewed students, 33 metaphors were depicted. Most of the metaphors were offered in response to the specific question probe - *Could you please draw (or describe) a picture of your/the postgraduate student experience (through your university*). A minority of the interviewees said that they are not 'visual thinkers' and others said that they could not think of suitable analogies. Metaphors were also included in this analysis when they occurred in other portions of the transcripts (as opposed to being offered in response to the interview question inserted above). Multiple demographic features of the interviewed students were considered, such as gender, research-based versus course-based and state or territory of study. Of the 261 students participating in the larger study, including both the interviewees described in this paper and those participating in engagement breakfasts described in other papers, the average student age was 35 years, the modal age was 24 years and the age range was 21 to 60. Sixty nine per cent of these students were female and 30.5 per cent were male (one did not disclose gender). The most common discipline of participating students was humanities (17 per cent), followed by business (11 per cent), and general sciences (10 per cent); however, almost half of the students did not explicitly disclose their discipline (45 per cent). Over half the sample identified as being full-time students (59 per cent). In terms of degrees, 52 per cent were enrolled in a doctoral program and 38 per cent in a master's program. Fifty-six per cent identified as being enrolled in research-based programs, 27 per cent in course-based programs and 7 per cent in mixed modes (elements of both course and research). An additional 9 per cent identified their programs as "other," while 1 per cent did not disclose their program. Among the 38 interviewed students, the only demographic groupings that appeared to cluster in the metaphor analysis were whether the students were enrolled in a masters or PhD. The relatively small sample size of 38 students means these groupings should only provoke further inquiry as opposed to being indicative or conclusive. Metaphors clustered into the demographic and thematic groupings are indicated in Table 1 below.

Table 1: Classification of postgraduate metaphors of their student experience

	Me	**Us**	**Lack of Us**	**IT**	**Total**
Masters	7	3	2	2	14
PhD Domestic	7	7	3	2	19
Total	14	10	5	4	33

The highest proportion of metaphors depicted an individualistic, personal construction of the higher education experience. Metaphors in this cluster were evenly divided between masters and doctoral students. Details of the student and educator perceptions of the postgraduate student experience will be reported in full elsewhere (Hamlin et. al., in preparation); a summary of the metaphors is provided here to contextualise the place of information technology in student responses. Five of these 'Me' metaphors were of adventurers and/or athletes physically striving to accomplish goals. These images were of a hurdler, a jungle walker, a mountain climber among 'lots of peaks,' a hoop-jumper and the hero of a 'choose your own adventure' book. Three were organic images, connoting movement and change. Of these, one was of a restaurant's 'blooming onion' which opens up to reveal the layers and another of a 'blooming flower' about which, the student said, 'I have had a lot of personal growth out of this, so I am thinking of a flower that is growing and trying to open up.' Another organic image was of a river which 'ebbs and flows.' Two other metaphors were mechanical, both with active moving parts. One was of motor vehicle gears, the student said, 'initially my PhD was in first gear, nice and cruisy … and then the PhD ramped-up and accelerated very quickly and I found it difficult to keep up.' The other mechanical image was as a rollercoaster ride in that, 'you are panicking, then you have fun as you have never had before.' Two of the metaphors were of add-ons, one described like a vitamin supplement and the other like a 'chain around my neck dragging me down.' On a closely related theme, the final metaphor was of 'balance' and in this case, where 'studies are a lower priority' than other pursuits. Of the fourteen metaphors that focused on personal pursuit and objectives, half were primarily positive, two mostly negative and the others mixed and largely subscribing to the metaphoric philosophy of 'no pain, no gain.'

The next highest thematic category of metaphors was relational, or in other words, emphasised the 'Us' in postgraduate studies. Seven of these metaphors were expressed by PhD students and three by masters students. Six of these ten metaphors aligned with the

'Me' category described previously. One of the metaphors was of 'journey' but this time, the student included fellow travellers in the image. 'I think the experience is the whole journey from the start to the end. The support that you get through the experience.' Four of these metaphors mentioned 'balance' with an emphasis on balancing time spent on studies and time spent with others outside of their education communities, most commonly referencing family. These four metaphors were of a juggler, too many hats, a seesaw and a black-and-white mime-mask, 'balancing two faces in your life.' Finally, one student described 'cross-pollination' experiences of universities and departmental staff working together to support students. While these first eight metaphors were about relational advantages to the student (one-way), two others depicted postgraduate studies as opportunities to contribute to others. One student used a banking-metaphor, describing regular reflection into questions about increasing cultural capital for all. The other metaphor in this theme was of 'art galleries' in that 'universities should collaborate and display research rather than owning the research and hiding it from others.'

Five other metaphors were also relational, but this time, clearly showing the antithesis of community, or in other words, depicting NOT-US and thereby negative sentiment. These were largely about a sense of isolation in their studies with examples being, 'draw a circle about 500m around your classroom' and use of the words 'isolated' and 'lonely.' On a similar theme, another student depicted the experience as a Lone Ranger, which was further described as 'not always an enjoyable experience.' Other themes were a gap in supports depicted as a tennis match, where they 'throw the problem to someone else – back-and-forth' and a social ranking or a caste culture of universities - 'We are second class citizens. At the federal level, the Department of Education treats us sometimes as students and will leave us out of conversations where we should be treated as a stakeholder – an equal stakeholder.'

Of interest was the paucity of direct references to the digital domain within these student depictions of their experience. Only two students made direct and explicit use of digital concepts in their descriptions - one using the metaphor of a 'firewall' to depict an impenetrable barrier between coursework and research studies. Another used Apple to describe the perceived ranking of institutions and graduates. 'The Apple difference – Apple does not have cheap products, but people still buy them.'

Of particular interest is that students seldom used digital terminology, nor did they directly associate their depictions with information technology. However, assumptions of digital pervasiveness seemed to be germane, evident either through descriptions of perceived gaps in digital support or failure to recognise that digital resources might be part of the resources they could use. In one example of this, an online masters student obliquely used metaphors of connectivity and discussed her desire for more interaction with other students via online systems provided by the university. 'So that's the online space and … students are…just writing their discussions and completing their assignments but they are not really connected to me, they kind of interact with the lecture but it is not…, really about socializing'. She further expressed that this would ideally be separate to fora moderated by the lecturer 'so if we want to talk about something private we shouldn't be there so if you want to talk about a lecturer or something you shouldn't be in the same space.' Another student undertaking a research degree mentioned various layers of support provided by his university including library supports for academic writing and reading, but did not emphasise information technology even when prompted by the interviewer. Thus, in response to a probe enquiring whether university facilities might include digital resources including computer labs, the student responded 'computer labs, yeah, including like sporting facilities."

Discussion

The 38 postgraduate students interviewed for this study represent a cross-section of the diversity in Australian postgraduate studies today – male, female; international or domestic; research or coursework oriented; part-time or full-time; vocationally or non-vocationally inspired; studying in online, face-to-face, or mixed mode. However, due to the relatively small number of research participants and non-random sampling, results should not be interpreted as representative. What can be ascertained is that across these various demographics, students expressed a rich view of their experiences encompassing the totality of their studies and lives. This analysis has particularly focussed on the ways in which postgraduate students used metaphors to describe how information technology contributes to their experience.

In keeping with earlier studies of metaphors (Billot & King, 2015), searching for and analysing the metaphors used by (and in some cases, not used by) students enables exploration of ways in which they might be expressing assumptions, values and opinions that may or may not have reached their conscious awareness. The use of metaphor analysis to probe a concept like information technology within a broad student experience is consistent with the idea that metaphors provide valuable insights to abstract phenomena by probing our understanding (Wegner & Nückles, 2015). Similar to other recent research using metaphors (Bager-Elsborg & Greve, 2017) whilst the use of some metaphors was consistent across interviewees (e.g. concepts of Me and Us) others represented a distinct and individual view of their experience (e.g. use of the term "firewall" as an expression of the differences between coursework and research studies). As with the work of Bager-Elsborg & Greve (2017), the current study was not designed to study the use *of* metaphors *per se* but rather explored their spontaneous use *by* participants. Further work to elaborate on the metaphors and/or posing these metaphors to additional participants might shed further light on the stability of the metaphors used by this relatively small sample. This study of student experience through metaphorical analysis would complement the call by Bager-Elsborg & Greve (2017) for a full exploration as an efficacious education research methodology.

Although limited in number, the references to information technology and digital presence by postgraduate students in this study are revealing in their scope. Some students used some metaphors of digital concepts to refer to other themes and referred to their experiences of information technology using metaphors – and did not reference information technology when it seemed to the authors that it was relevant. These instances where digital presence was apparently absent from postgraduate student metaphors/conceptualisation warrants further reflection on whether there are perceived benefits of digital tools and presence and whether they are as important to postgraduate students as they are believed to be by educators and researchers. Was it that many of the participating postgraduate students took digital presence and tools for granted and/or that they did not consider these factors as terribly important to their studies? It seems that some students not only think about information technology *for* their learning but also sometimes think *about* their learning using information technology concepts. With this in mind, it is interesting to consider how these depictions intersect with depictions of information technology put forward by leaders in higher education framed as the themes of the last three ASCILITE conferences (see ASCILITE, 2014). The theme for 2017 of - *Me. Us. IT*. - clearly resonates with the multiple metaphors used by students to describe their connections (and lack of connections) during their studies and the potential of IT to create virtual spaces for these connections. This is also true of the 2015 theme of - *Globally connected, digitally enabled* – signal[ling] a focus on reaching out to the world and bringing the world to our students' and the 2016 theme - *Show Me the Learning* - designed to focus attention on the demonstration of learning aided by the adoption of technology in the education space.

The potential of information technology to support student learning, teaching and connectedness has long been explored and discussed. One way in which this has been elaborated has been through evolution of the *Community of Inquiry (CoI) Framework* to 'define, describe and measure elements supporting the development of online learning communities´ (Garrison, Anderson, & Archer, 2000; Swan & Ice, 2010). The CoI model seeks to define three elements of an online/blended mode of students' experiences as *social presence, cognitive presence* and *teaching presence*. All three elements of this framework link to the metaphors used by postgraduate students in this study irrespective of whether they were online students or engaged in on campus studies: social presence – through the desire for connectedness; cognitive presence – through the emphasis on the importance of their learning; and teaching presence – through expressions of need for academic support. The *Community of Inquiry Framework* is presented, with the permission of the authors, as Figure 1.

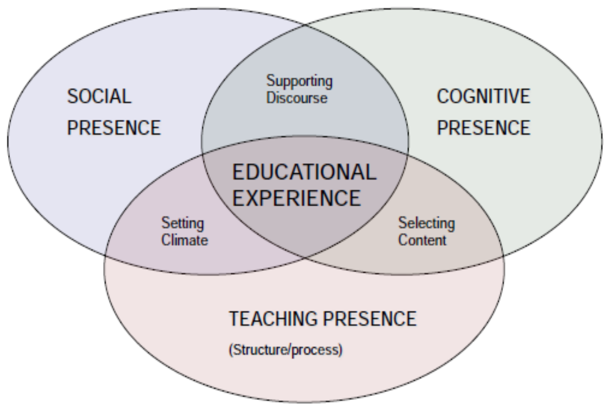

Figure 1. The Community of Inquiry (CoI) Framework (Garrison, Anderson, & Archer, 2000)

Cognitive presence

Analysis of the metaphors used by the interviewed postgraduates indicated that overall, the students appear to have a defined sense of their own personal motivations and objectives for the experience. Their use of metaphors that connote change seem to indicate their shared conception of the postgraduate student experience as cognitive growth and development. They also recognised that this change process is seldom smooth, linear or easy, using metaphors connoting complexity and 'messiness' such as a jungle and a mountain with many peaks. Notably, there was little talk of cognitive presence in the digital sphere. Students offered-up few metaphors that suggested reflection and growth regarding place and development in their digital lives.

Social presence

Postgraduate students who participated in this study frequently situated themselves in the context of others. These others were most frequently those who were not 'inside' the university student experience boundaries, such as research supervisors and teaching staff might be – more often referring to family and friends from outside university. Metaphors were frequently about balance between student and non-student roles and identities. There appeared to be little consideration of the overlap and interactivity between these selves. The digital metaphor used by a student in the social context was of a 'firewall' separating these two realms. Furthermore, students used metaphors to communicate despair about a lack of social presence within and among their student experience. Notably, metaphors depicting social presence did not address the role of digital communication and other productivity tools or learning management systems as moderators and/or bridges, joining, unifying and integrating life experiences and multiple selves.

Teaching presence

Given the digital focus of the analysis discussed in this paper, the CoI concept of teaching presence has been applied specifically to digital teaching presence. This means that analysts used this digital lens to examine the data for responses to two specific questions: 1) Did metaphors reference the online presence of teachers, and 2) Did metaphors depict teachers in the postgraduate domain as providing leadership in digital conception and content. The overall response to both of these questions was negative. Within the metaphors used by the students in this research, there was a notable non-digital picture of educators, with respect to how and what they taught.

Recommendations for quality improvement

One of the rich applied values of the CoI framework is the explicit identification of pedagogical actions situated at the intersection of the three types of presence. These actions are particularly applicable in cases such as the one depicted in this research, whereby the students' metaphors have revealed room for heightened presence in all three realms. This next section therefore recommends three actions applied from the CoI framework.

1. Supporting discourse – It is recommended that universities increase the use and explicit discussion about communication tools and approaches that engage students in scholarly digital communities and critical conversations, particularly about digital identities and leadership. For example, postgraduate students might be guided to discuss future technologies in the context of their career contributions to social change. Discussion questions might include: what technologies are you currently using that enable/enhance your discipline/industry; how might these technologies change/evolve; and what is your role in leading change including through application of digital solutions.

2. Setting climate – It is recommended that educators explicitly articulate expectations and model robust practice in digital engagement to heighten and expand social presence within the postgraduate educational experience and carries over beyond graduation, so that alumni are nurtured as leaders of social presence, including in the digital realm. Specifically, postgraduate students might be encouraged to consider not only mainstream digital tools that are currently being used in education and/or industry, but also future and emerging tools that have the potential to solve communication problems and social isolation of key groups, in particular. Discussion questions might include: what are prevalent and/or pressing problems or challenges for particular groups of people; what current tools of digital engagement might be used to ameliorate these problems; and what future solutions are needed.

3. Selecting content – It is recommended that educators design curriculum, research opportunities and/or assessment that fosters scholarly reflection, critique and application of digital presence. Educators are encouraged to ask themselves: what digital knowledge, skills and attributes should be embedded in curriculum to prepare postgraduate students as leaders in their discipline/industry; what current research about digital presence might be incorporated into and/or lead my teaching/research supervision; what research questions in the context of digital presence should I raise with my students; and what skills can postgraduates develop through their assessment activities and/or demonstrate in their portfolios.

Conclusion

Overall, there appears to be congruence between students' metaphors and the thoughts and intentions of educators regarding the potential for information technology to support learning and the broader student experience. However, the observation that information technology, although pervasive in their lives, did not feature more strongly in students' spontaneous depictions of their student experience supports the view of Jones, Heffernan and Albion (2005) that higher education has not yet succeeded in productively integrating technology, learning and teaching.

This study posed three research questions.

The research questions that guided the secondary analysis reported in this paper were:

1. What metaphors do postgraduate students use to depict their student experience?
2. What is the balance between individual, community and digital conceptualisations?
3. Based on these metaphors, how can the postgraduate student experience be improved?

In summary, results indicated that students use a diversity of metaphors to depict their experiences and most of these metaphors show movement, action and change.

The balance is weighted towards individual (Me) metaphors that emphasise personal gain, and then community (Us) metaphors, some of which are about social presence and others that show feelings of isolation, and finally, a few of which are contextualised in information technology and digital presence. Three recommendations are made to universities to improve quality of the postgraduate experience: supporting discourse, setting climate and selecting content, all in the context of digital realms.

The main strength of this research was that the use of metaphor served as a creative means of hearing about the student experience from the postgraduate point of view. This research demonstrated the effectiveness of this methodological approach, which warrants further investigation in its own right. The main limitation of this research was the relatively small sample size, such that comparisons across demographic groupings (e.g. domestic versus international students) could not be made.

From this study, three questions for further research emerged.

1. Do universities understand what postgraduate students know about the information technology resources available to them?
2. Do universities know how postgraduate students would like to use information technology – for (a) their learning and (b) to facilitate connectedness?
3. Do universities understand how their educators are currently using, and wish to use, information technology to support students?

Empirical responses to these three questions will help universities answer a fourth question:

4. Are universities deploying information technology resources in ways that maximise their impact for postgraduate student learning and engagement?

Answers to this question are critical to ensure that universities serve their postgraduate student population with strategies that target limited resources to areas of greatest impact for students and in so doing move towards realising the so-far under-utilised potential of information technology in enhancing the student experience.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., and Ananthanarayanan, V. (2017). *NMC Horizon Report: 2017 Higher Education Edition*. Austin, Texas: The New Media Consortium.

ASCILITE (2014). *Past conferences and proceedings*. https://ascilite.org/past-proceedings/

Bager-Elsborg, A. & Greve, L. (2017). Establishing a method for analysing metaphors in higher education teaching: a case from business management teaching. *Higher Education Research and Development.* [early access online view]. doi:10.1080/07294360.2017.1327945

Billot, J. & King, V. (2015). Understanding academic identity through metaphor. *Teaching in Higher Education, 20,* 833–844. doi:10.1080/13562517.2015.1087999

Conway, K. (2011). How prepared are students for postgraduate study? A comparison of the information literacy skills of commencing undergraduate and postgraduate information studies students at Curtin University. *Australian Academic & Research Libraries 42,* 121-135. doi:10.1080/00048623.2011.10722218

Crane, L., Kinash, S., Bannatyne, A., Judd, M-M., Eckersley, B., Hamlin, G., Partridge, H., Richardson, S., Rolf, H., Udas, K., & Stark, A. (2016). *Engaging postgraduate students and supporting higher education to enhance the 21st century student experience*. Final report prepared for the Learning and Teaching Support Unit, Australian Department of Education and Training.

Department of Education and Training. (2016). *Selected Higher Education Statistics*. Retrieved from: https://www.education.gov.au/selected-higher-education-statistics-2016-student-data

Dowell, M. S., & Bach, J. (2012). A comparative case study of service-learning in teacher education: Rethinking benefits and challenges of partners and placements. *PRISM: A Journal of Regional Engagement, 1,* 184-199. Retrieved from http://encompass.eku.edu/prism/vol1/iss2/8

Garrison, D. R., & Anderson, T. (2003). *E-learning in the 21st century.* Abingdon, Oxon: Routledge.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*, 87-105. doi:10.1016?S1096-7516(00)00016-6

Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, Principles, and Guidelines.* San Francisco, CA: Jossey-Bass.

Hill, Y., Lomas, L. & MacGregor, J. (2003). Students' perceptions of quality in higher education. *Quality Assurance in Education, 11,* 15-20. doi:10.1108/09684880310462047

Jancey, J., & Burns, S. (2013). Institutional factors and the postgraduate student experience. *Quality Assurance in Education*, *22,* 311-322. doi:10.1108/QAE-Nov-2011-0069

Jones, D., Heffernan, A., & Albion, P. R. (2015). *TPACK as shared practice: Toward a research agenda*. Proceedings of Society for Information Technology & Teacher Education International Conference 2015 (pp. 3287–3294). Las Vegas, NV: AACE

Kelly, E., Lesh, R., & Baek, J. (2008). *Handbook of design research methods in education: Innovations in science, technology, engineering, and mathematics learning and teaching.* New York, NY: Routledge.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by.* Chicago: The University of Chicago.

Masterman, E., & Shuyska, J. A. (2012). Digitally mastered? Technology and transition in the experience of taught postgraduate students, *Learning, Media and Technology, 37,* 335-354, doi:10.1080/17439884.2011.608361

McCartan, A. (2010). Use of IT in a postgraduate distance learning course: Part 1: Students' experiences. *Innovations in Education and Training International, 37,* 181-191. doi: 10.1080/13558000050138416

Morgan, M. (2014). Study expectations of 1st/2nd generation STEM postgraduate taught students. *Quality Assurance in Education, 22,* 169-184. doi:10.1108/QAE-03-2013-0014

Richardson, S., & Radloff, A. (2014). Allies in learning: Critical insights into the importance of staff-student interactions in university education. *Teaching in Higher Education*, *19*, 603-615. doi: 10.1080/13562517.2014.901960

Shaddock, A. (2014). *Using data to improve learning: A practical guide for busy teachers.* Camberwell, VIC: ACER.

Swan, K., & Ice, P. (2010). The Community of Inquiry framework ten years later: Introduction to the special issue. *Internet and Higher Education, 13,* 1-4. doi:10.1016/j.iheduc.2009.11.003

Tobbell, J., O'Donnell, V., & Zammit, M. (2010). Exploring transition to postgraduate study: shifting identities in interaction with communities, practice and participation. *British Educational Research Journal, 36,* 261–278. doi:10.1080/01411920902836360

Wegner, E., & Nückles, M. (2015) Knowledge acquisition or participation in communities of practice? Academics' metaphors of teaching and learning at the university. *Studies in Higher Education, 40,* 624–643. doi:10.1080/03075079.2013.842213

Yin, R. K. (2014). *Case study research design and methods (5th Ed.)* Thousand Oaks, CA: Sage.

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Online global collaboration: Affordances and inhibitors

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New teaching and learning approaches are emerging through the use of technology including online global collaboration. Educators involved in global collaboration forge external relationships with others beyond their immediate learning environment. They modify and adapt the curriculum to include global learning opportunities for their learners. Global collaboration provides opportunities for rich global, cognitive, social, cultural and life-changing experiences to their students. Online global collaboration broadly refers to geographically dispersed educators that use online technologies to learn with others beyond their immediate environment to support curricular objectives, intercultural understandings, critical thinking, personal, social and ICT capabilities. This paper will report some preliminary findings from an investigation into the perceptions of K-12 educators who facilitate global collaborative learning. Data were collected through semi-structured interviews that were then themed to identify the key affordances and inhibitors to online global collaboration. The paper will provide recommendations for global collaboration in teacher education.

Introduction

Online global collaboration is where partnerships are made beyond the classroom for the purpose of working and learning together on specific goals and co-creating new knowledge. The key factors are the design features of the collaboration, changes made in teaching and learning structures for all collaborative partners involved and use of online technologies (Garrison & Cleveland-Innes, 2005). With the advent of the Internet and new technologies, online global collaboration has evolved from the 1.0 version of information exchange, to the 2.0 version where artefact exchange and discussion as well as information exchange takes place. With the development of faster Internet and better technology tools, online global collaboration 3.0 allows learners to network, collaborate, co-create information and artefacts, and build knowledge together online and share this with others (Lindsay & Davis, 2012).

The practice of online collaboration includes sharing and co-creation including a shift from a world about content to one of context (Collaborative Society, 2013). For the purposes of this paper online global collaboration broadly refers to geographically dispersed educators, learners, classrooms, schools and other learning environments that use online technologies to learn with others beyond their immediate environment in order to support curricular objectives, intercultural understandings, critical thinking, personal and social capabilities and ICT capabilities (Lindsay, 2016). It is important to understand that the term 'global' can also apply to more localised connections, for example in the same town or state, particularly within close time zones. Benefits of online collaboration can be gained from working with other educators in contexts different from our own but within the same state. For example, a Metropolitan class working with a remote class will still gain benefits.

Contemporary educators face the challenge of how to leverage the unique opportunities provided by new technologies, especially Web 2.0 online technologies, to not just replicate face-to-face learning experiences, but also redefine the learning task (McKenzie, 2004). This paper will report some preliminary findings from an investigation into the perceptions of educators who facilitate global collaborative learning. Data were collected through semi structured interviews which were then themed to identify the key enablers and inhibitors to online global collaboration. The paper will also provide recommendations for those in higher education, specifically in teacher education, who are considering embedding online global collaboration into courses to support new practices and effective teaching using technology.

Collaborative learning

In the broadest sense 'collaborative learning' is a situation in which two or more people learn or attempt to learn something together. Dillenbourg (1999) stated educators have struggled with a definition of collaborative learning that includes multidisciplinary processes and enhanced learning outcomes. As distinct from cooperative learning where the required tasks are distributed amongst the learners (Laurillard, 2009), in the collaborative learning process learner's share and discuss and build on the outputs of their peers or collaborative partners. Fullan, Langworthy, and Barber (2014) believed that collaboration (working in teams to learn from and contribute to the learning of others using social networking skills) is a "deep learning task" (p. 22) and a skill for the future. Work in the future will require skills that are cross-platform, freelance and flexible, local and global (Boudreau, 2016).

Connected learning makes use of new technology tools to build online networks and learning communities (Siemens, 2006). Collaborative learning enables community building with a focus on individual and collective learning capacities (Ito et al., 2013). Nussbaum-Beach and Hall (2010) shared that connected learners direct learning, connect, and collaborate with others at a distance through ubiquitous technologies. Connected learning is influenced by the need for pedagogies that are more personal, social and participatory with special reference to Web 2.0 tools (McLoughlin & Lee, 2010). It is related to and is heavily influenced by connectivism (Siemens, 2005). Connectivism is considered a learning theory for the Digital Age and is based on principles from chaos, network, complexity and self-organization theories (Siemens, 2005). It acknowledges that connections can be made through computer networks and social networks. If educators see knowledge building as an outcome of different experiences and sharing a diversity of opinions, online collaborative learning provides an avenue for this type of learning.

The Internet has changed and continues to change the way learners connect by providing new forms of interaction and social construction of knowledge. Today's learners have grown up collaborating using online technologies (Tapscott, 2009) and these provide a platform for engaged learning, deeper understanding and exciting collaborative learning outcomes. The educator's role is critical for making a success of opportunities afforded by technology in online collaborative construction environments (Garrison & Cleveland-Innes, 2005; Laurillard, 2012).

Why is global collaborative learning important?

Purposeful connections between classes that lead to online global collaboration are important for a variety of reasons. Firstly, it prepares learners to be globally competent and act on issues of local and global significance. Hanvey (1982) discussed the "attainable global perspective" (p. 162) and introduced dimensions including cross-cultural awareness and knowledge of global dynamics. A succinct definition is provided by The Asia Society, "Global competence is the capacity and disposition to understand and act on issues of global significance" (Mansilla & Jackson, 2011, p. xii). Lindsay (2016) extends this to include "cross-cultural skills and understanding needed to communicate outside one's environment" (p. 143).

Secondly, online global collaboration provides a focus for digital and online technologies. As a disruptive, immersive and ongoing innovation, the ability to connect beyond the classroom builds skills in the use of new or emerging tools for online and ubiquitous computing. The practice of online collaboration goes beyond merely integrating technology and working virtually with others in the world, it provides new understanding about the power of technology for humanity (Lindsay, 2016). Veletsianos (2016) posited that by employing emerging technologies in learning, new ways of viewing the world are also opened up and new "ways of exploring knowledge, scholarship, collaboration, and even education itself" (p. 11).

The third reason why online global collaboration is important is related to moving from a local to global collaborative learning mode and creating a new paradigm for modern learning. Learners can go beyond the textbook to connect, not just with current content, but also with people who are the voice - peers, experts and online communities - while building collaborations for a deeper understanding of the world (Lindsay, 2016). The paradigm shifts to include online collaboration as a norm is shared by Lee and Ward (2013) who stated that "while insular, 'stand alone' teaching has characterized the teaching of a paper-based world, collaborative teaching could well characterize that of an increasingly digital and networked world; a world where collaboration and integration are the norm" (p. 3).

A fourth reason is that online collaboration supports 'glocalisation'. Discussed by Friedman (2007), to glocalise is about respecting differences and applying to the local context without homogenization. The goal is not for one culture to emerge but to find differences as well as commonalities, to absorb international best practices and meld with local traditions. Taguena (2008) shared that, "A glocal approach means presenting global knowledge within a local context that respects human rights. It encapsulates the concept 'think globally, act locally'." Lindsay (2016) posits, "A glocalised curriculum supports global collaborative practices and goes beyond the usual institution handbook declaration of a global approach to community learning" (p. 144).

Internationally, K-12 curriculum outcomes require a commitment to the concepts of global learning, collaborative learning and learning with ICTs. For example, internationally applied ISTE standards for students (2016) include 'Global collaboration' as one of the key elements, where "Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally". In Canada, one of the outcomes from the ICT curriculum is that "Students will seek alternative viewpoints, using information technologies" (Alberta Learning, 2003, p. 6). Additionally, the Australian Curriculum includes general capabilities which are knowledge, skills, behaviours and dispositions that students are expected to develop during their schooling. One of the capabilities is to "develop intercultural understanding as they learn to value their own cultures, languages and beliefs, and those of others" (Australian curriculum, n.d.). Nations have recognised that in today's world it is important for students to "make connections between their own worlds and the worlds of others, to build on shared interests and commonalities, and to negotiate or mediate difference" (Australian Curriculum, n.d.).

Also, the Higher Education edition of the 2017 Horizon report (NMC, 2017) has indicated that collaborative learning is an important outcome of a higher education qualification and is a short-term trend in higher education for the next one to two years. The report discussed gains related to collaboration including: social, emotional and cognitive gains along with the developing of leadership skills, increased self esteem and higher-order thinking. Technology has enhanced the ability of collaboration to occur online and with others in different geographical locations which can also lead to the development of cultural competencies. Additionally, global collaboration can assist in developing employability or soft skills such as cultural competency, communication, teamwork, problem solving, and self -management, which are essential in the workplace (Minnesota State, 2017). These skills are transferable between disciplines, workplaces and countries as many countries list the same or similar employability skills (La Trobe University, 2013; Minnesota State, 2017; University of Kent, n.d.).

Affordances and inhibitors of global collaboration

Research related to educators as agents of change, qualities of and conditions for implementing online global collaborative projects using ICT (An & Reigeluth, 2011; Kim, Kim, Lee, Spector, & DeMeester, 2013; Laurillard, 2009) showed that inhibitors to adopting new modes of learning with digital technologies not only include hardware and software, but teacher beliefs and attitudes. A multiple case study research design employed by Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur, (2012) examined similarities and differences among pedagogical beliefs and technology practices of educators using emerging technologies. Results suggested knowledge and skills as well as attitudes and beliefs (described as second-order barriers) not hardware, software and networking issues (known as first-order barriers) are the gatekeepers for the better use of technology for learning. Greenhow, Robelia, and Hughes (2009) found similar inhibitors and affordances to learning using Web 2.0 technologies. Laurillard (2009, 2012) revealed first-order challenges that include infrastructure, access to technology, policies and curriculum development are more easily fixed than second-order challenges, namely teacher attitudes and beliefs.

Arteaga (2012) researched outlier educators who used collaboration to formulate a digital pedagogy and concluded that what is needed is educator professional learning that adopts social interactive practices in conjunction with reorganisation of learning spaces (physical and virtual) to accommodate new modes of knowledge flow, as well as opportunities for learner connection, recombination and re-creation. According to Harasim (2012) Online Collaborative Learning (OCL), which focuses on "collaborative learning, knowledge building and Internet use as a means to reshape formal and informal education in the Knowledge Age" (p. 80) helps move learning from didactic to active. Despite extreme levels of Internet adoption in the real world, teachers are reluctant to embrace new practices using it in the educational world (Harasim, 2012).

Tondeur, van Braak, Ertmer, and Ottenbreit-Leftwich (2017) concluded that effective technology integration should not be a stand-alone event and that teachers' beliefs about 'good' education are a critical dimension in professional development and meaningful use of technology in education. Choi et al. (2016), advised that collaboration and communication amongst students from different countries will not be achieved without cultural and social support. Harasim (2012) stated that through OCL applications there needs to be an emphasis on knowledge work, knowledge creation, and knowledge community. In practical terms Lindsay (2016) alleged that online global collaboration in the classroom means geographically dispersed learners; use of online technologies to forge viable connection and communication; learning that is 'with' not just 'about'; and collaborators who share ideas online and co-create new understandings.

Method

The purpose of this qualitative research was to document and analyse the experiences of educators who had implemented online global collaboration in the classroom and to identify affordances and inhibitors of online global collaboration. After ethics approval was gained K-12 teachers, solicited through the authors' professional and social networks, from different parts of the world were invited to share their online global collaborative experiences in a one-hour semi-structured interview. The participants in the study were experienced online global collaborative educators who had been involved in an extended online global collaboration that was continuous for at least six weeks. The 'six weeks' criterion was chosen as this is a significant amount of time to have built a collaborative relationship with one or more classrooms at a distance and possibly co-create learning outcomes. Typical examples of this include The Global Read Aloud (6 weeks in length, see https://theglobalreadaloud.com/) and iEARN Learning Circles (8+ weeks, see http://www.globallearningcircles.org/).

A single-case design with embedded multiple units of analysis was chosen for this research (Yin, 2014). The context was K-12 education, the case was the phenomenon of online global collaboration, and the multiple units of analysis were individual educators. The focus of this case study was the lived experiences of educators as they used technology to implement an online experience that was global and collaborative. The research questions for the study included:

1. *What are the experiences of educators who implement online global collaboration?*
2. *What are the inhibitors and affordances for effective online global collaboration?*

Interview response transcripts were created from the audio recordings. The interview data were analysed using an open coding method (Strauss & Corbin, 1990). Data reduction occurred using an inductive process where common themes and categories were identified from the interview transcripts that were in Google doc tables with lines numbered. Each transcript was colour-coded to reflect the theme. Key ideas were coded to major themes and then categorised as either inhibitors or affordances. Direct quotes from the participants (pseudonyms provided) are formatted in italics in the discussion below.

Preliminary findings and discussion

Data was collected through semi-structured interviews from educators teaching in six different countries (n=9), namely Australia, USA, New Zealand, Ecuador, Thailand and Canada. They shared experiences and perceptions of the main enablers or affordances supporting their online global collaborative activities. As shown by Table 1: Brief profile of interviewees, five of them had been teaching for more than 25 years, and were 50 years or older. Their teaching areas included high school, primary school, as well as ICT and library specialists. They had typically been implementing global projects that run for 6 or more weeks and had been involved in online collaboration for a number of years.

Table 1: Brief profile of interviewees

Participant age	Length of time teaching	Grade levels/ subject areas taught	Examples of online projects
3 x 60+	4 x 30+ years	2 x HS (Grades 7-12)	The Global Read Aloud http://theglobalreadaloud.com/
2 x 50-59	1 x 26-30 years	4 x PS (Grades K-6	Flat Connections http://www.flatconnections.com/
3 x 40-49	2 x 16-20 years	2 x ICT specialist	iEARN learning Circles http://www.globallearningcircles.org/
1 x 20-29	2 x 6-10 years	1 x Library specialist	

In answering the first research question, the experiences of educators who implement online global collaboration is diverse with certain commonalities such as finding ways to connect meaningfully with the world and using new technologies for synchronous and asynchronous collaboration. Donna discussed her experience and stated, "*I've been involved with a network of teachers I never would have even met, would have known, or participated in global collaboration without having these experiences.*" Stella shared,

> *I like to work with other people around the world … my students learn from them, rather than reading textbooks or looking things up online that might help them, and I find that they're quite happy once they've connected with people and collaborated with them to go and research online a little more about the area where those people come from.*

The second research question investigated the inhibitors and affordances of effective online global collaboration. These will be discussed in the next section.

Inhibitors to online global collaboration

Communication issues were a common inhibiting theme. This included schools not responding, language barriers, and lack of understanding how to communicate with others at a distance because educators had not done this before or were inexperienced in a global context. Being able to communicate online is a skill educators can learn and model so that global project goals are clearly communicated and understood to ensure student success. Reflecting on communication Donna shared, "*I think some of the biggest challenges can be inconsistencies in involvement or communication and it's the same...I sometimes think it's the same whether you are face to face or not*". Lindy mentioned that *"I think that sometimes people see it as ... like how could you actually have any kind of connection or relationship with anyone* *you have never met?"* Snyder (2016) found global learning was impacted by teachers not responding in a timely manner, issues with time zone differences and effective communication, or even miscommunication. Jill recognised, *"You can write something or you can speak to someone and you think you know what you're talking about and then you find out well no that's not being interpreted the way I was expecting."*

Many participants shared that **technology infrastructure and access** was inadequate within the school including a lack of bandwidth, closed learning systems like Office 365, closed networks, inconsistent and unreliable technology and policies that prevent technology tools from being used. Stella shared, *"The barriers for us in our small country school initially were technology, access to it. We had a very poor bandwidth so we couldn't do a lot of synchronous-type connections".* Hew and Brush (2007) found resources (as in hardware, access, time and technology support) was the most commonly reported technology integration barrier. In contrast, Ertmer and Ottenbreit-Leftwich (2013) found "Teachers with strong beliefs in the pedagogical value of technology have been observed to overcome these barriers" (p. 177). Snyder (2016) found access to technology and online sites through the Internet, website blocking and filtering, limited bandwidth and technology failures and device allocation caused some schools to exit global collaborative projects. Oran (2011) stressed limits on technology use in schools as a major inhibitor, while An and Reigeluth (2011) shared research showing that 57% of those surveyed perceived lack of technology and lack of time as the top barriers to technology integration.

A **lack of time** on the part of the educator to consider how to apply and implement, and/or sustain online global collaboration was another key inhibitor. Arteaga (2012) identified how time consuming and exhausting online communication and collaboration was amongst outlier educators, especially working across time zones. Oran (2011) had a similar view and revealed insufficient time to teach for global learning. Jill shared *"I just keep coming back to that 4-letter word TIME...the demands from within the teaching role, classroom or whatever, are just escalating. So I think time is the biggest hurdle."*

A **lack of autonomy in the classroom** was indicated by the participants as an inhibitor. Ertmer and Ottenbreit-Leftwich (2010) also found that the context in which teachers work often constrains individual efforts and promotes a reluctance to adopt innovation. In her interview, Janice shared that when blogging with another classroom she was asked to take the blog down. Isolation as an educator and being the only one implementing online global collaboration was shared by many participants, including Lindy who stated,

> *There is really nobody else in the school … that's doing some of the stuff I am doing in the classroom with my kids. So I feel isolated in that sense and I feel like if I had somebody else, a couple of other people that I could collaborate with we would be able to do bigger and better...not so much bigger, but better and more effective learning experiences for the kids than I am doing right now.*

This aligns with Barbour, Davis, and Wenmoth (2016) who revealed a lack of inter-cluster and intra-cluster consistency and cooperation leading to isolated learning, and Oran (2011) who cited lack of contact with others in the same school as a barrier.

Within the school a **lack of priority for global collaboration** was an issue. Stella shared frustration with other activities taking time *"We're so involved with data collection on literacy and numeracy and a lot of those other wonderful personal skills and needs of students that aren't being met as much."* The overcrowded curriculum, being stymied by the evaluation and accreditation process meant there was little room for global collaboration. The focus on content learning rather than process was shared by Meredith, *"A lot of people still believe that it is about the mastery of content knowledge and the recall of content knowledge."* Oran (2011) found that although the curricula did not include global learning educators used it as an alternative to meet standards and skills required.

Oran (2011) and Arteaga (2012) revealed that global collaborative educators were determined to overcome barriers and found ways to connect and collaborate. Arteaga (2012) reinforced that "barriers did not deter them from continued professional social networking. Instead outlier teachers discovered, effected, shared and reflected practical solutions" (p. 143), and "Outlier teachers exercise a philosophy that is based on collaborative sharing of ideas and resources and getting beyond barriers" (p. 148).

Affordances to online global collaboration

Through the semi-structured interviews educators shared key affordances supporting their online global collaborative activities. A commonality was **establishing effective communication between educators** for mutual understanding of the global collaboration project structure including objectives and timeline. Lock and Redmond (2006) revealed that time is required for "various stakeholders to meet, develop shared philosophies, discuss viewpoints about ICT integration, clarify expectations and tasks, and develop a climate of trust to ask questions and negotiate decisions around the work (p. 244). Snyder (2016) shared that appropriate planning and communication supported collaborative activity, while Stornaiuolo (2016) discussed cosmopolitan activity and how important it was for educators to be able to manage challenging conversations through technology enhanced communications.

A major affordance came in the form of **support from stakeholders** such as administrators (Oran, 2011), parents and other community members. Enlightened support means encouraging educator risk-taking and allowing or accepting failure sometimes. As Stella stated,

> *I have a very supportive leadership team and parents and community. They just love the fact that the students in our school are no longer, you know, living in their own bubble but they're actually out there interacting with the world. And I find parents particularly are very supportive of that maybe because of our cultural and geographical isolation.*

Lindy spoke about a supportive technology director, *"We have a tech director … who was very much for … getting kids to do whatever is out there ... to explore different ways to learn. So he is very supportive so that's a positive thing."* Kim et al. (2013) reinforced this when they stated a crucial condition for change is the active involvement of leadership. Further, Snyder (2016) shared,

> Both teachers' and administrators' buy-in was important to integrating digital citizenship, social media, and global collaboration into the middle school curriculum. Policies should reflect buy-in as should teachers and their willingness to learn about new technologies, such as social media tools, to support students taking on the roles associated with digital citizenship. (p. 269)

Some of the participants spoke about **effective technology in the school** leading to improved bandwidth, access to a robust wireless network and hardware and online tools, and having no major restrictions on what could be used for learning, including being able to share learning beyond the classroom. As Lindy shared, *"If we can justify that it is educational they will unblock it for us and we will be able to use it."* The open use of Web 2.0 tools for collaboration was a major affordance to many. As Greenhow et al. (2009) stated, "Web 2.0 technologies enable hybrid learning spaces that travel across physical and cyber spaces according to principles of collaboration and participation" (p. 247).

Participants shared that **a small and trusting global network** (often called a Personal Learning Network (PLN)), helped to engage with those already doing global collaboration. When asked about culture change amongst educators within a school Stella stated, *"They need to understand how to network and how to learn from their network, how to share with them how to add value to it and somehow they need to be able to connect with others."* Educators overcame barriers through leveraging peers (Snyder, 2016), both internal (within the same school) while external (beyond school boundaries) networking is recommended in order to facilitate collaboration (Kim et al., 2013). An and Reigeluth (2011) found "Appropriate communities of practice or social networks have the potential to provide ongoing support outside formal training" (p. 61).

Affordance came also through **educator experience and beliefs** and the ability to move into more advanced pedagogies and participate in different activities, as evidenced by Jill who commented, *"I like to think that as teachers become a little bit more experienced in their teaching they've got over the nitty gritty of what they're doing in the classroom then they can sort of broaden out a little bit more."* Tondeur et al. (2016) found that qualitative evidence indicated that teachers' experiences with technology were perceived to be an enabler for supporting pedagogical belief change, while belief in the value of collaborative learning leads to more group work (Kim et al., 2013).

Some participants referred to **educator 'personality' or mindset** being conducive to online collaboration through taking a personal interest in connecting and collaborating, as Meredith stated, *"Some of it has been a personal interest finding out how technology can transform and enhance learning for students."* Participants came from different situations therefore it may be harder to generalise, however as global collaborative educators they were collectively determined to move beyond the norm. Research on outlier educators by Arteaga (2012) found this same behaviour, "It was evident that all teachers persevered, acted as creative catalysts for finding solutions to barriers, and held high expectations of self to surpass any barriers and enhance the quality of their teaching through collaboration" (p. 156).

Another benefit of online global collaboration revealed by the participants was **an enhanced awareness of self and one's place in the world** as well as a deeper knowledge of culture and country leading to decreased ethnocentricity and capability to build empathy with others. Union and Green (2013) when studying global projects and the impact on overcoming ethnocentrism concluded that "Web 2.0 technology helped, to a measurable extent, to impede student ethnocentrism and promoted positive working relationships that were related to student ethnocentrism during the global collaborations that were investigated" (p. 122). Global collaborative educator, Stella, revealed, *"I think when we collaborate globally we learn just as much about those other people as we do about ourselves and I think our own personal sense of being an Australian etc. is terribly important as well."*

Implications for Teacher Education in higher education

This research was conducted within a K-12 context and the affordances found in this study can be transferred to learning within teacher education. As previously mentioned, positive attitudes and skills, such as, cultural competency, multi-modal communication, the ability to adopt technology tools for modern learning objectives, problem solving, and a better grasp of the motivations for thinking global while acting local are possible outcomes for online global collaboration. Evidence of educator reluctance to adopt change (Flammia, 2012; Ertmer & Ottenbreit-Leftwich, 2010) indicates that changes are required to teacher education approaches to enable pre-service teachers to apply new ideas in K-12 classrooms (Stevens & Craig, 2012; Kivunja, 2013; Archambault, Wetzel, Foulger, & Williams, 2010). Pre-service teacher learning should include preparation for the knowledge society through collaboration skills and knowledge creation (Resta & Laferrière, 2007); a dynamic curriculum, open communication, social, peer-to-peer and multimodal learning design, global resources, and creation of content through innovative collaborations (McLoughlin & Lee, 2008); and the ability to develop online identities, network and share (Veletsianos, 2015).

Deeper understanding of what OCL is (Harasim, 2012) and how this can foster global collaboration is a necessary skill, as is being able to move beyond cooperative to collaborative learning whereby participants interact throughout the process to co-produce a finished product (Harasim, 2012). OCL also includes cultural competency to create learning relationships and environments (Lock & Redmond, 2011) as well as the confluence of technology and learning theories to empower learners to take greater responsibility over their learning situation and ultimate learning goals (Kang, Bonk, & Kim, 2011).

Teacher education courses have a responsibility for designing learning to provide OCL models and experiences to prepare pre-service teachers to be effective teachers of the digital generation (Kivunja, 2013) and understand the tools and practices enabling online collaborative work with others at a distance (Chandra & Chalmers, 2010). Sobel and Taylor (2005) found that pre-service teachers requested “more exposure, more explicit modeling and demonstration, more cultural information and more candid conversations” (p. 86). Using Web 2.0 tools for collaborative knowledge building gave pre-service teachers the confidence to incorporate these into future teaching practice and shifted the agency of learning from the individual to one that is shaped by the community (Chandra & Chalmers, 2010). Stevens and Craig (2012) shared a framework for teacher education to move from a traditional classroom to open networked learning that includes local and global community engagement and collaborative communities to support emerging and fast-developing technology-infused learning environments. Redmond and Lock (2009) provide an example of what online global collaboration can look like in practice within teacher education.

Educators in higher education also have a responsibility to present models of teaching with technology (Ertmer & Ottenbreit-Leftwich, 2010) as well as design and scaffold practical experiences to support collaboration competency while including global opportunities within and beyond the single institution (Archambault et al., 2010). The iCollab project (see https://icollab.wordpress.com/about/) is one example where several groups of lecturers and students, all involved in higher education courses in different contexts used social media tools to create a flexible environment for collaboration and cooperation and to engage in open, creative and collaborative learning (Cronin, Cochrane, & Gordon, 2016). Although they shared that nurturing global collaboration and networked learning in higher education required significant effort and commitment, the benefits “[h]ave enabled a new level of creativity and the potential for authentic global and cultural learning experiences - for our students, for ourselves and for a widening global network of educators” (Cronin, Cochrane, & Gordon, 2016, p. 11).

Conclusion

There are a number of limitations to this study. Firstly, the data came from a small sample size (n=9) who may not be representative of educators who participate in global online collaboration more broadly. Secondly, the data came from only one data source and was not triangulated with other sources. Having said that, the participants were from a range of international contexts and the affordances and inhibitors were common across locations. This qualitative study, despite these limitations, contributes to the ongoing discussions about enhancing learning through online global collaboration and therefore the need for teacher education to see the relationship of teaching with technology (Ertmer & Ottenbreit-Leftwich, 2010) and positive student outcomes related to online global collaborative learning. Future research in this area could include replication studies in higher education and with a larger number of educators.

Online technologies provide new ways of connecting and collaborating with others locally and internationally. Common responses to the benefits of global collaboration include fostering intercultural understanding and gaining a global perspective, increased engagement amongst students, the application of new learning modes and building confidence and skills with emerging technologies and in online learning modes. Students realise the power of connecting globally and that technology tools serve a learning purpose beyond socialisation. However they do require digital access and digital fluency.

Educators across the world are demonstrating the possibilities for engaged and collaborative learning leading to enhanced outcomes by connecting beyond their classrooms. This paper has explored the perceptions of online global educators, presented affordances and inhibitors for global online collaboration, and suggested recommendations for higher education.

As educators in multiple sectors strive to provide learning environments where global discussions occur providing to multiple perspectives, this paper adds to the broader dialogue and debate about online collaboration. There is an expectation that as learners graduate, they have the skills and dispositions to effectively work in groups, collaborate, and co-create new understanding and solve problems in a virtual environment. Online global collaboration is one way to provide them with opportunities to gain these skills.

References

Alberta Learning. (2003). Information and Communication Technology. Retrieved from https://education.alberta.ca/media/3114953/ictpos.pdf

An, Y.-J., & Reigeluth, C. (2011). Creating technology-enhanced, learner-centered classrooms: K-12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education, 28*(2), 54-62. doi:10.1080/21532974.2011.10784681

Archambault, L., Wetzel, K., Foulger, T. S., & Kim Williams, M. (2010). Professional development 2.0: Transforming teacher education pedagogy with 21st century tools. *Journal of Digital Learning in Teacher Education,* 27(1), 4-11.

Arteaga, S. (2012). Self-Directed and Transforming Outlier Classroom Teachers as Global Connectors in Experiential Learning. (Doctoral dissertation, Walden University). Retrieved from https://www.learntechlib.org/p/128793

Australian curriculum. (n.d.). General capabilities. Retrieved from https://www.australiancurriculum.edu.au/f-10-curriculum/general-capabilities/intercultural-understanding/

Barbour, M. K., Davis, N., & Wenmoth, D. (2016). Primary and Secondary Virtual Learning in New Zealand: Examining Barriers to Achieving Maturity. *International Journal on E-Learning, 15*(1), 27-45.

Boudreau, J. (2016). Work in the future will fall into these 4 categories [Blog post]. Retrieved from Harvard Business Review https://hbr.org/2016/03/work-in-the-future-will-fall-into-these-4-categories

Chandra, V., & Chalmers, C. (2010). Blogs, wikis and podcasts: collaborative knowledge building tools in a design and technology course. *Journal of Learning Design, 3*(2), 35-49.

Choi, I., Bae, Y., Kim, M., Hodge, E., Way, B., Choi, J., Shin, S. (2016). A Study on Globally-Connected Learning Based on Smart Education: Focused on American and Korean Elementary School Students. *International Journal of Applied Engineering Research, 11*(3), 2059-2070.

Collaborative Society. (2013). Collaboration - on the edge of a new paradigm [video file]. Retrieved from https://vimeo.com/77240879

Cronin, C., Cochrane, T., & Gordon, A. (2016). Nurturing global collaboration and networked learning in higher education. *Research in Learning Technology*, 24. doi:10.3402/rlt.v24.26497

Dillenbourg, P. (1999). What do you mean by collaborative learning? In P. Dillenbourg (Ed.), Collaborative-learning: Cognitive and computational approaches (pp. 1-19). Oxford, UK: Elsevier.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255-284. Doi: 10.1080/15391523.2010.10782551

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E. & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423-435. doi: 10.1016/j.compedu.2012.02.001

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education, 64*, 175-182. doi: 10.1016/j.compedu.2012.10.008

Flammia, M. (2012). Preparing Students for the Challenges of the Virtual Workplace. In *Proceedings of Global TIME 2012* (pp. 5-10). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Flat Connections (global projects). Retrieved from http://www.flatconnections.com/global-projects/

Friedman, T. (2007). *The world is flat 3.0: A brief history of the XXI century*. New York, NY: Picador.

Fullan, M., Langworthy, M. & Barber, M. (2014). *A rich seam: How new pedagogies find deep learning*. London: Pearson.

Garrison, D. & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education, 19*(3), 133-148. doi: 10.1207/s15389286ajde1903_2

Global Read Aloud (global project). Retrieved from https://theglobalreadaloud.com/

Greenhow, C., Robelia, B., & Hughes, J. E. (2009). Learning, Teaching, and Scholarship in a Digital Age Web 2.0 and Classroom Research: What Path Should We Take Now? Educational Researcher, 38(4), 246-259. doi:10.3102/0013189X09336671

Hanvey, R. G. (1982). An attainable global perspective. *Theory into practice, 21*(3), 162-167. doi:10.1080/00405848209543001

Harasim, L. (2012). *Learning theory and online technologies*. New York, NY: Routledge.

Hew, K.F. & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research and Development, 55*(3). 223-252. doi: 10.1007/s11423-006-9022-5

iEARN Global Learning Circles (global project). Retrieved from http://www.globallearningcircles.org/

Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., Watkins, S. C. (2013). *Connected learning: An agenda for research and design*. Irvine, CA: Digital Media and Learning Research Hub.

ISTE Standards for Students. (2016). Retrieved from http://www.iste.org/standards/standards/for-students

Kang, I., Bonk, C. J., & Kim, M.-C. (2011). A case study of blog-based learning in Korea: Technology becomes pedagogy. *The Internet and Higher Education, 14*(4), 227-235.

Kim, C., Kim, M. K., Lee, C., Spector, J. M. & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education, 29*, 76-85. doi: 10.1016/j.tate.2012.08.005

Kivunja, C. (2013). Embedding Digital Pedagogy in Pre-Service Higher Education to Better Prepare Teachers for the Digital Generation. *International Journal of Higher Education, 2*(4), p131.

La Trobe University. (2013). 8 essential employability skills. Retrieved from https://career-ready.blogs.latrobe.edu.au/2013/08/16/8-essential-employability-skills/.

Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. New York, NY: Routledge.

Laurillard, D. (2009). The pedagogical challenges to collaborative technologies. *International Journal of Computer-Supported Collaborative Learning, 4*(1), 5-20. doi: 10.1007/s11412-008-9056-2

Lee, M. & Ward, L. (2013). *Collaboration in learning: Transcending the classroom walls*. Camberwell, Victoria: ACER Press.

Lindsay, J. (2016). *The global educator: Leveraging technology technology for collaborative learning and teaching*. Eugene, VA: International Society for Technology in Education.

Lock, J., & Redmond, P. (2006). International online collaboration: Modeling online learning and teaching. *Journal of Online Learning and Teaching, 2*(4), 233–247.

Lock, J., & Redmond, P. (2011). International online collaboration: Giving voice to the study of diversity. *One World in Dialogue*, *1*(1), 15–19.

McKenzie, W. (2004). *Are you a techno-constructivist?* Retrieved from http://www.educationworld.com/a_tech/tech/tech005.shtml

McLoughlin, C. & Lee, M. J. (2010). Personalised and self regulated learning in the web 2.0 era: International exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology, 26*(1), 28-43.

McLoughlin, C., & Lee, M. J. (2008). The three p's of pedagogy for the networked society: Personalization, participation, and productivity. International Journal of Teaching and Learning in Higher Education, 20(1), 10-27.

Mansilla, V.B., Jackson, A. (2011). *Educating for global competency.* Retrieved from http://asiasociety.org/files/book-globalcompetence.pdf

Minnesota State. (2017). *Employability Skills.* Retrieved from https://www.careerwise.mnscu.edu/careers/employability-skills.html

New Media Consortium (NMC). (2017). *Horizon Report: 2017 Higher education Edition*. Retrieved from http://cdn.nmc.org/media/2017-nmc-horizon-report-he-EN.pdf

Nussbaum-Beach, S., & Hall, L. R. (2010). *The connected educator: Learning and leading in a digital age*. Bloomington, IN: Solution Tree Press.

Oran, H. G. (2011). Teaching for Global Learning through Telecollaboration: A Case Study of K-12 Educators' Conceptualizations and Practices about Global Education. (Ed.D). Retrieved from http://digitalcommons.kennesaw.edu/etd/468/

Resta, P., & Laferrière, T. (2007). Technology in support of collaborative learning. *Educational Psychology Review*, 19(1), 65-83.

Redmond, P., & Lock, J. (2009). Authentic learning across international borders: A cross institutional online project for pre-service teachers. In C. Maddux (Ed.), *Research highlights in information technology and teacher education 2009* (pp. 265-273). Chesapeake, VA: Society for Information Technology and Teacher Education.

Siemens, G. (2005). *Connectivism: A learning theory for the digital age*. Retrieved from http://www.elearnspace.org/Articles/connectivism.htm

Siemens, G. (2006). *Knowing knowledge*. United States: Lulu.com.

Snyder, S. E. (2016). Teachers' perceptions of digital citizenship development in middle school students using social media and global collaborative projects. (Doctoral dissertation, Walden University). Retrieved from http://scholarworks.waldenu.edu/dissertations/2504/

Sobel, D. M. & Taylor, S. V. (2005). Diversity preparedness in teacher education. *Kappa Delta Pi Record, 42*(2), 83-86.

Stevens, K., & Craig, B. (2012). Two frameworks for preparing teachers for the shift from local to global educational environments. *Journal of Open, Flexible and Distance Learning*, 16(2), 11-25.

Stornaiuolo, A. (2016). Teaching in global collaborations: Navigating challenging conversations through cosmopolitan activity. *Teaching and Teacher Education, 59*, 503-513. doi: 10.1016/j.tate.2016.07.001

Strauss, A., & Corbin, J. (1990). Open coding. In A. Strauss & J. Corbin (Eds.), *Basics of qualitative research: Techniques and procedures for developing grounded theory* (pp. 101-121). Thousand Oaks, CA: Sage.

Tagüeña, J. (2008). 'Glocal' approach makes global knowledge local. Retrieved from http://www.scidev.net/global/communication/opinion/-glocal-approach-makes-global-knowledge-local.html

Tapscott, D. (2009). *Grown up digital* (Vol. 361). New York: McGraw-Hill.

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. *Educational technology research and development, 65*(3), 555-575. doi: 10.1007/s11423-016-9481-2

Union, C., & Green, T. (2013). The use of Web 2.0 technology to help students in high school overcome ethnocentrism during Global Education Projects: A cross-cultural case study. *The Georgia Social Studies Journal, 3*(3), 109-124.

University of Kent. (n.d.). What are the top ten skills that employers want? Retrieved from https://www.kent.ac.uk/careers/sk/top-ten-skills.htm

Veletsianos, G. (2016). The Defining Characteristics of Emerging Technologies and Emerging Practices in Digital Education. In G. Veletsianos (Ed.), *Emergence and Innovation in Digital Learning: Foundations and Applications*. Athabasca, Canada: Athabasca University Press.

Veletsianos, G. (2015) 'University curricula should include the teaching of networked scholarship', George Veletsianos blog. Available at: http://www.veletsianos.com/2015/07/ 21/teach-networked-digital-scholarship-curricula

Yin, R. K. (2014). *Case study research: design and methods* (Fifth ed.). Los Angeles: SAGE.

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Challenges and tensions in the role of the LMS for medical education: Time for the "next generation LMS"?

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In the context of discussions of a “next generation LMS” and other contemporary challenges in higher education, this case study looks at the iterative process a team of educational designers and Medical School academics at Australian National University used in a review of the ANU's Medical School LMS sites. Adopting the framework of the actor network theory, this reflective process discovered the tensions, dynamics and issues involved, and worked to gain and maintain key Medical School staff engagement and support for the review and for any changes that might be recommended. This paper reflects on emerging possible models for technology-enhanced learning beyond our current institutional LMS while acknowledging the institutional constraints on learning innovation within the global higher education context. Next generation LMS models may provide a more flexible future solution that could be applicable not just to medical education, but to higher education generally.

Introduction

Universities rely on their learning management system (LMS) to deliver educational content online. However, as technology-enhanced learning and teaching (TELT) practices mature, questions have been raised about the suitability of the LMS to adequately meet the current and future needs of students and educators (Adams Becker et al., 2017; Brown et al., 2015; McGee & Green, 2008; Sclater, 2008). This is an especial challenge for medical schools that utilise an LMS to provide a single-sign-in, all-in-one portal not just for the provision of an integrated spiral curriculum but also a range of automated administrative, tracking and reporting functions (Back et al., 2016). Moving the focus of the LMS away from its primary purpose of constructing learning through interaction with multimedia and collaboration with peers and educators creates tensions between the LMS, the university, and the diverse needs of the users. Actor-network theory (Latour, 2005) enables the exploration of how people, ide**as,** processes, politics, cultural and historical factors, and technologies inter-relate and form the complex realities in which educational designers work. This paper theorises that in medical education the LMS is a site of tension that is not easily resolved, and it is into this site of tension that educational design projects function. It is beyond the scope of this paper to explore specific alternative models, although some reference is made to emerging visions of interlinked, flexible systems to meet higher education learning needs, for example in the 2016 Horizon Report.

Background

In 2016, the Medical Education Unit (MEU) of the Australian National University Medical School contacted the university’s central educational design team to discuss revision of the online spaces used to deliver the four-year graduate entry medical program. These spaces existed in numerous sites, within the university’s institutional instance of the Moodle-based LMS. This request was in response to student and staff dissatisfaction with the customised Moodle LMS design created for the Medical School to replace a previous bespoke platform known as 'MedOnline'. MedOnline was designed specifically for the Medical School in 2000. The platform was created to provide content management as well as communication and administration tools specific to the delivery of medical education. However, it was composed mostly of static resources with limited interactivity. Given that the remainder of the university utilised the institutional Moodle-based LMS, the MedOnline platform was unsustainable. Therefore, in 2012 all of the MedOnline functions were migrated to the university’s LMS. Customisations were integrated to accommodate the unique communication and administration functions previously delivered by MedOnline. These customisations included tools for managing timetabling and recording the contact information and teaching participation of the vast number of educators, many of whom are clinicians external to the university. These functionality requirements pushed the LMS to its limits, making it difficult to navigate and manage. The result was a system which was more recognisable as a content management repository and administration interface rather than an interactive and collaborative learning environment.

ANU Medical School professional and academic staff recognised that the prioritisation of administrative over pedagogical imperatives in the LMS customisation had resulted in negative feedback from students and staff. Thus there was an overwhelming desire for improvement. Nevertheless, there remained a strong cultural attachment to the provision of complex administrative and human resource management functions via the LMS.

To identify the issues causing dissatisfaction with the customised LMS, a team of educational designers from ANU Online, and members of the MEU, initiated a project to review the existing LMS and recommend improvements. This paper describes and reflects on the review process undertaken by the educational design team. In addition, issues specific to medical education that affect the design of an online learning environment are discussed. Finally, we reflect on whether these issues are confined to medical education alone or whether they expose widespread issues emerging around the limitations of a “one-size-fits-all”, proprietary, institutional-based LMS platform in higher education.

We suggest that the existence of the LMS within a complex network of technology, people, policies, educational needs, institutional factors, and information technology services impacts any changes to technology or pedagogy within a given curriculum. Actor Network Theory (ANT, Latour, 2005) has been used to understand technological change and the shifting interdependent and influential relationships between technology and people. It is a theoretical framework which “savours mess, contradictions, the local rather than the universal, and close noticing…” (Bleakley, 2012, p. 466). In this paper we apply ANT to capture the reflective process LMS-review participants experienced, which led to new understandings and awareness of and relationships with the LMS.

Methodology and data collection

A mixed-methods approach was used to evaluate the LMS and included: (1) a survey, (2) focus groups, and (3) interviews. Ethics approval for this study was received from the Australian National University Human Research Ethics Committee. An electronic survey using Qualtrics (Qualtrics, Provo, Utah, USA) was distributed to all Year 1-4 medical students (N=400) via mailing lists and electronic bulletin boards. The survey was composed of closed and open-ended questions to obtain demographic data and determine student use of the LMS, including identification of what they found worked well or not well and suggested improvements. In addition, students were asked to rate their experience of the LMS using a five-point Likert scale. All analyses were performed using Qualtrics.

At the end of the survey, students had the opportunity to volunteer to participate in a focus group. Full-time academic and professional staff who regularly use the LMS (N=49), based on recommendations from the MEU, were invited to attend an interview. Semi-structured questions were used to explore student and staff views on and experience with the LMS and its impact on their teaching and learning activities. All interviews and focus groups were recorded, with the consent of each participant, before being transcribed coded, classified and analysed using Dedoose (Hermosa Beach, California, USA). Thematic analysis method was used for qualitative data collected from survey open-ended questions, focus groups and interviews.

In total, 121 students (30% of total students) responded to the survey, and 33 students (6 Year 1, 4 Year 2, 11 Year 3, and 12 Year 4) and 20 staff (6 academic, 14 professional, 41% of total staff) participated in the focus groups and interviews.

Results

Dissatisfaction with the LMS was the overwhelming response from the Medical School community. Students found the LMS confusing and difficult to use, and it hampered rather than supported their ability to study effectively. Navigation problems were the main source of complaint, with resources and assignments difficult to find and use, and many course sites filled with dense information that was hard to extricate. Overall, students rated their experience with the Medical School LMS sites as average to poor. In response to the question, “What three words would you use to describe your experience with the LMS, students indicated they found it 'confusing', 'frustrating', 'difficult', and 'slow' (Figure 8).

Figure 8: Student-reported experiences of the LMS

Students commented that they weren’t sure what the LMS was supposed to be delivering for them:

> *“As a student I get a bit confused about what the LMS’s ultimate aim is - is it an uploading centre? It is a resource information* [site]*? Or is it a resource provider itself?”* - Year 3 student, survey response

> *"Keep the LMS streamlined and organised, focussed on the resources/communication provided by/from the MEU (don't try to make it a 'one-stop shop' with other services that third-parties do a better job of providing)."* – Year 1 student, survey response

There was evidence of a lack of understanding of how the LMS works, with staff often unsure how to improve it as they did not feel they received adequate support or training in its use. When asked about difficulties in using the LMS, an academic staff member responded in interview:

> *"In the end you should be able to fix it but I just can't be bothered. And the* [student] *groups constantly say, I'd prefer to use Facebook. And I as the academic say, well I don't want any patient details going on Facebook, so we'll just do an email group."*

This sentiment resonated with many staff and students. Rather than try to "make" the LMS meet their needs, which they felt the system could not do or that it would be too difficult to try, they would rather just use a third-party platform. The survey revealed that students regularly use external systems such as Facebook for communication and Google Docs for sharing documents and collaborating:

> *"All have mobile support, but that is not why I use them over the LMS. The LMS would be too limited and clunky for collaborative work. G*[oogle] *Drive and Facebook have 1,000s of developers working on updates and software improvements, so I don't see myself shifting those activities to the LMS. The LMS development is likely to be far slower and the software less flexible compared to other services."* - Year 2 student, survey response

Furthermore, both academics and students expressed a desire for more interactive learning opportunities such as videos and formative quizzes with feedback. To compensate, students accessed a range of external sites such as YouTube, Wikipedia, and Khan Academy as well as medicine specific sites like MedScape, Toronto Notes, and quiz databases for the U.S. Medical Licensing Examination (USMLE). This practice is common: medical studies are increasingly turning towards more user-friendly technologies to meet their educational requirements (Hollinderbäumer et al., 2013). However, these approaches are not without their flaws and it is evident that educator input is required to ensure relevancy and accuracy (Azer, 2015).

There was a pervasive sense that the LMS was a constraint to usability and educational outcomes:

> *"Medical people don't think in silos or boxes, we need resources that are holistically arranged, not overly prescriptive, available across all years and sites, easily searchable."* – Academic staff member, interview

> *"I hadn't even considered the LMS as a learning tool. I think of it as an administrative tool."* – Year 2 student, focus group

> *"I make slides available to students on the LMS, and I provide descriptions of teaching sessions on the LMS, but I don't really think in any meaningful sense I deliver education via the LMS."* – Academic staff member, interview

Many of these problems stem from the same issue: Moodle is a learning management system, designed for interactive teaching and learning tasks. However, from this review it was apparent the Medical School primarily used the LMS for administrative and organisational purposes. Students had to access new information and announcements from a large number of possible communication channels over several different sites, but there were limited opportunities for interaction with their peers or academics. It became evident to the educational design team that medical education is complex, with specific requirements both educationally and administratively, that had resulted in the Medical School using the LMS as a "one-stop-shop" to meet these complex needs.

The outcome of this design was an LMS that students found challenging to use, with confusing navigation and seemingly impenetrable to search and access learning materials. This subsequently impacted professional staff to whom students would turn to complain or seek assistance to access information and materials. It was obvious that the course sites needed significant revision to improve the user interface design. An updated, more visually appealing design was envisaged by the educational design team as these issues emerged. However, it was evident this would be difficult to achieve with the layers of administration functions imposed on the sites and the limitations this placed on the extent to which the course sites could be changed. It was also clear that any new designs would need to factor in mobile accessibility, as 90% of students reported using their mobile devices to access the Medical School course sites but the user experience was very poor.

Additional complexities that became apparent during the analysis of the data included the following:

- The ANU Medical School must interface with a range of external bodies such as hospitals and other medical institutions, relevant regulatory bodies, government departments and medical research repositories.

- Substantial student learning occurs in clinical locations external to the university – both for practicums as well as lectures, tutorials and assessment.
- Medical education is profoundly vocational and involves rostered rotations in a variety of clinical settings, combined with attendance at formal teaching sessions. Students and their teachers need to be linked into the very latest medical information that may make a difference to the health of individuals and populations.
- Medical education is based on an integrated spiral curriculum composed of multiple disciplines, rather than just a single course.
- Many staff teaching into the medical program are clinicians, general practitioners, or hospital staff who do not hold positions at the university, meaning they are unable to access the university-only LMS.

Within this multifaceted environment, the institutional LMS struggled to meet the needs of staff and student. While the plug- in met these needs for a period of time, albeit in a way that was not particularly user-friendly, it became apparent that the plug-in is not sustainable, and we need to explore other alternatives for integrating all of the Medical School needs into a coherent, user-friendly set of digital environments.

Discussion

Actor-network theory (ANT) is ideal for exploring the complexities of relationships and inter-dependencies of information and communication technology (ICT) projects within education (Tummons, J., Fournier, C., Kits, O. & MacLeod, A., 2017)). As a framework, ANT avoids linear understandings and focuses instead on revealing complexity (Bleakley, 2012), and problematizes the idea that only humans have agency within a network (Sayes, 2014). When we expand the definition of agency beyond just human action, and include "things [which] might authorize, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid, and so on" (Latour, 2004, p. 226), we are able to explore how every entity in the network (human or otherwise) can have an effect on that network. "How to make someone do something" is the central concern of ANT (Latour, 2005, p. 59).

> A network can be established through persuasion, inducement, coercion or any combination of these. And a network can break down at any point or link: consequently, the social project can be slowed down, misdirected or even lost, whether the broken link is an object (e.g. a rule or regulation that has been forgotten or misinterpreted), or a person (e.g. someone who has decided for whatever reason not to act in the way that the network requires). Both people and objects can make (or fail to make) other people do something; that is to say, both people and objects are granted agency within ANT. (Tummons et al., 2017, p. 3)

Using new technologies in educational contexts is often fraught with difficulties, and liable to breakdown or fail, but this is often not solely the responsibility of the technology, nor solely of the people set to use the technology. Speaking of the difficulties involved in making changes to an institutional LMS, Mewburn et al. (2014, p. 646) writes:

> Our paper draws attention to the source of trouble originating in humans and non-humans working together - it was rarely the problem of one or the other 'standing in the way of progress'. Most of the non-human actants in our technology actor-network, while cheap, available and easy to engage with, operate within a complex policy and legal environment - full of other actors with the ability to influence at a distance in complex and perhaps unintentional ways.

Below, we examine the connections between human actors (teachers, students, clinicians, executives, and educational designers) and non-human actors (such as the LMS, computers, mobile devices, human resource systems, internet access) in the context of ANU Medical School. When depicted as an actor-network, it becomes very clear why it is so challenging to "just change things".

The first issue at work in the ANU Medical School is that a large percentage of the staff who teach into the program are not employed by the university, and access to the LMS and all institutional systems are not available to them. Many of these individuals may only teach one or two sessions in a year in a volunteer capacity, and they rotate rapidly: it was too onerous a task to organise HR credentials for them. This has a flow-on effect where clinicians were not engaged with the LMS, and are reliant on professional staff in the School to upload documents for them. The clinicians are also unable to see what had been taught by others, and cannot create learning activities for students. The resulting student dissatisfaction led to the initiation of the review process described above, but until the HR issue is dealt with, this issue cannot be easily resolved. As an inherently vocational program, direct contact with clinicians and clinical environments is essential to the program.

Another issue is the historical factor of MedOnline, the previous LMS, and how Moodle was customised with a bespoke plug-in in order to match the functionality of MedOnline. This influences how the LMS sites look and function, and these cannot be substantially changed as it would cause the plug-in to break down. First created in 2011, the plug-in is static, and has begun to degrade in functionality as the university updates the LMS on a yearly schedule and new features and themes are introduced. The use of the LMS is, in one sense, “locked down”. In order to deal with this, students frequently rely on external sites such as Facebook (for communication) and Google Docs (for collaboration). The educational designers hope to replace the plug-in using a combination of Office365 collaboration tools and a digital content repository, though this cannot occur until the university progresses through a procurement process to select a repository product and integrate it with the LMS. However, most of the staff and students in the School are not aware of these “behind-the-scenes” processes, and only experience the outcome: poor user experience. This has led to dislike of the LMS, and unwillingness to use it as a result (see Figure 2, below).

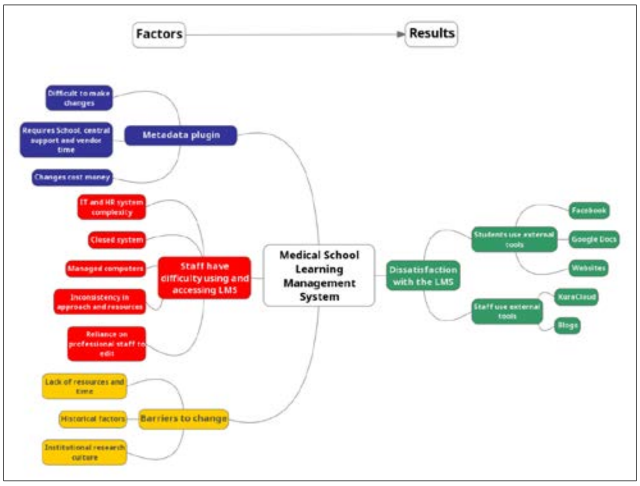

Figure 2: Actor-Network of effects of technology on user experience

The technology and access to it substantially affects the behaviour of staff and students within the School. In fact, it could be said that the customised database plug-in is a dominating actor, repressing and thwarting the drive from academic actors to rejuvenate their learning environment and improve the learner experience. A common refrain is that “the LMS is terrible”, and this narrative has led to a general unwillingness to use it at all. Despite these factors, there has not been a major breakdown in the use of the LMS and it is still very much central to the delivery of the program. While the LMS may not be adaptable, the actor-network is: staff and students are persistent, dedicated, and “hack” their own solutions when one is not readily apparent. Several academics have begun using other Moodle sites, external blogs, eBooks or adaptive learning tools such as KuraCloud to meet their desire for user-friendly and innovative uses of technology.

Limitations

Whilst 30-40% of students and staff participated in the survey and interviews, all staff and students were given the opportunity to view the results and provide feedback. This ensured that the results were representative of the key stakeholders. Though it may be argued that the limitations of the plug-in are a weakness of the study, the role of the plug-in and its contribution to the complex organisation and functionality of the LMS were not readily apparent at the study outset and emerged as a major limiting factor during the course of the study.

Emerging challenges to the role of the LMS

Dissatisfaction with LMSs, as they are currently delivered in higher education, is not unique to the Medical School in this case study, but is expressed by many scholars (McGee & Green, 2008; Garcia-Penalvo et al., 2011; Herold, 2014; Vogten & Koper, 2014; Adams Becker et al., 2017, Watters, 2014). A theme among these authors is that the LMS is extremely limited in comparison to far more flexible tools on the open internet, in the form of Web 2.0 communication, social networking, collaboration and research applications.

There is a lack of comprehensive empirical data on the use of LMSs for medical education (Back et al., 2016). Previous studies have focussed on individual disciplines, rather than integrated spiral medical curricula, or investigated elements of TELT rather than focussing on the role of the LMS (Zakaria et al., 2013; Kukolja-Taradi et al., 2008; Childs et al., 2005). One study investigating 505 undergraduate medical students´ utilization of and problems with a LMS has been conducted (Back et al., 2016). The results were consistent with the findings of our study: Back et al. found that medical students primarily use the LMS to acquire information about curricular content, access teaching resources and prepare for assessments; the importance of the LMS for communicating with other students or teachers was minimal (2016).

Consistent with our student cohort, primary complaints about the LMS concerned inadequate content integration and structure, problems locating resources, and a lack of interactivity. Medical schools also frequently encountered issues with clinicians and access to the LMS, and found that the level of support required to enable clinical educators to use non-intuitive interfaces should not be underestimated (Gray & Tobin, 2010).

The strengths of the LMS are also its weaknesses. They provide closed “walled gardens” (Garcia-Penalvo, F. J., Conde, M.A., Alier, M., & Casany, M.J.,2011) of learning and activities that are protected from theft of intellectual property, the dangers of the open internet in terms of security and personal safety, and the intrusion into proprietary interests of universities in a competitive global higher education market. But it is this very security and safety that also restricts access, flexibility and innovation. The specific issues causing a restlessness among those confined to the LMS platform have been identified as:

- Lack of interoperability between tools that are part of the LMS package being purchased and tools that might belong to other providers or are open source (Sampson & Karampiperis, 2006; Brown et al., 2015)
- Lack of interoperability between SCORM learning objects within an LMS and other functions of the LMS, limiting the ability to share and re-use such objects (Sampson & Karampiperis, 2006)
- Inflexibility and inability to customise and personalise learning (Sclater, 2008; Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall, Giesinger, C., and Ananthanarayanan, V. 2017)
- Inability to partner with other higher education institutions due to proprietary LMSs (Sclater, 2008)
- The structure of LMSs around institutional norms and rules, implying an inherent conservatism and lack of innovation (Watters, 2014)
- Complexity and difficulty of navigating current LMS sites and using the tools (Zanjani, N, Edwards, S. L., Nykvist, S. & Geva, S.,2017)

Using Actor Network Theory, it could be said that LMS technology is an actor favoured by higher educational institutional actors, as a unified solution to problems that are largely financial, administrative, and the outcome of the impact of globalisation and global competition for universities. These global forces act on universities and result in the use of a form of technology that may belong in a previous era, rather than in a new age of open resources, open learning and a highly connected world. The continued use of an outdated form of technology could be seen to create tension as students and teachers bypass the LMS for newer technology that is more suitable for contemporary communication and learning needs. It is this tension between the different actors that perhaps will drive the LMS towards a newer iteration of its model.

A vision of something beyond the unified "one size fits all" of an institutional LMS is emerging expressed in language like "learning ecosystem", "digital learning system/environment", and "Personal Learning Environment" (Dahlstrom et al., 2014; Adams Becker et al, 2017) to enable lifelong learning. Rather than the "walled garden", the future digital learning environment will function as a portal to a series of interconnected systems. The cloud is frequently mentioned as a cheaper and more flexible option to university-based proprietary IT systems supporting an LMS (Lal, 2015). Technavio predicts that by 2020, 80% of all organisations will adopt a cloud-based LMS (Technavio, 2016). However, given the competitive global model that has been adopted by most universities, institutional self-preservation and self-promotion may continue to mandate that learning occurs behind digital walls with limited bridges and portals into and out of the external, connected world. While teaching and educational design staff may be motivated to design integrated learning environments that incorporate external applications and sites, global university competition and proprietary attitudes, and security concerns, also form as actors in the network, putting a brake on developments, or perhaps steering developments towards a particular outcome.

Conclusion

The primary discovery of this review was that user dissatisfaction has arisen as a result of the incompatibility between the multi-faceted requirements of the ANU Medical School and the limitations of a "one size fits all" institutional LMS platform. This may be an early warning sign that the model for technology enhanced flexible learning using a single, central LMS platform is inadequate for a medical school, and possibly for teaching and learning throughout higher education. This model, which is still largely limping along as the only viable solution for most universities, may have reached its use-by date. The 2017 Horizon Report published by Educause includes "next-generation LMS" as a mid-term trend in its list of "six trends accelerating higher education technology adoption" (Adams Becker, 2017, p. 3), and asserts that:

> Learning ecosystems must be agile enough to support the practices of the future. In using tools and platforms like LMS, educators have a desire to unbundle all of the components of a learning experience to remix open content and educational apps in unique and compelling ways. (Adams Becker et al, 2017, p.2)

The developing trend is for "next-gen" LMSs that are modular in nature, interoperable with a range of applications that are able to be customised to include open educational resources and practices. With its multiple components needing integration into its delivery and curriculum, a new model for the LMS is certainly needed for the Medical School in this case.

The requirements of medical schools, ascertained in this review, highlight many of the features desired in a "next gen" LMS. The model of learning is founded on the acquisition of real-world skills and current knowledge on a wide range of medical issues overseen by a large number of clinical teachers and supervisors. This requires a system that can cope with the meaningful integration of technology to support skills-based training, access to voluminous e-libraries and e-resources and the rostering of staff and students together with effective communication channels. A modular system that has good interoperability between different applications and can make use of open education resources and communication platforms together with rostering applications would be ideal.

The reflective approach of the ANU Online educational design team and Medical Education Unit staff led them to recognize the particular needs of delivering an integrated spiral blended learning medical curriculum within the constraints of an institutional LMS. In trying to solve the problems and issues discovered in the review, the team and the collaborating Medical School staff may need to link in to the wider discussion advocating a modular and flexible virtual learning environment rather than the unified, walled LMS solution, perhaps becoming part of a technological evolution in the making. As part of this evolution, the constraints imposed by globalising university institutional requirements might result in a new alternative as a hybrid solution.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall, Giesinger, C., and Ananthanarayanan, V. (2017). *NMC Horizon Report: 2017 Higher Education Edition*, Austin, Texas. Retrieved from: https://www.nmc.org/publication/nmc-horizon-report-2017-higher-education-edition/

Azer, S. A. (2015). Is Wikipedia a reliable learning resource for medical students? Evaluating respiratory topics. *Adv Physiol Educ, 39*(1), 5-14. doi: 10.1152/advan.00110.2014

Back, D. A., Behringer, F., Haberstroh, N., Ehlers, J. P., Sostmann, K., & Peters, H. (2016). Learning management system and e-learning tools: an experience of medical students' usage and expectations. *International Journal of Medical Education*, *7*, 267–273. http://doi.org/10.5116/ijme.57a5.f0f5

Bleakley, A. (2012) "The proof is in the pudding: Putting Actor-Network-Theory to work in medical education." *Medical Teacher.* 34(6): 462-467. doi: 10.3109/0142159X.2012.671977

Brown, M, Dehoney, J & Millichap,, N. (2015) *The Next Generation Digital Learning Environment* in Educause Learning initiative 2015. Retrieved from https://library.educause.edu/~/media/files/library/2015/4/eli3035-pdf.pdf

Childs, S., Blenkinsopp, E., Hall, A., & Walton, G. (2005). Effective e-learning for health professionals and students--barriers and their solutions. A systematic review of the literature--findings from the HeXL project. *Health Info Libr J, 22 Suppl 2*, 20-32. doi: 10.1111/j.1470-3327.2005.00614.x

Dahlstrom, E. D., Brooks, C., & Bichsel, J. (2014) *The Current Ecosystem of Learning Management Systems in Higher Education: Student, Faculty, and IT Perspectives* Research report Louisville, CO: ECAR, September 2014. Retrieved from https://net.educause.edu/ir/library/pdf/ers1414.pdf

Garcia-Penalvo, F. J., Conde, M.A., Alier, M., & Casany, M.J. (2011) Opening Learning Management Systems to Personal Learning Environments. *Journal of Universal Computer Science*, 30(1), 1222-1240. Retrieved from http://www.jucs.org/jucs_17_9/opening_learning_management_systems/jucs_17_09_1222_1240_garcia.pdf

Gray, K., & Tobin, J. (2010). Introducing an online community into a clinical education setting: a pilot study of student and staff engagement and outcomes using blended learning. *BMC Medical Education, 10*(1), 6. doi: 10.1186/1472-6920-10-6

Herold, B. (2014). Identity crisis for the LMS driven by tech advances. *Education Week, 34*(6), 2-2, 3, 5, 3. Retrieved from http://www.edweek.org/ew/articles/2014/10/01/06lms-overview.h34.html.

Hollinderbäumer, A., Hartz, T., & Uckert, F. (2013). Education 2.0 -- how has social media and Web 2.0 been integrated into medical education? A systematical literature review. *GMS Z Med Ausbild, 30*(1), Doc14. doi: 10.3205/zma000857

Kukolja Taradi, S., Đogaš, Z., Dabić, M., & Drenjančević Perić, I. (2008). Scaling-up Undergraduate Medical Education: Enabling Virtual Mobility by Online Elective Courses. *Croatian Medical Journal*, *49*(3), 344–351. http://doi.org/10.3325/cmj.2008.3.344

Lal, P. (2015) Organisational learning management systems: time to move learning to the cloud! in *Development and Learning in Organisations*; 29.5 (2015): 13-15. http://dx.doi.org/10.1108/DLO-12-2014-0093

Latour, B. (2004) Nonhumans. In: Harrison, S; Pile, S; and Thrift, N (eds) *Patterned Ground: Entanglements of Nature and Culture*. London: Reakiton Books, 224-227.

Latour, B. (2005) *Reassembling the social: An introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Mewburn, I., Freund, K., & Rutherford, E. (2014) Badge trouble: piloting open badges at the Australian National University. In B. Hegarty, J. McDonald, & S.-K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology. Proceedings ascilite Dunedin 2014*, 643-648.

McGee, P & Green, M. (2008) Lifelong learning and systems: A post-Fordist Analysis. *MERLOT Journal of Online Learning and Teaching*ol , 4(2) Retrieved from http://jolt.merlot.org/vol4no2/mcgee0608.pdf

Sampson, D.G. & Karampiperis, P. (2006) Towards the Next Generation Activity-Based Learning Systems. *International Journal on E-Learning*, 2006; 5(1); 129-150. Retrieved from: http://www.learntechlib.org/p/21766

Sayes, E. (2014) Actor-Network Theory and methodology: Just what does it mean to say that nonhumans have agency? *Social Studies of Science*. 44(1): 139-149. https://doi.org/10.1177/0306312713511867

Sclater, N. (2008) Web 2.0, Personal Learning Environments, and the Future of Learning Management Systems. *Educause Research Bulletin*, Issue 13 EDUCAUSE Center for Applied Research. Retrieved from http://www.educause.edu/eca

Technavio Research. (2016) Next gen LMS market will boom with over 80% of organizations likely to adopt cloud-based LMS by 2020: Technavio. (2016). *Education Letter,* 69. Retrieved from https://www.technavio.com/report/global-education-technology-global-next-gen-lms-market-2016-2020

Tummons, J., Fournier, C., Kits, O. & MacLeod, A. (2017) Using technology to accomplish comparability of provision in distributed medical education in Canada: an actor-network theory ethnography. *Studies in Higher Education*. DOI: 10.1080/03075079.2017.1290063

Vogten, H., & Koper, R. (2014) Towards a new generation of Learning Management Systems. Presentation given at the *6th International Conference on Computer Supported Education* (CSEDU), 1-3 April 2014, Barcelona, Spain.

Watters, A. Beyond the LMS *Hack Education* 05/09/2014. Retrieved from: http://hackeducation.com/2014/09/05/beyond-the-lms-newcastle-university

Zakaria, N., Jamal, A., Bisht, S., & Koppel, C. (2013) Embedding a learning management system into an undergraduate medical informatics course in Saudi Arabia: lessons learned. *Med 2 0, 2*(2), e13. doi: 10.2196/med20.2735

Zanjani, N, Edwards, S. L., Nykvist, S. & Geva, S. (2017) The Important Elements of LMS Design that Affect User engagement with e-learning tools in the higher education sector. *Australian Journal of Educational Technology,* 33 (1), 19-31. https://doi.org/10.14742/ajet.2938

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Addressing inconsistency in use of the LMS: A collaborative approach

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Inconsistency in the use of the learning management system (LMS) by academic staff is a source of dissatisfaction among university students in the UK. One solution is to establish a set of minimum standards (or baseline) for LMS use within an individual institution. Another is to supply templates – frameworks for LMS course sites – with a view to providing students with a seamless experience in their interactions with the LMS. This paper describes how the issue of inconsistency was addressed at a leading research university in the UK through an exploratory project, WebLearn Improved Student Experience (WISE). The widespread devolution of responsibility for site management to administrative staff, together with the 'maverick' creation of course sites by those academics who chose to engage with the WebLearn LMS, had resulted in unevenness in students' access to learning materials. The project team engaged in close collaboration with 19 departments in order to achieve the immediate purpose of improving uptake of, and consistency in, their LMS presence. The ultimate aim was to develop a support package comprising LMS templates and 'best practice' guidelines that would enable departments in the future to achieve the same objective, either unsupported or with minimal assistance from the central team of learning technologists. The project was evaluated using a modification of the Innovation Histories method, which included interviews with 13 participants. The evaluation findings additionally threw into relief the complex social and cultural factors at play that can inhibit a consistent student experience in an institutional LMS.

Introduction

For over two decades the learning management system (LMS)[1] has been the cornerstone of digital education for both campus-based and online courses. Yet, in a substantial proportion of higher education institutions in the UK, the LMS is still not used to its full potential, whether 'full potential' is measured (for example) in terms of uptake by academic staff or by the broadening of their pedagogic repertoire to capitalise on the variety of tools available.

This paper is concerned with the first of these measures: uptake. Increasingly, uptake is couched in terms of consistency in use of the LMS by academics. It has been suggested that students' appreciation of 'a reliable and seamless experience' (Cook & Obexer, 2014, p. 71) in technology-enhanced learning (TEL) generally (i.e. not just the LMS) is second only to their appreciation of TEL *per se* (Walker et al., 2016). However, as Reed and Watmough (2015) observe, an inconsistent LMS experience – in which 'some module spaces are empty whilst others overflow with administrative information, lecture content and support materials' (p. 69) – is now a source of substantial dissatisfaction among university students, as captured in surveys of the student experience.

The paper describes the approach taken to tackle inconsistent use of the LMS in one of the UK's leading research universities, the University of Oxford, through the provision of templates: 'frameworks for, or initial states of, course VLE sites' (Fresen, Hill & Geng, 2014). More specifically, it focuses on an exploratory, practice-based project in which the LMS support team worked collaboratively with departments[2] across the University to develop a set of LMS templates and accompanying 'best practice' guidelines. The ultimate goal was to enable departments to design, or redesign, their LMS sites in a more consistent manner, with minimal support from the central team.

A brief survey of the research literature relating to consistency and support for academics to engage with the LMS opens the paper; particular reference is paid to two solutions: minimum standards and templates. Next, the motivation for the project and the team's *modus operandi* with the participating departments are described. An account of the project evaluation then follows, providing input into a discussion of the findings and their implications.

Literature survey

In gathering students' input into a review of their institutional LMS, Cook and Obexer (2014) identified three aspects to consistency:

- structure and navigation of LMS sites between departments;
- use of the LMS by academics, 'so that students know what to expect from [the LMS], across all units' (p. 73);
- the use of tools within the LMS.

A fourth aspect can be added to this list, derived from the quotation from Reed and Watmough (2015) in the Introduction above:

- content and activities between modules (or courses) within the same department.

Quantitative evidence of the patchiness in LMS provision between courses and departments can be found in the 2016 TEL survey of higher education institutions in the UK conducted by the Universities and Colleges Information Systems Association (UCISA) (Walker et al., 2016). Even though all respondents to the survey had at least one LMS in their institution (and 28% had additional, departmental, LMSs), in only 42% of cases were all courses supported by the LMS. Among respondents from the Russell Group of 24 leading UK research universities (http://www.russellgroup.ac.uk), the proportion was even lower: 35%.

One explanation for this state of affairs is proposed by Bothma and Cant (2011), who found that, although the academics whom they interviewed overwhelmingly supported the idea of an LMS, only a few actually used it. In other words academics may recognise its value in supporting students' learning, but do not engage with it themselves: 'a "disconnect" exists between what lecturers believe is an important learning technology and their day-to-day practices' (p. 382). Furthermore, McGill and Hobbs (2008) suggest that, since the LMS is a learning environment, students may feel it has a greater impact on their learning than teachers feel it has on their teaching. They also suggest that staff have a more complex relationship with the LMS than students do, since they have to develop the learning materials and facilitate the learning activities undertaken by the students in the LMS.

Another reason for the patchiness in academics' use of the LMS in some institutions is in part a function of the principle of academic autonomy and an opt-in model of engagement (Dutton, Cheong & Park, 2004). This may be exacerbated in research-intensive universities, where research is privileged over teaching (Masterman, 2016).

However, the principal barriers to academics' engagement with the LMS remain those of time, acceptance of technology and lack of support (Bothma & Cant, 2011; Walker et al., 2016; Rienties, Giesbers, Lygo-Baker, Ma & Rees, 2016). Indeed, for Cook and Obexer (2014), 'investment in staff capability building is the most important cornerstone of the successful use of digital technologies in learning and teaching' (p. 73), with Dutton et al. (2004) reminding us that training needs to go beyond the mere features of the LMS. Bothma and Cant (2011) suggest additional ways to motivate academics' use of the LMS, including helping them to see the benefits, adopting a more managed approach to its use at the department level, establishing departmental mentoring programmes and including LMS use as a criterion in academics' performance appraisals.

Yet, none of the approaches listed above addresses the specific problem of consistency in academics' use of the LMS. This is tackled by Reed and Watmough (2015) and Varga-Atkins (2016) in their studies relating to minimum standards, or baselines, for LMS use. Many of these standards currently 'focus on administrative tasks and supportive information, rather than factors that necessarily enhance learning and teaching' (Reed & Watmough, 2015, p. 72) and/or 'stipulate to staff the required or recommended course information and content to be provided for students' (Varga-Atkins, 2016); however, others additionally contain guidelines on the visual presentation of material (e.g. UCL, 2016). Currently, though, the use of baselines is less widespread in Russell Group institutions than in universities as a whole (Walker et al., 2016).

The second approach to consistency, and the one addressed in the current paper, is the use of LMS templates, intended as 'partially built online space[s] to enable lecturers or tutors to "get started" quickly' and to provide students with a more structured and consistent learning experience (Fresen, Hill & Geng, 2014). Fresen and colleagues envisage a set of templates for different pedagogic purposes, such as tutorials, lecture series and assessment. In principle, all the teacher should need to do is to populate the template with 'the teaching and learning content – the body of knowledge that constitutes the core materials and activities in the course.' Importantly, a template should be 'practical, easy to understand and useful to academic staff before, or even without, support from learning technologists.' That said, Fresen et al. emphasise that a template must be accompanied with guidance on how to modify and implement it, since the 'organic interplay between pedagogical dimensions and course site properties' gives an academic choice over the way the content is presented within the template. Thus, a template is seen to act as a starting-point, not as a constraint. This is the perspective adopted by the project team in the work described in the present paper.

Genesis of the WISE project

A member of the prestigious Russell Group, the University of Oxford is characterised by a distinctive model of individual and small-group teaching, and by a devolved model of management and decision-making. In relation to TEL in general and to the LMS in particular, this means that:

- teaching competes with research for an individual academic's priorities, and so administrative staff are often responsible for maintaining the resources on LMS sites;
- small-group teaching makes the role of the LMS less apparent in the view of some academics;
- the principle of academic autonomy is perceived to militate against setting a LMS baseline.

The institutional LMS, WebLearn, is based on the open source Sakai platform, which is maintained by a community of developers based in institutions around the world (https://www.sakaiproject.org), including the development team responsible for WebLearn at Oxford. The developers in each institution can customise the tools within Sakai according to their local requirements; customisations that are considered to be of benefit to the community as a whole may subsequently be incorporated into the core Sakai platform.

Sakai was selected for Oxford's LMS both for its customisability and because its functionality supports the University's ethos and accepted practices. For example, the user management features have been modified to support devolved system administration and to allow students to access courses other than their own (reflecting the principle of openness within the University) (Lee, 2008). WebLearn users are supported by two learning technologists; a substantial online collection of guidance is provided; and a user group (comprising primarily administrative staff) meets termly. Because TEL support falls within the central IT services department, WebLearn has been less fully integrated into professional development programmes for academics than it might otherwise have been.

Internal research conducted during 2012 and 2013 (Geng, Fresen & Wild, 2013) indicated that student satisfaction was high where individual departments had paid attention to the design and maintenance of their WebLearn sites. However, in many departments the devolution of responsibility for site maintenance to administrative staff – often with little technical knowledge – together with the 'maverick' creation of sub-sites by those academics who chose to engage with WebLearn, had resulted in inconsistencies of all four types listed in the literature survey above. For example, the data showed that students taking courses in two departments found variations between them in WebLearn use; some lecturers uploaded all their lecture notes to WebLearn and others not at all; individual lecturers were inconsistent in uploading their materials; and timetables were made available sometimes through the WebLearn Calendar tool and sometimes as PDF files. Students also highlighted the importance of clarity and consistency, not only in site structure but also in the layout of materials. They expressed a preference to access their learning materials week by week, instead of having to access them through a menu of tools.

The inconsistent use of WebLearn, coupled with issues relating to its usability in general and with a desire to encourage academics to treat it as more than just a repository of learning materials, provided the motivation for the WebLearn Improved Student Experience (WISE) project in 2015–16. The overall goals were 1) to increase the uptake and optimise the use of WebLearn across the University to support teaching and learning, and 2) to increase student and staff satisfaction with WebLearn. These goals were to be achieved through improving the usability of WebLearn tools, and the structure and visual design of WebLearn sites.

Given the tiny number of learning technologists supporting WebLearn, departments wishing to restructure and redesign their sites in the future would need to be able to do much of the work either on their own, or with minimal individual support from the central team. Therefore, a core activity of the project was to develop a self-help support package encapsulating templates and accompanying guidance on best practice, as recommended by Fresen et al. (2014).

This paper reports work on developing the support package; work relating to usability is described in Laurent, Fresen and Burholt (in press).

The 'WISE' approach

Developing the desired support package entailed working intensively with a number of academic departments in order to broaden our understanding of their educational needs and the context in which they operated *vis-à-vis* WebLearn in terms of key stakeholders, their capabilities, and the enabling factors and constraints at play. From experience, we knew that we would be working largely with administrative staff; nevertheless, we aimed to engage directly with academics too.

For the purposes of the project, the central team of WebLearn learning technologists was augmented to four; in addition, a project manager was appointed who also served as the project evaluator. Over the period May 2015–October 2016 we collaborated with 19 departments across the University to redesign their existing WebLearn sites or to design new ones.

Most of the departments were recruited through an email to the WebLearn user group. They represented a wide range of disciplines and all course types: undergraduate, campus-based taught postgraduate, blended taught postgraduate and doctoral training. The size and complexity of the WebLearn sites in different units varied. The extent of work ranged from a simple revamp of a department's top-level page(s) to a complete restructuring of the site hierarchy and extensive use of WebLearn's Lessons tool. A few departments created brand new WebLearn sites from scratch.

Departments joined the project and finished at different times, which allowed us to refine our *modus operandi* and outputs progressively through 19 iterations. Work with each department started with an initial meeting, and then proceeded through a five-stage cycle: requirements gathering for the new site structure, prototyping (customising the templates), building and populating the site, launching it, and evaluating its usability with students. Ideally, the usability evaluations would have preceded launch; however, the building phase tended to take place during the vacation (when students were away from the University), ready for launch at the start of the next term. Even so, conducting evaluations on live sites did not preclude minor adjustments in response to students' feedback.

The WebLearn Lessons tool was central to the technical aspects of the work, in order to address head-on students' complaints about the difficulty of finding their learning materials. It was used to underpin the site templates and to encourage departments to provide students with the structured pathway that students desired (Geng et al., 2013), including content such as lecture slides, readings, links to web pages and audio/video clips, and activities such as discussion forums and tests.

Developing the 'WISE' support package

The iterative way of working enabled us progressively to refine the artefacts that were intended to comprise the support package: four templates for sites, and the 'best practice' guidelines. The templates were intended to provide a starting-point for the development (or redevelopment) of WebLearn sites, to encourage consistency of site structure and layout across the University, and to reduce planning time and the learning curve for academics using them. In contrast to Fresen et al. (2014), the templates were designed with a focus on navigability rather than pedagogy and offered a hierarchical structure:

- departmental site: 'landing page' for department-wide materials and information;
- programme site: for an undergraduate or postgraduate programme of study;
- course site: for a single course or module;
- tutor site: to present teaching materials and activities under the control of an individual academic.

It was not possible to remove the tool-oriented navigation menu on the left side of the WebLearn window, which is a standard feature of the platform. Early in the project, one department requested a layout using 'boxes' in the main window to provide a more user-friendly way to access resources and learning activities. The 'box' design was taken up by subsequent participating departments and became integral to the templates (Figure 1).

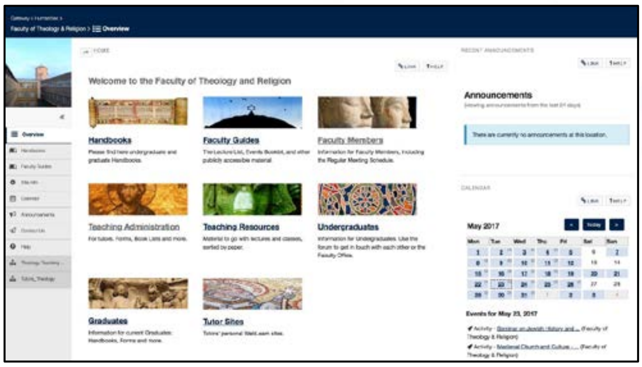

Figure 9: A WebLearn site redesigned from a template, showing the standard tool-oriented menu (on the left) and the 'box' design introduced in the WISE project to improve usability

We developed the 'best practice' guidelines from our evolving experience with the departments, but finalised them only after the end of the project. The guidelines included advice on creating sites from the templates, using the Lessons tool, and good practice in web page layout and presentation of content, together with pre-existing advice on copyright and the use of images. They were made available on a WebLearn site developed using the Lessons tool.

Developing the templates entailed software changes to the WebLearn Lessons tool over the course of the project, which were made by the WebLearn development team. This resulted in a temporary slight disadvantage to the earlier participants, who missed the benefits of later enhancements. However, the changes were subsequently incorporated into the core Sakai platform. An upgrade of the Sakai platform and, hence, of WebLearn in September 2016 thus harmonised the Lessons tool functionality for all participants.

Evaluating the WISE project: compilation of an innovation history

To evaluate the WISE project as a whole, we formulated three questions:

1. To what extent have the new templates and the use of the Lessons tool contributed to greater consistency in students' experience of WebLearn?
2. Which are the key stakeholder groups involved in the redesign of departmental WebLearn sites, and what are the relationships between them?
3. What is needed to ensure the sustainability of the project for a) the participating departments and b) departments wishing to make use of the support package in future?

To address these questions, we sought a method that would allow us to identify the common factors across the experience of the participating departments that are conducive to the successful redesign of WebLearn sites and, conversely, the factors that can impede it. The approach adopted was a modification of Innovation Histories: 'a method for recording and reflecting on an innovation process' (Douthwaite & Ashby, 2005, p.1). Participants in an innovation draw on their recollections and on project documents in order to build a collective narrative of events: the innovation history. This activity 'stimulates discussion, reflection and learning amongst stakeholders' (p. 1), and the lessons thereby extracted are incorporated into future planning.

The innovation history is compiled from two intermediate artefacts: a timeline of events and an actor network matrix (which can be converted into a network map to aid visualisation). Normally, an actor network matrix consists of individual actors. Because of the iterative format of our work (i.e. a series of 19 cycles within an overarching chronology), it was appropriate to include stakeholder groups as well. As a result, the actor network matrix comprised the WISE team, the WebLearn development team, administrative staff, academic staff, head of department, departmental teaching and learning committee, students, IT support staff and the departmental WebLearn coordinator. Participants were asked to describe their relationships with the other stakeholder groups in their department and to score each one on a scale from 0 ('not relevant') to 4 ('crucial'). An additional score, 4X, was available to denote relationships that were 'crucial, but missing' (Douthwaite & Ashby, 2015).

As an artefact, the innovation history is split into three columns: a narrative of events, direct quotations or paraphrases of participants' comments on individual events, and reflections on individual events by the project team. For clarity, the printed page is laid out so that these three categories are clearly distinguishable from each other (Figure 2).

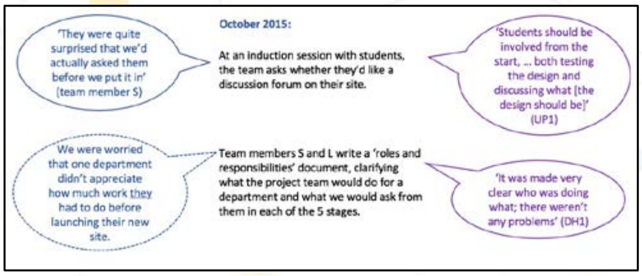

Figure 10: Extract from the innovation history. Comments (solid outlines) and reflections (dotted outlines) by the project team are on the left of the narrative; quotations from participants are on the right. Participant codes are explained in the main text of this section

Ideally, the innovation history is created through direct collaboration between the project team and the participants; however, the difficulty in bringing busy staff together meant that we gathered their contributions through interviews with 13 participants instead. Since the participants had experience of their part of the project only, they were interviewed in relation to their own individual timelines. The overarching timeline was created by the project team; contributions from the interviewees were slotted in as appropriate. Table 1 summarises the evaluation process.

Table 1: Evaluating the WISE project: activities and outputs

Date	Activity	Outputs
17/0616	Team workshop 1	Draft timeline
19/07/16	Team workshop 2	Stakeholder group matrix: team perspective
26/07/16	Team meeting	Interview questions
21/09/16–03/11/16	Interviews	Individual stakeholder group analyses; contributions to innovation history
Oct 2016	Preliminary analysis	Provisional key findings from data; collated stakeholder group matrix and network map
24/10/16	Team workshop 3	Finalised timeline; agreement on emergent findings
Nov–Dec 2016	Detailed analysis	Finalised innovation history; evaluation report

The project evaluator conducted five interviews with individuals and four with pairs. Interviewees were nominated by the other members of the project team and came from a range of disciplines. Two interviewees had academic posts, nine had administrative posts, one worked in IT support and one was a student. The interviews lasted 35–60 minutes and primarily addressed these topics:

- the interviewee's experience of collaboration with the WISE team;

- construction of the stakeholder group matrix from the interviewee's perspective;
- the major changes made to the site, including the use of the Lessons tool;
- feedback from colleagues about the new site;
- the knowledge and skills that the interviewee would consider necessary for others to design, or redesign, their WebLearn sites without the benefit of such intensive support.

Approval for the interviews was received from the University's Central Ethics Committee.

In the sections that follow, interviewees are identified by three-character codes denoting their role (**A**cademic, a**D**ministrator, I**T** support, st**U**dent), the division of the University in which they work (**H**umanities; **S**ocial Sciences; Maths, **P**hysical & Life Sciences, **C**ontinuing Education) and a sequential number.

Evaluation findings

The project evaluator conducted a provisional analysis of the interview data and presented the preliminary findings for discussion in the third team workshop (Table 1). Once these findings had been agreed, a more in-depth analysis took place. This section reports the outcome of the in-depth analysis and is organised according to the three evaluation questions.

1. Contribution of the templates and Lessons tool to promoting consistency

Qualitative data from the interviews indicate a positive transformation of existing WebLearn sites as a result of engaging with the WISE team. For example, AH1 described her department's previous site as 'like opening up a cupboard and finding out that everything's just been jammed in everywhere. You don't want to go back and look again.' After the redesign, her cupboard '[has] nice ordered shelves, and everything makes sense.' Another academic, who did not take part in the evaluation but permitted her feedback to be shared publicly, commented that her department's new design would ensure consistency across courses. A student, who likewise allowed their informal feedback to be reported, expressed the desire for all module sites to be structured in the same way as the redesigned site.

The usability evaluations reported by Laurent et al. (in press) confirmed that students find navigation more efficient where the design uses a clear and attractive layout with boxes and images on the main page, and minimises the use of tools on the left-hand navigation menu (as shown in Figure 1). However, the team also discovered limitations in the usability of some areas of the underlying Sakai platform – particularly navigation – that could not be modified locally by the WebLearn developers within the scope of the WISE project.

Although the Lessons tool appears to have been central in implementing consistency in the visual design and structure of WebLearn sites, it is not easy for site maintainers to set up. The interviewees did not comment on this, since in many cases the WebLearn team created the basic Lessons pages for them and they only had to add the content. It was only in the team evaluation workshops that the usability issues in the Lessons tool came to the fore, including the need to edit HTML code in order to change the number of boxes. One team member commented: 'It's a shame, because the power of the Lessons tool and the power of Sakai sometimes get pushed aside amid the challenge of doing the site layouts and the structure.'

2. Key stakeholder groups

The quantitative data obtained from the stakeholder network analysis were somewhat fragmented. We were unable to recruit interviewees from all nine stakeholder groups identified, and those whom we did interview had not necessarily interacted with representatives of all the other eight groups in their departments. Data reported in this section are, therefore, largely qualitative and concentrate on the stakeholder groups that featured the most prominently in interviewees' oral responses.

The interviews confirmed what we already knew: that the key users of Oxford's LMS are administrative staff. Reasons for academics' lack of involvement include time (DS1), dislike or fear of technology (DH1, DP1) and a sense that uploading resources is 'an admin job' (DS2). The downsides of the reliance on administrative staff to maintain WebLearn sites include low technical skills ('We're all just administrators, aren't we? … we have no real … understanding of the technology': DS2), a high turnover of staff (DP1), and lack of influence over the academics to engage with WebLearn themselves ('if people don't take it up there's not much you can do': DS1).

Although academics' lack of involvement in WISE was 'the one big disappointment' (DS1) for some interviewees, not all administrators deemed this relationship 'crucial but missing' in the actor network matrix. Indeed, some departmental administrators (e.g. DH1) reported that they purposely prevent academics from accessing WebLearn. This is to minimise the creation of individual sub-sites and pages that had contributed the chaotic site structures which, in turn, triggered the department's decision to participate in WISE.

In spite of the constraints, we were able to collaborate with a small number of enthusiastic academics. For example, AH1 had not used an LMS before, but was familiar with many websites and found the Lessons tool 'the most sensible way to divide things up'. She was able to benefit from the WISE team's redesign of the

WebLearn site for a similar discipline; even so, she had to devote a lot of personal time to the work.

Although the student experience was the *raison d'être* of the WISE project, for reasons of timing the project was carried out with students largely on the periphery until the fourth stage in the cycle (usability evaluation). Exceptions were DH1, AH1 and DP2, who consulted students in earlier stages. Overall, however, the situation was not ideal: 'Students should be involved from the start, … both testing the design and discussing … "Is this a good idea? Or is it just a good idea in theory, but in practice nobody's going to use it?"' (UP1). DH2 commented: 'if the students are really pushing it … it's going to have a lot more weight than just us admin team saying "Well, we think you should do this."'

The final relationship about which interviewees spoke in detail was the one between themselves and the WISE project team. The extent and nature of this collaboration varied. One department was largely self-reliant, involving the WISE team only to ensure that what they were doing already constituted 'best practice' (DC1). At the other end of the spectrum, smaller departments, where administrative staff had no local technical support, needed extensive hand-holding (e.g. DS2). In terms of communication, interviewees generally spoke appreciatively. For example, DS3 'felt we had a lot of opportunity to get across what we needed,' and DP2 appreciated the team's sharing of insights into students' needs and preferences: 'we were … able to … go "Ah, OK, so we can exploit this knowledge,"… and I thought that was really good.' We also relied on the goodwill of departments when software bugs were discovered, especially early in the project (e.g. DH1, DP1). In a few cases, relationships became temporarily strained during technical problems after launch (DS2, DP1); we took prompt action to resolve matters.

3. Sustainability

As interviewee DS1 commented, the challenge facing participants was to 'move from having a good job done in WISE to having WebLearn really well used across the department.' However, he reported interest in the redesigned sites among only a minority of academics in his department. In contrast, DH1, TH1 and AH1 reported that academics in their departments had reacted with enthusiasm. Initially, some academics continued to hand over their materials for uploading to WebLearn; TH1 and AH1 responded by writing 'how to' guides and providing one-to-one training respectively, which resulted in more academics uploading content themselves. DH1 observed that academics who were previously reluctant to engage with WebLearn themselves remained reluctant, but she felt that the natural turnover of academics would lead to greater interest in use of the LMS over time.

Maintaining consistency in the use of the redesigned sites would also depend on adherence to new ways of working. We became aware, through the interviews and through communications with other participants, of staff disregarding new editorial guidelines on visual design (DH1), disrupting the new site structure (AH1) and reverting to a tool-based access to learning materials. Commenting on the third example, a project team member said: 'It's the path of least resistance … setting up a folder in Resources takes one minute. Figuring out how to set up a new Lessons tool might take longer.'

The long-term sustainability of the work done by the WISE project would depend on the uptake and successful implementation of the support package in the wider University. In this respect, interviewees felt that staff responsible would need to be 'tech-savvy' (DP1) to some extent, with an understanding of file organisation (AH1), hyperlinks (AH1) and the WYSIWIG editor (DH1). Even so, DP1 felt 'you would need some support even to adapt the templates … and just basic stuff of knowing where to plug in different bits and pieces, and how it actually functions behind the scenes.' On the 'people' side, DS1 commented: 'you'd have to find a champion, an evangelist … who was enthusiastic about it and prepared to take on as much of the work as needed to be done, and to make it visible then and try to enthuse people.' The people who most need to be enthused, in TH1's view, are the academics: 'sell the idea … that it's going to be easier for them to use, it's going to save them so much more time … and that it will help the students in that they'll be able to find all the material.'

Discussion

WISE was an exploratory, developmental project in a real-life setting, which delivered evolving outputs to a relatively small number of participating departments over a limited period. As such, it could not be expected to achieve outcomes measured using tests of significance, all the more so in an institution which permits individual academics considerable latitude in the decisions they make about their teaching.

The primary goal of increased uptake of WebLearn across the University proved unattainable within the timescale of the WISE project. Nevertheless, the project achieved modest results in terms of more consistent, and usable, WebLearn sites through the templates and 'best practice' guidelines – the second of the two project goals. In addition, contributing the software modifications in the Lessons tool to the core Sakai code has automatically extended the reach of some of the technical benefits, not only to other departments in Oxford, but also to the world-wide Sakai community.

Although the support package brought improved consistency in terms of visual presentation and navigation, the usability of the underlying Sakai platform reported by Laurent et al. (in press) is of concern. Usability is important because it can determine whether or not an individual academic is willing to persist with a tool after first use – and sustained, regular use by teaching staff is a key aspect of a consistent student experience in the LMS (Cook & Obexer, 2014). Unfortunately, in the case of an open source platform such as Sakai, where tools are developed by different parties, the user interface may be inconsistent between tools. This can make it difficult for users who do not understand – and should not need to understand – how the overall LMS has been put together. Consistency in the user interface also applies between the LMS and the other tools and websites with which users are familiar. In the words of one WISE team member, the LMS should 'look like the thing they were using last night … like Google Docs', which for participants such as DS1 and DH1 had not previously been the case.

In relation to the human dimension of innovation, Douthwaite and Ashby (2005) characterise an innovation as 'an interactive and experiential learning process mitigated by social networks' (p. 4). This characterisation is borne out in the analysis of the role of different stakeholder groups in the WISE project. It also resonates with analytical frameworks that have been employed in other research into LMS use, such as the social shaping of technology (by Dutton et al., 2004), communities of practice (by Ellaway, Dewhurst & Macleod, 2004) and Activity Theory (by Varga-Atkins, 2016). In the words of Ellaway et al., 'all VLE functions exist in a "blended" relationship with human activities' (2004, p. 127).

The devolution of management of WebLearn sites to individual departments, coupled with the freedom of individual academics to decide whether or not to engage with WebLearn directly, has resulted in frequent mismatches between the designated (job) role of an individual member of staff and their actual role in relation to the LMS. It is true that we worked with non-academic staff who had a genuine interest in encouraging academics to use WebLearn as more than just a document repository (e.g. DS1, TH1). Even so, our experience indicates that, in a devolved institution such as Oxford, the central LMS support team needs to be supplemented by learning technologists working locally in the University's academic departments. This view is now shared at a strategic level (University of Oxford, 2016).

Inconsistencies in the use of WebLearn within and between departments invite a further human solution in addition to the support package already developed: namely, a consensus on a baseline for educational provision in the LMS (as per Reed & Watmough, 2015). Indeed, the potential for such a baseline was discussed with academics in a separate study that ran concurrently with WISE (Masterman, 2015); the data indicated that a baseline could be implemented in a manner compatible with the institutional principles of academic autonomy and devolved decision-making.

Reference to institutional principles prompts consideration of a further factor: institutional culture. Digital education tools such as the LMS should both support an institution's model of teaching and learning and reflect (or embody) its core values and cultural practices (Lee, 2008). While the selection of Sakai as the platform underlying WebLearn made possible the enactment of Oxford's ethos and accepted practices through the LMS, the work of the WISE project suggests that this may have come at some cost: namely, sub-optimal usability and an inconsistent experience for students. The challenge for the future is to achieve a balance between, on the one hand, the flexibility needed to support a devolved model of administration and the needs and preferences of different departments and academics, and on the other hand, the constraints that may be desirable for the sake of usability and consistency.

Conclusion

Consistency – or the lack of it – in use of the LMS in university teaching is a topic of concern in the UK (Reed & Watmough, 2015), if not elsewhere. However, as yet it is under-represented in the peer-reviewed literature. This paper has offered a contribution to a solution in the form of a self-help package of templates (with supporting explanatory documentation) and best-practice guidelines that was developed iteratively in close conjunction with stakeholders from 19 academic departments.

The outcome of any innovation hinges not only on the artefacts that it delivers, but on the sociocultural context in which the work is carried out: the ethos and practices of the community which it is intended to benefit, the optimal alignment of roles and capabilities within that community, and the properties (or attributes) of the tools and technologies at the community's disposal. An appreciation of this context, and of the tensions between its elements that need to be balanced in order for the innovation to take permanent hold, may benefit from analysis through the lens of theory and evaluation frameworks such as Innovation Histories.

Notes

1. In the UK, the LMS is generally referred to as the virtual learning environment (VLE).
2. The term 'department' is used in this paper as an umbrella term for all academic units within a university: e.g. faculties, schools and institutes, as well as departments.

Acknowledgements

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References

Bothma, C.H., & Cant, M.C. (2011). Adopting learning technologies: from belief to practice. *Educational Studies*, *37*, 375-389. https://dx.doi.org/10.1080/03055698.2010.511697

Cook, R., & Obexer, R. (2014). A time for everything: Reviewing an institution's virtual learning environment. In B. Hegarty, J. McDonald, & S.-K. Loke (Eds.), *Rhetoric and reality: critical perspectives on educational technology. Proceedings Ascilite Dunedin 2014* (pp. 69-76).

Douthwaite, B., & Ashby, J. (2005). *Innovation histories: A method for learning from experience (ILAC Brief 5)*. N.p.: Institutional Learning and Change Initiative. Retrieved from http://ageconsearch.umn.edu/bitstream/52515/2/ILAC_Brief05_Histories.pdf

Dutton, W.H., Cheong, P.H., & Park, N. (2004). The social shaping of a virtual learning environment: The case of a university-wide course management system. *Electronic Journal of e-Learning*, *2,* 70–81. Retrieved from http://www.ejel.org/volume2/issue1/p70

Ellaway, R., Dewhurst, D., & McLeod, H. (2004). Evaluating a virtual learning environment in the context of its community of practice. *Research in Learning Technology, 12*, 125–145. https://doi.org/10.1080/0968776042000216192

Fresen, J., Hill, R.K., & Geng, F. (2014). A collection of suggested electronic course templates for use in higher education. *Research in Learning Technology, 22*. http://dx.doi.org/10.3402/rlt.v22.21669

Geng, F., Fresen, J., & Wild, J. (2013). *WebLearn Student Experience Project (WLSE): Requirements gathering report*. Oxford: University of Oxford. Retrieved from https://weblearn.ox.ac.uk/x/NpGr1w

Laurent, X., Burholt, S., & Fresen, J. (in press). Usability methodology and testing for a virtual learning environment. *International Journal on E-Learning*.

Lee, S.D. (2008). The gates are shut: Technical and cultural barriers to open education. In T. Iiyoshi and M.S.V. Kumar (Eds.), *Opening up education: the collective advancement of education through open technology, open content, and open knowledge* (pp. 47–59). Cambridge, MA: The MIT Press. Retrieved from https://mitpress.mit.edu/sites/default/files/9780262515016_Open_Access_Edition.pdf

Masterman, E. (2016). Bringing open educational practice to a research-intensive university: Prospects and challenges. *The Electronic Journal of e-Learning, 14,* 31-42. Retrieved from http://www.ejel.org/volume14/issue1/p31

Masterman, L. (2015). *DIGE 2: Student digital experience project 2. Research report.* Oxford: University of Oxford (not publicly available).

McGill, T.J., & Hobbs, V.J. (2008). How students and instructors using a virtual learning environment perceive the fit between technology and task. *Journal of Computer Assisted Learning, 24*, 191–202. https://doi.org/10.1111/j.1365-2729.2007.00253.x

Reed, P., & Watmough, S. (2015). Hygiene factors: Using VLE minimum standards to avoid student dissatisfaction. *E-Learning and Digital Media, 12*, 68–89. https://doi.org/10.1177/2042753014558379

Rienties, B., Giesbers, B., Lygo-Baker, S., Ma, H.-W. S., & Rees R. (2016) Why some teachers easily learn to use a new virtual learning environment: A technology acceptance perspective, *Interactive Learning Environments, 24*, 539-552. https://dx.doi.org/10.1080/10494820.2014.881394

UCL (2016). *UCL e-learning baseline: Enhancing e-learning provision*. London: University College London. Retrieved from https://wiki.ucl.ac.uk/display/UCLELearning/UCL+E-Learning+Baseline%3A+enhancing+e-learning+provision

University of Oxford (2016). *Digital education strategy*. Retrieved from http://www.digitaleducation.ox.ac.uk/sites/default/files/digitaleducation/documents/media/Digital%20Education%20Strategy%202016-2020%20%28final%29.pdf

Varga-Atkins, T. (2016). A study of the role of a technology-enhanced learning implementation group in mediating an institutional VLE minimum standards policy. *Research in Learning Technology, 24*. https://dx.doi.org/10.3402/rlt.v24.32815

Walker, R., Voce, J., Swift, E., Ahmed, J., Jenkins, J., & Vincent, P. (2016). *2016 Survey of technology enhanced learning for higher education in the UK*. Oxford: Universities and Colleges Information Systems Association. Retrieved from https://www.ucisa.ac.uk/-/media/files/publications/surveys/tel%20survey%202016_nov16.ashx

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A framework for program wide curriculum transformation

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Designing and delivering higher education programs in a global climate of constant change, technological advances and uncertain futures leads to the need for curriculum transformation practices that are innovative and responsive. This paper describes a university-wide approach to developing a framework for program level transformation that is strengths-based, data-informed and design-led. A strengths-based approach builds on good practice, creating a space that is positive and forward looking. Data-informed practice and the inclusion of data wranglers on the project allowed for conversations about the known, unknowns and desirable directions to take place and inform directions. Design-led practices introduced design thinking principles such a building empathy and co-design with students, alumni and industry. The emergent framework has three key stages: vision, design and build. The vision stage focuses on the program team, its students, industry and desired direction for transformation. The design stage focuses on defining challenges, ideating, co-designing and creating a plan for development. The build stage uses a rapid prototyping and iterative approach to development that incorporates user testing early in the stage. The project has delivered a framework for program level transformation and innovation and has shown that a strengths-based approach that is data informed and engages with students as co-designers has the capacity to unite teams, inform program visions and allow for innovative practices to emerge. Taking a learner experience approach to design also highlighted the value in engaging students and industry in curriculum design from the start of the process rather than simply as end users.

Introduction

Technological advances, globalisation of education, policy changes and increased pressures on the higher education institutions to be more competitive and responsive to user demands are fundamentally changing the learning and teaching landscape (Craig, 2015; Evans-Greenwood, O'Leary & Williams, 2015). As well as challenges, change brings with it opportunities and in this context, the opportunity to enhance the learning and teaching of programs emerges as pivotal to the success of any university. Rethinking the curriculum design is not new (King, 1993; Raban, 2007) but what is emerging is the practice of thinking more broadly about the influences and approaches used when designing curriculum. As will be shown in this paper, program design needs to be a team activity, as shown by Dempster, Benfield & Francis (2012) that goes beyond the academics and accrediting bodies but incorporates ideas from areas such as learning analytics, design thinking, appreciative enquiry and user experience design (Hokanson & Gibbons, 2014). In order for this change to have broad, sustainable and transformational impact, it needs to occur at the institutional level (Beetham, 2012).

A key question that emerges from this need is, *how can we engage in program level innovation that addresses these demands?*

To being with, we need to unpack what we mean by program level innovation so we can determine the main elements that need to be considered. To innovate as a program is to go beyond 'business as usual' and look at the program from a perspective that will potentially enhance its design and delivery - having already established the need for change.

As a starting point to this work, a project team was established from across a dual-sector Australian university, made up of learning designers, academics, support services and student representatives. Added to this, an external consultant with expertise in learner experience (LX) design was engaged. The project was termed the Learning and Teaching Innovation (LTi) initiative. In order to create an opportunity for university wide impact and change, it was important that from the onset groups from across the university were included. Collaboration and a team based approach is not only a design thinking principle (Burdick & Wills, 2011) but one that is valued in many organisations including higher education. A report resulting from a five-year study on university transformation by the UK Joint Information Systems Committee, JISC (2008) recommends that enhanced collaboration and engagement, including within-team collaboration, engagement with industry and sharing of design practice, was important in achieving transformative practice.

Project approach

Strengths-based

As a way to foster collaboration, a strengths-based approach was taken. It involves working from participants' pre-existing strengths in their capacities as individuals and focusing on this rather than using a deficit model of identifying weaknesses. Such an approach is more likely to build trust, empathy and enhance the capacity to engage and collaborate (Linley, 2008). This approach was important to the project, as we wanted to create an environment of positivity with a willingness to contribute and engage with the ideas being presented through this project.

Data-informed

Program data provided a starting point from which to discuss the program. This included student demographics and cohort data, student feedback, academic performance, graduate outcomes, mode of delivery, and LMS activity. To do this, data wranglers (Clow, 2014) were used to present that data in an aggregated and visual way, so that it could be used as part of the conversation. It is important to make the distinction between data-led and data-informed, as data available in higher education is often only part of the story and open to much speculation and interpretation. To help facilitate the engagement with the data, concerns about data reliability and student response rates were addressed by the data wranglers. The data presented to the teams was used to identify strengths, trends and raise questions as well as provide some evidence to support directions that may be taken by the program team (Schwartz & Gurung, 2012).

During the data gathering stage, students form each program were interviewed and a set of student 'profiles' created for each program. The interviews were conducted and the profiles were created by user experience (UX) designers who were independent from the program teams (Garrett, 2010). The interview data was used to generate profiles that were an aggregate from the interviewees and 'personas' given to these. This way it felt like the program team could talk about 'real' students and how program design could impact their personal learning journeys.

Having current student profiles added to the mix of data and information about the program and were used throughout the planning stages. Again, these profiles were a way to build a picture and allow independent starting points for conversations to be had about learning and teaching practices without having to identify individual staff or students.

Design-led

Taking a design-led approach enabled program teams to being to think about their program from a challenge or question identification starting point. This is not a traditional way of looking at program development, the starting point often resides with content and learning outcomes, such as is demonstrated by Moon (2002). The challenge here was to take a different lens, one that is non-linear making trial and error a key part of the process (Cassim, 2013; Fischer, 2011).

Identifying challenges and agreeing on ones to address was part of the process. Taking these challenges and addressing them in a cyclical, iterative process then allowed the design to drive the process rather than waiting until everything was finished before we could determine if the solution was appropriate. This process allowed the program team and the students supporting them to engage in design thinking and develop these skills, an approach illustrated by Razzou and Shute (2012). Figure 1, demonstrates this design thinking approach through the double diamond model (Design Council, 2005). The first diamond is all about discovery, in this case the data and profiles as well as the interpretation of these by the program team, and the second diamond opens up possibilities to each challenge identified with design-led approach to building rather than a more traditional one solution per challenge approach to learning design.

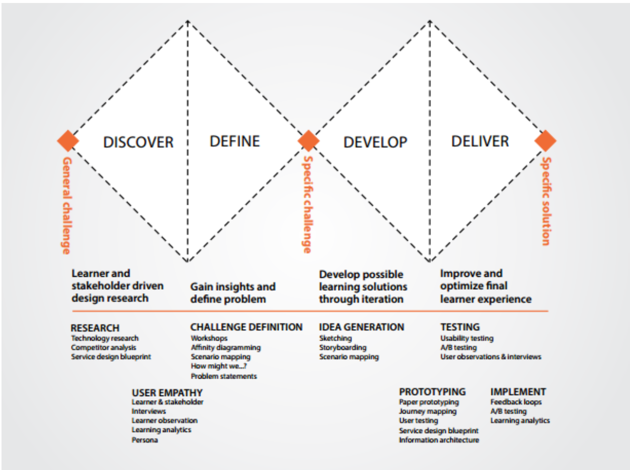

Figure 1: Double diamond design model

Learner experience (LX) design

Design thinking provided the backbone for the approach, but getting into the detail of ultimately enhancing the learning experience called for more targeted work. This came in the form of learner experience (LX) design. An emergent field, LX design borrows from the fields of user experience design (Law, Roto, Hassenzahl, Vermeeren &

Kort, 2009) and service design (Stickdorn, Schneider, Andrews & Lawrence, 2011) merging them with learning design to create a powerful way of designing learning experiences. In brief, user experience design focuses on users' perceptions and responses to their interaction with a product, and service design focuses on the design of organisational services. On their own these design methods do not address the complexity of higher education, but combined and with the addition of learning design, we see the case for the development of the LX design branch. The student profiles created early in the project were an essential part of the LX design approach as was the iterative process for building solutions.

The project participants

The LTi project was a pilot for the university and had a six-month time frame. During this time, the project was scoped, volunteer program teams from across the main disciples of the university spanning both the higher education and Vocational Education sectors (the university is dual sector) were identified. In total, nine programs took part in this pilot.

The framework

A framework capturing the above approach was generated early in the project to show how all the pieces of the puzzle came together and to be used as a basic map for program teams to navigate the terrain we were presenting to them. Ownership and understanding of this framework was central to the success, and in order to achieve this, the framework emerged from an initial two-day retreat involving the program leaders, learning designers and support staff. Through a series of design thinking activities led by an external consultant, a framework emerged showing the stages of the project as well as the activities demonstrating the desired innovative approach to program enhancement and development. Figure 2, demonstrates the framework, outlining the three key phases of vision, design and build.

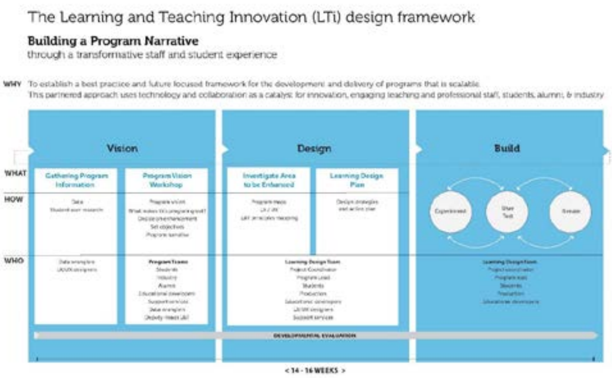

Figure 2: The three-phase LTi framework

Vision phase

The vision phase of the framework was all about getting the program team and stakeholders together, to build a narrative for the program during a one-day 'vision workshop. This was achieved by exploring the questions: what it is that makes this program great and what do we know about the program (from the data and student profiles). This formed a basis for the identification of challenges facing the program. To ensure there were no surprises with the data presentation, data wranglers met with each program manager before sharing this with the wider team. This also ensured that any interpretations made by the wranglers were appropriate and relevant.

The workshop was for the program team (including sessional teaching staff) industry representatives, student and alumni representatives, learning designers and support staff. The external facilitator engaged everyone in activities designed to build empathy within the group, elicit input from all stakeholders and arrive at a number of challenges facing the program. As shown in Figure 1, these are the Discover and Define stages of the first diamond, highlighting the importance of the vision workshops in setting the agenda for each program team.

The most rewarding part of the workshops was the interaction between students, industry and academics. For one discipline, the students took the opportunity to make connections with the industry representatives, an opportunity that they otherwise may not have had. In terms of the input these groups provided to the program team as one participant out it:

When industry came for the [Program Vision] Workshop, they really provided direct input, and that was a good thing, and students provided direct feedback, very open, and the way the program is structured, we looked at a lot of positive things. (Academic/Teacher)

This was not necessarily the case for all nine programs, with some not achieving such positive outcomes due to difficulty and at times reluctance, to invite and engage with external stakeholders. For some there was fear of exposing their vulnerabilities to industry with potential negative consequences. A fear that by the end of the six months may have slowly began to dissipate. This project as well as working to enhance programs from a learning and teaching perspective, also worked to improve the culture of participation and collaboration.

Design phase

In many ways, the design phase was probably the most challenging. This is where the identified challenges were prioritised with the program team and then entered the process of ideation and solution generation. The work was facilitated by learning designers assigned to each program, who themselves may have been grappling with design thinking and LX design processes. Added to this, using students as co-designers was a key part of the process.

Most program team members and learning designers when working with challenges would quickly arrive at a solution and wish to proceed with this, rather than unpacking the challenge further, seeking student input and testing possible scenarios. An example of this was when a program team identified the challenge of first year students not understanding key concepts for application in later years of the degree program. A solution of creating videos about these key concepts was quickly reached by the academics without further examination of the problem. Was this a matter of content? What did the students think? Are videos useful and do they have to be created or can they be curated? These any many more questions needed to be applied to the challenge before a final solution could be reached. In this case the learning designer and the LX facilitator worked with the program team to engage students and seek alternative solutions before a final one was implemented - not videos!

Students as co-designers (Goodyear, 2015) rather than just end user feedback providers was a refreshing way of engaging with the program teams. As Watson (2003) notes, it is important that students be informed about changes made as a result of feedback in order for them to engage more fully with the process. As one academic commented:

> I think [Student Co-Design] is the most innovative part of the project, that idea about hey, why don't we ask students some questions. It's a no-brainer but it's not something that we typically do, particularly at a program level. (Academic/Teacher)

Though the input from the students was valuable and appreciated, the challenge of engaging a broader range of students still exists, and like our challenge with engaging some staff, this is part of the culture change:

> I guess we could have done a better job in reaching a broader student population, because we also have people who will not show up, people who will not do interviews. But we still… I don't think we captured the whole thing. We handpicked the people for the interviews, and the people we invited, or the people who accepted the invites, were a certain type of student, mostly, really good students. So, we might have missed the people who were already happy, compared to the rest, about the program. (Academic/Teacher)

Build phase

The build phase, aligning with the Deliver stage of the double diamond (Fig 2) used a rapid prototyping approach (Chookittikul, Kourik & Maher, 2011) so as to ensure the user feedback could be incorporated during the build. A team of graphic designers, video producers and web developers, together with the other support services of the university were available to support the needs of the program teams during this stage. The LTi project manager and the learning designers had a key role in ensuring timelines were met and appropriate resources were made available to support the various projects.

Community of Practice

Mention has been made of the team of learning designers (or academic developers) who worked with the program teams during the project, but ordinarily worked in different areas of the university (such as Business, Design or Engineering). To facilitate and support this group, a Community of Practice (CoP) was created that brought together the group almost weekly to discuss the project, share experiences, get to know each other as well as engage in professional development. The CoP contributed to the development of resources for the project, discussed strategies to ensure timelines were met and most importantly engaged with colleagues who they otherwise may not have worked with, even though their work was similar. The external LX consultant engaged by the project, also conducted workshops for the CoP to help them engage with often unfamiliar practices of design thinking and LX design.

Evaluation

A developmental evaluation (Patton, 2011) approach was used for the overall evaluation of the project. As argued by (Leonard, Fitzgerald & Riordan, 2016) this approach is well suited to the multi-faceted nature of higher education environments as well as aligning well with design thinking principles. By focusing the evaluation on the process rather than just the end product, we were able to keep adapting the process over the life of the project. As Patton (2011) demonstrates this is not so much a methodology as it is a set of activities that are used to question what is occurring in order to provide direction. So we don't have an evaluation that gives a final verdict on the project but instead one that informs decisions while the project is occurring.

This approach was especially useful for the learning designers and through the CoP they were able to use what was emerging from the evaluation to inform their practice. An example of this was through the development of a service blueprint (Shostack, 1982) for the project. Service blueprints are a visual representation of the service process, in this case all processes that occurred during the project represented in categories of roles and functions as well as being mapped over time. This is represented in Figure 3.

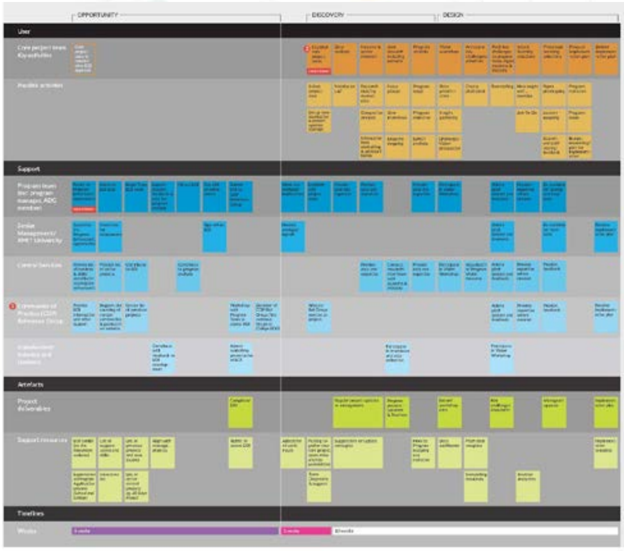

Figure 3: Service Blueprint for the LTi project

As Radnor, Osborne, Kinder & Mutton (2014, p. 410) state:

> Its [blueprint] prime purpose is both to evaluate the position of the service user in the service delivery process managers and to promote user integration and impact at the centre of these processes.

The development of the service blueprint for the LTi project evolved over the duration of the project and was used as way for the project team and the learning designers to evaluate and iterate over time. The outcome here was having a final blueprint as well as applying developmental evaluation to the process.

Conclusion

The LTi project delivered a framework for program level transformation and innovation and has shown that a strengths-based approach that is data informed and engages with students as co-designers has the capacity to unite teams, inform program visions and allow for innovative practices to emerge. The service blueprint produced can be taken as a map for this process to be applied and adapted by future teams.

A process of selecting program teams to engage has been developed and endorsed by the university, as 'readiness' to engage in this process is a key requirement for a program team to engage and transform. As one academic noted:

> I would recommend it [participation in the LTi Project]. The condition that I would put on is that, if you're going to put in for it, you have to be willing to have input and assistance from other people. (Academic/Teacher)

The CoP of learning designers formed during the project, continues to grow and engage with other projects that are university wide. The need for support and development of learning designers as they navigate and support the changing higher education landscape was highlighted by this project. Providing this support enhanced the outcomes and ensured that was learned from this project will continue to be used and embedded in the various discipline groups of the university.

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References

Beetham, H. (2012). *Institutional approaches to curriculum design: Final synthesis report*. JISC.

Burdick, A., & Willis, H. (2011). Digital learning, digital scholarship and design thinking. *Design Studies*, 32(6), 546–556.

Cassim, F. (2013). Hands on, hearts on, minds on: design thinking within an education context. *International Journal of Art & Design Education*, 32(2), 190-202.

Chookittikul, W., Kourik, J. L., & Maher, P.E. (2011). Reducing the Gap between Academia and Industry: The Case for Agile Methods in Thailand. *Eighth International Conference on Information Technology: New Generations,* 239-244.

Clow, D. (2014). Data wranglers: human interpreters to help close the feedback loop. *Proceedings of the Fourth International Conference on Learning Analytics and Knowledge,* 49-53. ACM.

Craig, R. (2015). *College disrupted: The great unbundling of higher education.* New York: Palgrave.

Dempster, J. A., Benfield, G., & Francis, R. (2012). An academic development model for fostering innovation and sharing in curriculum design. *Innovations in Education and Teaching International*. 49(2), 135-147.

Design Council (2005) *The 'Double Diamond' Design Process Model*. Retrieved January 13, 2017, from http://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond

Evans-Greenwood, P., O'Leary, K., & Williams, P. (2015). *The paradigm shift: Redefining education.* Australia: Centre for the Edge.

Fischer, G. (2011). Understanding, fostering, and supporting cultures of participation. *Interactions*, 18 (3), 42-53.

Garrett, J. J. (2010). *Elements of user experience, the: user-centered design for the web and beyond.* Pearson Education.

Goodyear, P. (2015). Teaching as design. *HERDSA Review of Higher Education*, 2, 27-50.

Hokanson, B., & Gibbons, A. (2014). Design in educational technology. *Emergence*, 209(218), 265-267.

King, A. (1993). From sage on the stage to guide on the side. *College Teaching*, 41 (1), 30-35.

Law, E. L. C., Roto, V., Hassenzahl, M., Vermeeren, A. P., & Kort, J. (2009). Understanding, scoping and defining user experience: a survey approach. *In Proceedings of the SIGCHI conference on human factors in computing systems*, 719-728. ACM.

Leonard, S.N., Fitzgerald, R.N. & Riordan, G. (2016). Using developmental evaluation as a design thinking tool for curriculum innovation in professional higher education. *Higher Education Research & Development*, 35 (2), 309-321.

Linley, A. (2008). *Average to A+: Realising strengths in yourself and others.* Coventry, England: CAPP Press.

Patton, M.Q. (2011). *Developmental evaluation: Applying complexity concepts to enhance innovation and use.* New York: Guilford Press.

Raban, C. (2007). Assurance versus enhancement: less is more? *Journal of Further and Higher Education*, 31(1), 77-85.

Radnor, Z., Osborne, S. P., Kinder, T., & Mutton, J. (2014). Operationalizing co-production in public services delivery: The contribution of service blueprinting. *Public Management Review*, 16(3), 402-423.

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? *Review of Educational Research*, 82, 330-348.

Reynolds, M. (2014). Equity-focused developmental evaluation using critical systems thinking, *Evaluation*, 20(1), 75–95.

Schwartz B.M., & Gurung, R.A.R. (2012). *Evidence-based teaching for higher education*. Washington: DC: American Psychological Association.

Shostack, G.L. (1982). How to design a service. *European Journal of Marketing*, 16(1), 49-63.

Stickdorn, M., Schneider, J., Andrews, K., & Lawrence, A. (2011). *This is service design thinking: Basics, tools, cases.* Hoboken, NJ: Wiley.

Watson, S. (2003). Closing the feedback loop: ensuring effective action from student feedback. *Tertiary Education & Management*, 9(2), 145-157.

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Note: All published papers are refereed, having undergone a double-blind peer-review process.

Using threshold concepts about online teaching to support novice online teachers: Designing professional development guidelines to individually assist academic staff (“me”) and collectively guide the institution (“us”)

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As online learning expands across the higher education sector, individual university lecturers are required to take on roles that incorporate responsibilities for designing and teaching online courses. Their growing capacities to fulfil these roles are sometimes supported by professional development (PD) programs within their institutions while some staff engage in staff development activities outside their home institutions. These programs and activities may take place within Communities of Practice (CoPs) while others are conducted on an individual basis. While much research has been undertaken into the field of online teaching and learning, including investigations into the most useful technological tools to incorporate into the design of online courses, the design of PD curricula to support the needs of novice teachers of online courses has not been as extensively explored. This paper reports on the outcomes of an Office for Learning and Teaching (OLT) funded project which purposely set out to identify the threshold concepts about online teaching that university lecturers develop as they engage in both the individual and communal aspects of designing and teaching online courses. The paper explains how the identification of threshold concepts about online teaching informed the development of a set of curriculum guidelines for the PD of novice online teachers. Recommendations for the design of PD for individual teachers (at the “me” level) are provided along with recommendations for the institution (at the “us” level).

Introduction

The professional development (PD) programs and activities offered to individual novice online teachers in university contexts vary greatly in their nature and success rates (Baran, Correia, & Thompson, 2013; Kennedy, 2015). Many of these initiatives are offered in group contexts using Communities of Practice (CoP) formats that promote the benefits of social learning and mentoring (Koch & Fusco, 2008; McDonald, 2014). Alternatively, online self-help resources for professional learning purposes offer personalised learning experiences for university staff seeking guidance about online pedagogy and practice. However, the curricula of group-based PD programs or individually-focused resources do not always meet the needs of individual novice online teachers. In a novel approach to understanding the nature of online teachers’ core expertise, the researchers involved in the project reported in this paper sought to determine the threshold concepts that online teachers acquire as they develop experience in online teaching. These online teaching threshold concepts were then used to inform the development of PD guidelines for novice online teachers that are applicable at an individual academic staff level (relevant to “me”) and promote collective support at an institutional level (relevant to “us”).

Background

At all levels of learning, there are times when an obstruction to moving to the next level in the learning process is overcome. This could be called a revelation or, in colloquial terms, a 'light bulb moment' for the learner. Over a decade ago, Meyer and Land (2003) labelled such a learning experience as a threshold concept, explaining that "It represents a transformed way of understanding, or interpreting, or viewing something, without which the learner cannot progress" (p. 1). Threshold concepts have certain characteristics (Cousin, 2006; Meyer & Land, 2005) and are said to be transformative; typically, the gaining of a threshold concept involves a conceptual shift for the learner as they acquire new understandings. A threshold concept is irreversible because, once adopted, it will not be forgotten. Threshold concepts are said to be integrative as they bring about connections with the learner's pre-existing knowledge. A threshold concept will also have boundaries. According to Meyer and Land (2006), "any conceptual space will have terminal frontiers, bordering with thresholds into new conceptual areas" (p. 6). Some of these boundaries are defined from a disciplinary perspective; aspects of the concept may be particular to one specific discipline. Troublesome knowledge (Cousin, 2006; Perkins, 2006) is often associated with the acquisition of threshold concepts and has been linked to feelings of disquiet and discomfort for the learner: "Getting students to reverse their intuitive understandings is also troublesome because the reversal can involve an uncomfortable, emotional repositioning" (Cousin, 2006, p. 4).

While threshold concepts are often reported as being useful when identifying key components of a curriculum designed to facilitate *student* learning, often within a specified discipline, they are also useful in pinpointing significant learning thresholds for *teachers* in PD contexts. For that reason, the study of threshold concepts for higher education teachers has become a significant area of research and may be implemented to reverse the practice of overfilling the curriculum at the expense of good pedagogy. Cousin referred to this as an "overstuffed curriculum" (2006, p. 4). For a beginning online teacher working in tertiary education, not only do they need to identify the threshold concepts with which their students are contending, but they also need to identify their own set of threshold concepts related to the practice of online teaching (Northcote et al., 2017).

The project on which this paper is based used a survey (Online Teaching Self-Efficacy Inventory) (Gosselin, 2009) and reflective journals to gather data from academic and PD staff for the purpose of identifying a range of threshold concepts about online teaching. Through a selection of data analysis and triangulation techniques, including two rounds of consultation with experts using the Delphi Method, described later in this paper, these data were distilled to twelve threshold concepts about online teaching which incorporated the following issues:

- monitoring and giving feedback to individual students and groups of students;
- course design;
- alignment of learning activities and assessments;
- time demands of online teaching as compared to on-campus teaching;
- students learning without the constant presence of a teacher;
- the importance of online student presence;
- the difference between student presence in online and on-campus contexts;
- the role of online students' self-regulation;
- interactivity in online learning; and
- the value of online interaction for learning and the benefits of online synchronous communication.

The actual threshold concepts about online teaching that were identified in this project can be found at the project's website, *Threshold Concepts for Novice Online Teachers* (see Figure 1). The process of identifying a set of threshold concepts about online teaching has the potential to inform designers of PD programs about the obstacles which may challenge teachers as they learn to facilitate online learning. As well as acknowledging the online teacher's role as a facilitator of learning, as evident in Salmon's work (2013), many of these threshold concepts also acknowledge the role of both teacher and student presence, which is reflective of the work of such scholars as Garrison and his colleagues' research about teacher presence (Akyol & Garrison, 2008; Garrison & Cleveland-Innes, 2005) and Kear and her colleagues' research about student presence (Kear, 2010; Kear, Chetwynd, & Jefferis, 2014).

The threshold concepts identified throughout our project embody the roadblocks that online teachers frequently encounter. Following identification of the threshold concepts, the main purpose of the project was to use these threshold concepts about online teaching to inform the development of PD for novice online teachers. The collection of threshold concepts aligns with some of the blockages to effective online teaching identified by Kreber and Kanuka (2013) who suggest that these blockages can be cleared through the use of inquiry-based approaches to PD that use online communication technologies. The idea of integrating technology into the actual design of continuous PD to promote critical reflection was also found to be effective by Baran, Correia and Thompson (2011).

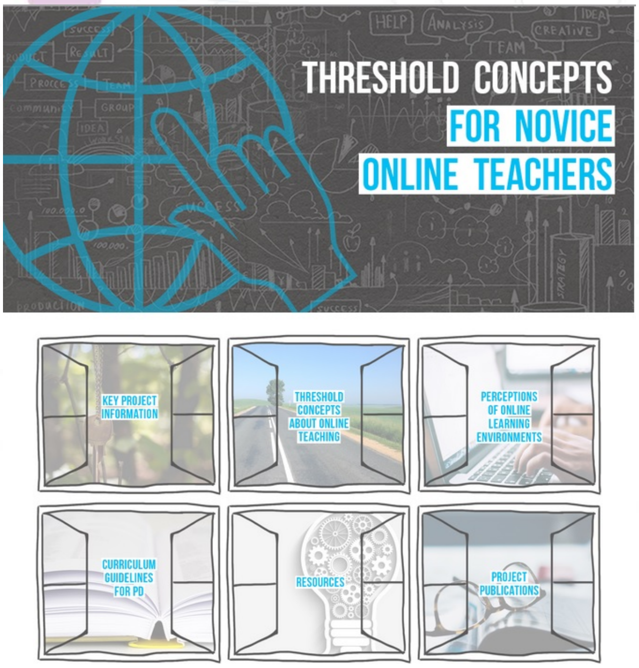

Figure 1: Project website – Threshold concepts for novice online teachers
Available at: http://tcs4nots.avondale.edu.au/

As well as issues regarding the use of technology in PD, its ongoing impact has also been noted as problematic. Determining whether or not PD makes a difference to those who participate is well documented (Ebert-May et al., 2011; Wayne, Yoon, Zhu, Cronen, & Garet, 2008). Ebert-May et al. (2011), in an analysis of the impact of a PD session on active learning strategies, found that faculty members who attended and participated in PD were often left alone afterwards and thus reverted to their previous practices, some of which were not ideal. They recommended from this study that on-site expert support be continued after the PD session took place and that teachers should be seen as 'apprentices' in the new teaching methods they were learning about: "Regular and timely feedback from experts is fundamental to the PD process" (Ebert-May et al., 2011, p. 557).

The idea of effective PD being represented on a continuum rather than being provided via isolated events was reported by Rientes, Brouwer and Lygo-Baker (2013) in a study which implemented online PD for higher education teachers. They found that measurable changes in teachers' practices and beliefs were evident over time when the PD provided incorporated relevant technology and was made up of regular modules. On the same theme, Mirriahi, Alonzo, McIntyre, Kligyte and Fox (2015) reported a study that indicated multiple approaches over a period of time are necessary to bring about improved professional knowledge of digital literacy for higher education teachers. The guidelines presented in this paper, intended for use when designing PD programs, resources and activities for novice online teachers in universities, are also offered with such considerations in mind; that is, to create PD programs that adopt multiple formats, including on-campus and online formats, and methods that cater for individuals and groups of educators. The method by which these PD guidelines were developed is now described.

Methodology

A multisite and multiphase mixed methods research methodology (Creswell & Plano Clark, 2011) was adopted in this research project. The study aimed to establish a set of guidelines to inform the design of PD curricula for the purposes of transforming the capacities of novice online teachers in higher education. This work builds on previous investigations that have been underway since 2010 (Northcote, Gosselin, Reynaud, Kilgour, & Anderson, 2015; Northcote, Reynaud, Beamish, Martin, & Gosselin, 2011), with a similar intent: to inform the development and delivery of professional training programs for online educators. The study followed a sequential three-phase design. In the first two phases of the study, both quantitative and qualitative data were collected, analysed and compared to determine, firstly, teachers' threshold concepts about online teaching, and secondly, teachers' and students' perceptions about online education.

To determine the threshold concepts about online teaching that were developed as tertiary educators gained expertise in designing and teaching online courses, data from questionnaires and reflection journals were sought from higher education teaching staff and PD officers at three tertiary institutions. Two of the institutions are in Australia (one is a public university and the other is a private provider), and one public university is in the USA. The data collection instruments for this study were designed and selected to capture data about the concerns and challenges faced by academic teaching staff while developing online teaching skills. Their recollections about successful online teaching experiences were also gathered. Qualitative data were gathered from 70 staff who contributed responses to a semi-structured reflective journal about difficulties encountered as they developed online teaching skills and online pedagogy. Also, 107 staff provided quantitative responses to a self–reporting questionnaire, the *Online Teaching Self-Efficacy Inventory* (OTSEI) (Gosselin, 2009). Data from the OTSEI provided information that enabled the researchers to assess the participants' self-efficacy beliefs within five areas encompassing online pedagogy: (1) web-based course structure; (2) online curricular alignment; (3) course content migration; (4) virtual interaction; and (5) selection of technological resources. The combined analysis of the qualitative and quantitative data gathered throughout the study provided insight into some of the instrumental moments of development through which online teachers typically progressed as they developed experience in online course design and online teaching, incorporating both highlights and concerns. Through triangulation of the qualitative and quantitative data, the researchers identified the threshold concepts that novice and experienced teaching staff encountered as they familiarised themselves with online pedagogy and gained experience teaching in online environments. These threshold concepts were further categorised into thematic clusters.

Next, a panel of experts were consulted to provide feedback about the threshold concepts that had been identified in the study's first phase. The panel was made up of 16 distinguished national and international scholars with expertise in threshold concepts, PD and online pedagogy. These experts' insights were captured using two rounds of a modified online Delphi technique (Keeney, Hasson, & McKenna, 2006, 2011; Powell, 2003) that has also been adopted by other threshold concept researchers (Nicola-Richmond, Pépin, & Larkin, 2015; Townsend, Hofer, Hanick, & Brunetti, 2016). The panel members' responses were analysed using an 80% or above agreement level as an indication of consensus. This iterative process continued through a further round of feedback to refine the threshold concepts themselves and the thematic clusters used to categorise them. This process, in addition to consideration of the reflective journal and OTSEI data, resulted in multiple data sources being gathered across the study's phases and research settings, the result of which provided answers to the study's first research question: *What threshold concepts about online pedagogy are perceived as essential for novice higher education teachers teaching in online contexts?* The threshold concepts identified in this phase of the study are currently being published elsewhere, and are also available on the project's website (*Threshold Concepts for Novice Online Teachers* (http://tcs4nots.avondale.edu.au/).

Once a set of threshold concepts about online teaching were identified, the second phase of the study was enacted in which both students and teachers in higher education contexts provided evidence, through focus groups and questionnaires, about their preferred online learning environments. This second phase of the study pursued answers to the following research question: *How do higher education teachers and students perceive online learning contexts?* Questions were posited to groups of higher education students and teaching staff via online questionnaires and focus groups about their preferred ways of teaching and learning in online contexts. This phase of the study ensured that the final set of PD guidelines produced from the project reflected not only the perspectives of experts and teaching staff, but that they were also embedded with the views of students.

The final and third phase of the study synthesised the study's earlier findings into a set of practical recommendations to guide the development and delivery of PD curricula for online educators. This final phase of the study, reported in this paper, sought answers to the following research question:

> What guidelines can be established to inform the design of professional development curricula to transform the capacities of novice online teachers in higher education?

These PD guidelines are presented below, as the results of this study.

Results: recommendations for practice - curriculum design guidelines for the PD of novice online educators

The 12 threshold concepts about online teaching formed the foundation of the curriculum guidelines that were created to inform the construction of PD outputs (such as programs, events, activities and resources) for novice online teachers. These curriculum guidelines were described at both a wide-scale institutional level (the "us" level) as well as an individual academic staff level (the "me" level), as illustrated in Figure 2. To ensure that the professional learning journeys of individual academic staff were realistically set within the context of an institution's overall direction and support services, both the institutional and individual level were considered important.

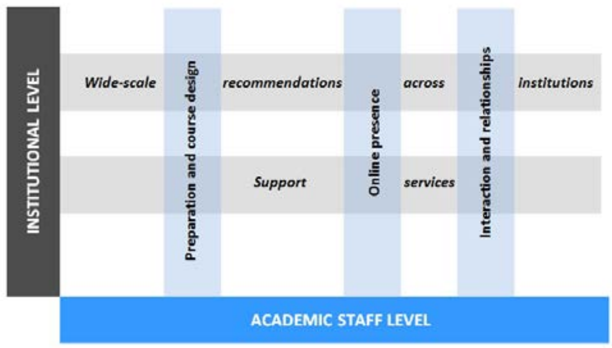

Figure 2: Cross-linking of PD guidelines recommended at the institutional and academic staff level

Both the institutional PD guidelines and the guidelines that were purposefully designed for individual academic staff reflected the concerns of online educators as they were expressed throughout earlier phases of the project. For example, when developing guidelines that specifically met the needs of novice online educators in higher education contexts, of special note was the expressed concern by the study's participants about the lack of immediacy experienced when communicating in online courses. This concern was typified by comments such as:

> *The class discussions just miss a touch of depth when it is all online.*
> *Communication is a problem. At times getting in contact with a professor by email is challenging.*

It is difficult to engage students who are not face-to-face.

The pedagogies are different and more difficult to get experiential learning happening.

Furthermore, the question of determining students' responses to online courses was identified as a major area of concern for teaching staff, described as follows:

It's difficult to connect with the students.

There is absence of feedback loop from online audience.

If there is a problem - how do you monitor this?

These concerns and needs, expressed by participants in the project, are specifically cited as topics within the PD guidelines, as outlined in Tables 1 and 2.

At the institutional level, or the "us" level, broad recommendations were developed for application across institutions (see Table 1) to support the PD of novice online teachers at the "me" level. These were largely expressed in terms of institutional recommendations about policies related to teaching and learning, and recommendations about the provision of support services to provide education to novice online teachers about both the pedagogy and logistics of online teaching and learning. In this way, the professional guidelines that were identified at the end of the project included suggested methods for implementing PD programs for novice online educators as well as recommendations regarding the content of such programs.

Table 1: Institutional recommendations for the support of novice online teachers

Professional development category	**Institutional recommendations**
Wide-scale recommendations across institutions	Policies related to teaching and learning should: 1. specify expectations that students enrolled in distance or online courses must portray an online presence through participation in online activities, completing and submitting assessment tasks and accessing course material; 2. emphasise that lecturers should ensure that online and on-campus students require equitable (but not always exactly the same) opportunities to achieve the learning outcomes in a course; 3. teachers should be given time and resources to practise online communication techniques using varied tools; 4. state the expected timeframe within which students should expect to have their questions answered by their lecturers; and 5. workload allocations should be scheduled for the design and preparation as well as the facilitation of online courses, noting that online teaching may take more time than on-campus teaching.
Support services	Institutional support services need to provide training to novice online teachers in why, how and when to: 1. operate online communication software and tools; 2. use online software and tools to manage students' assessment tasks and provide prompt feedback; 3. meet the needs of both online and on-campus students within the same LMS course site; 4. structure a course in an engaging manner; 5. clarify instructions and expectations; 6. engage in learning about the major barriers and breakthroughs that experienced online teachers have encountered; 7. develop an online presence that does not dominate the online space; and 8. scaffold, guide and stage learning activities and processes.

At the individual academic staff level, or the "me" level, guidelines for PD curricula were developed to assist teaching staff in the areas of preparation and course design, online presence, and interaction and relationships (see Table 2). The same thematic clusters used to categorise the actual threshold concepts about online teaching were used to group the PD curriculum guidelines. Whereas the institutional guidelines, as outlined in Table 1, were focused on the setting up, support and delivery of PD for novice online teachers, the curriculum guidelines for their PD, as outlined in Table 2, were more focused on the content of these programs relevant to individual teachers.

Table 2: Curriculum guidelines for the design of PD for novice online teachers

Professional development category	Professional development curriculum guidelines
Preparation and course design	When designing an online course, special attention must be paid to developing course components that allow for regular back and forth communication between lecturers and their students. The components of an online course need to be aligned (learning outcomes, content, activities and assessment tasks) and these links need to be emphasised to students.
Online presence	Mechanisms must be designed and put in place to enable the teacher to take an active role in facilitating online interaction and communication. It is important for online teachers to inform students enrolled by distance or on-campus mode that, although their needs may be met in different ways by the course and the lecturer, both groups will be treated equitably. Students have a diverse range of expectations about the skills required of online teachers whereas teachers' expectations of the skills they (teachers) require are less diverse and more pragmatic. This issue requires teachers to ensure there are opportunities to discuss teacher-student and student-teacher expectations of each other's roles during the course. Teachers and students need opportunities to express themselves online in socially appropriate ways and in ways that they can engage in academic material that fosters deep learning. The notion of online presence needs to be considered and fostered through online interaction. Teachers need to encourage self-regulation in their students and both teachers and students may need to develop an understanding that students can learn without the constant presence of teachers.
Interaction and relationships	The issues that students find to be important in online courses include: equity, prompt responses and feedback, use of authentic examples. The issues that teachers find very important in online courses include: equity, student independence and assessment submission. Sometimes the issues that students find important do not always align with what teachers find important. Students' and teacher's expectations and preferences may differ in terms of the value of collaborative learning and group work tasks. Online dialogue between students and teachers needs to be facilitated to ensure a shared understanding is developed between both groups about the purpose, frequency, nature and options associated with online contact between teachers and groups of students, teachers and individual students, and between students. Students and teachers typically agree upon the value of online communication and the importance of using real world examples but there may be clashing expectations about how independent students are expected to be by their teachers compared to how independent students believe they should be in online learning contexts.

Discussion

The OLT project outcomes reported in this paper have contributed to knowledge and advanced the field of planning professional learning for teachers who are novices to online pedagogy. Meyer and Land (2005) used the term "threshold concepts" to refer to particular concepts that are fundamental to understanding a field of practice and, although initially challenging, these concepts, when acquired, open up new ways of thinking and practising. The framework of threshold concepts is now being applied widely within many disciplines, to enhance student learning, as well as in PD contexts where academic staff members are learners of new pedagogies (Bunnell & Bernstein, 2012). The present study applied threshold concepts theory to the field of PD with the anticipation of advancing the skills and expertise of novice teachers in the area of online teaching.

A preliminary study on threshold concepts for novice online tertiary educators produced an initial set of concepts on which this study builds. These concepts included the notion that face-to-face and online learning and teaching approaches differ in fundamental ways (Northcote et al., 2011) and that, because of this, teachers new to online pedagogy need to be supported and inducted into new practices. Since teaching online lacks visual immediacy and is often asynchronous, it differs from traditional face-to-face pedagogy and therefore requires transformations in practice, pedagogy and teacher identity.

One of the challenges associated with identifying threshold concepts is that they are unique to particular disciplines and that, in the case of online pedagogy, each individual teacher may have different needs and experience different learning thresholds during the process of gaining online teaching expertise. This variation of individuals' experiences of threshold concepts is recognised in the literature (Barradell, 2013) and, therefore, the views of faculty, students and novice online educators were acknowledged as the foundation for cross-linking professional learning guidelines to meet multiple needs (Figure 2).

The study broadly identified three thematic conceptual clusters as encapsulating online pedagogy: 1) course design; 2) the development of online presence; and 3) the facilitation of interaction and relationships with and among students. A striking feature of the qualitative data collected was that individual practitioners who responded showed different levels of skills and understanding in handling the online environment, indicating the need for PD approaches that responded to the tripartite needs of the institution, faculty and students.

Tables 1 and 2 above show the different approaches to content and skills development that were designed. At the individual academic staff level, the guidelines focused on the micro level skills of preparation and course design, online presence and building interaction and relationships. At the institutional level (Table 1), the strategy was to support and deliver PD for novices to online pedagogy, including specific curriculum guidelines for PD and recommendations for the content of these programs (Table 2). These PD guidelines provide flexibility and adaptability in the provision of "just-in-time" support for novices in online pedagogy, while enabling staff who are more proficient and experienced to evolve professionally.

It has been claimed that the threshold concepts framework helps in curriculum development as it highlights troublesome concepts and key practices, also known as "jewels in the curriculum" (Land, Meyer, Cousin, & Davies, 2005) which become the foci for professional learning. By responding to staff and student needs, and taking into account their perceptions of online teaching, the guidelines developed have inspired thinking about PD as an integrative, holistic and responsive approach that ensured the inclusion of student and staff voices. These guidelines are based upon research-informed and expert-sanctioned evidence. Similar approaches could be adopted across multiple disciplines to adopt threshold concepts as a theoretical framework to explore staff and student learning needs in tertiary and further education and as a means of engaging these multiple audiences in scholarly conversation about their respective pedagogic needs.

Conclusion

The research-informed practical guidelines outlined in this paper are intended to inform the way in which curricula for PD programs are designed for and delivered to novice online educators. These guidelines are based upon recently gathered data about threshold concepts of online pedagogy, which were identified using an evolved methodology that has been under development and in practice since 2010. Guidelines are provided at the institution-wide level (the "us" level) as well as at the level of the individual teaching academic (the "me" level). While much literature has reported on the way in which online teaching and online learning *should* occur as well as how teachers *should* be supported to facilitate online learning, the PD guidelines outlined in this paper are based on evidence from experienced online teachers who are currently teaching in higher education contexts. These guidelines also incorporate specialised advice provided by world-renowned experts from the fields of threshold concepts, PD and online pedagogy. In this way, the PD guidelines outlined in this paper go beyond practical recommendations that we *think* are relevant. Instead, the authentic context in which they were developed along with the relevant stakeholders who were consulted to form them ensure that these guidelines are grounded in practice and are underpinned by current educational theory and research. University administrators and staff development managers may find the guidelines reported in this paper useful in the coordination and provision of PD programs, activities and resources for teaching staff. Novice and experienced online educators may use the guidelines to inform their own future professional learning about online teaching.

References

Akyol, Z., & Garrison, D. R. (2008). The development of a community of inquiry over time in an online course: Understanding the progression and integration of social, cognitive and teaching presence. *Journal of Asynchronous Learning Networks, 12*(3-4), 3-22.

Baran, E., Correia, A.-P., & Thompson, A. (2011). Transforming online teaching practice: Critical analysis of the literature on the roles and competencies of online teachers. *Distance Education, 32*(3), 421-439.

Baran, E., Correia, A.-P., & Thompson, A. (2013). Tracing successful online teaching in higher education: Voices of exemplary online teachers. *Teachers College Record, 115*(3), 1-41.

Barradell, S. (2013). The identification of threshold concepts: A review of theoretical complexities and methodological challenges. *Higher Education, 65*(2), 265-276.

Bunnell, S. L., & Bernstein, D. J. (2012). Overcoming some threshold concepts in scholarly teaching. *Journal of Faculty Development. Special Issue: Threshold Concepts in Educational Development, 26*(3), 14-18.

Cousin, G. (2006, 23 January 2015). An introduction to threshold concepts. *Planet.* Retrieved December 17, 2016, from http://www.et.kent.edu/fpdc-db/files/DD%2002-threshold.pdf

Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage.

Ebert-May, D., Derting, T. L., Hodder, J., Momsen, J. L., Long, T. M., & Jardeleza, S. E. (2011). What we say is not what we do: effective evaluation of faculty professional development programs. *BioScience, 61*(7), 550-558.

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education, 19*(3), 133-148.

Gosselin, K. P. (2009). *Development and psychometric exploration of the online teaching self-efficacy inventory.* (PhD), Texas Tech University.

Kear, K. (2010). Social presence in online learning communities *Proceedings of the 7th International Conference on Networked Learning* (pp. 1-7). Aalborg, Denmark.

Kear, K., Chetwynd, F., & Jefferis, H. (2014). Social presence in online learning communities: The role of personal profiles. *The Journal of the Association for Learning Technology, 22*, 1-15.

Keeney, S., Hasson, F., & McKenna, H. (2006). Consulting the oracle: Ten lessons from using the Delphi technique in nursing research. *Journal of Advanced Nursing, 53*(2), 205-212.

Keeney, S., Hasson, F., & McKenna, H. (2011). *The Delphi Technique in nursing and health research*. Oxford: Wiley-Blackwell.

Kennedy, J. (2015). Using TPCK as a scaffold to self-assess the novice online teaching experience. *Distance Education, 36*(1), 148-154.

Koch, M., & Fusco, J. (2008). Designing for growth: Enabling communities of practice to develop and extend their work online. In C. Kimble & P. Hildreth (Eds.), *Communities of practice: Creating learning environments for educators* (Vol. 2, pp. 1-23). North Carolina: Information Age Publishing.

Kreber, C., & Kanuka, H. (2013). The scholarship of teaching and learning and the online classroom. *Canadian Journal of University Continuing Education, 32*(2), 109-131.

Land, R., Meyer, J. H. F., Cousin, G., & Davies, P. (2005). Conclusion: Implications of threshold concepts for course design and evaluation. In J. Meyer & R. Land (Eds.), *Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge* (pp. 195-206). London and New York: Routledge.

McDonald, J. (2014). Community, domain, practice: Facilitator catch cry for revitalising learning and teaching through communities of practice. ALTC Teaching Fellowship Final Report 2014. Sydney: Australian Government Office for Learning and Teaching.

Meyer, J. H. F., & Land, R. (2003). Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practising within the disciplines *Enhancing Teaching-Learning Environments in Undergraduate Courses Project, Occasional Paper 4* (pp. 1-12). Edinburgh: University of Edinburgh.

Meyer, J. H. F., & Land, R. (2005). Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. *Higher Education, 49*(3), 373–388.

Meyer, J. H. F., & Land, R. (2006). Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge. New York: Routledge.

Mirriahi, N., Alonzo, D., McIntyre, S., Kligyte, G., & Fox, B. (2015). Blended learning innovations: Leadership and change in one Australian institution. *International Journal of Education and Development using Information and Communication Technology, 11*(1), 4-16.

Nicola-Richmond, K. M., Pépin, G., & Larkin, H. (2015). Transformation from student to occupational therapist: Using the Delphi technique to identify the threshold concepts of occupational therapy. *Australian occupational therapy journal*.

Northcote, M., Gosselin, K. P., Reynaud, D., Kilgour, P., & Anderson, M. (2015). Navigating learning journeys of online teachers: Threshold concepts and self-efficacy. *Issues in Educational Research, 25*(3), 319-344.

Northcote, M., Gosselin, K. P., Reynaud, D., Kilgour, P., Anderson, M., & Boddey, C. (2017). Reversing the tyranny of distance education: using research about threshold concepts to humanise online course design. In M. Northcote & K. P. Gosselin (Eds.), *Handbook of research on humanizing the distance learning experience* (pp. 232-255). Hershey, PA: IGI Global.

Northcote, M., Reynaud, D., Beamish, P., Martin, T., & Gosselin, K. P. (2011). Bumpy moments and joyful breakthroughs: The place of threshold concepts in academic staff development programs about online learning and teaching. *ACCESS: Critical Perspectives on Communication, Cultural & Policy Studies, 30*(2), 75-90.

Perkins, D. (2006). Constructivism and troublesome knowledge. In J. Meyer & R. Land (Eds.), *Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge* (pp. 33-47). New York: Routledge.

Powell, C. (2003). The Delphi technique: Myths and realities. *Journal of Advanced Nursing, 41*(4), 376-382.

Rienties, B., Brouwer, N., & Lygo-Baker, S. (2013). The effects of online professional development on higher education teachers' beliefs and intentions toward learning facilitation and technology. *Teaching and Teacher Education, 29*, 122-131.

Salmon, G. (2013). *E-tivities: The key to active online learning* (2nd ed.). London and New York: Routledge.

Townsend, L., Hofer, A. R., Hanick, S. L., & Brunetti, K. (2016). Identifying threshold concepts for information literacy: A Delphi study. *Communications in Information Literacy, 10*(1), 23-49.

Wayne, A. J., Yoon, K. S., Zhu, P., Cronen, S., & Garet, M. S. (2008). Experimenting with teacher professional development: Motives and methods. *Educational Researcher, 37*(8), 469-479.

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Evaluating the sustainability of tablet devices in blended learning

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Blended approaches to teaching and learning and higher education often demand the provision of substantial investments in professional development, curriculum change and technological resources. Given the intense effort required for successful courses, focus has turned increasingly on the sustainability of blended learning in higher education. In this study, we adopt an argument based approach to the sustainable use of tablet computers in a university pathway course. After mapping out the argument with key stakeholders, we conduct a participatory action research project that takes into account observations, interviews and personal reflections. Results of the evaluation point to a 'weak argument' for the continued use of tablet computers that demonstrates their use is not sustainable. We conclude with suggestions to turn to issues of curricular alignment and further adoption of argument based evaluation for educational technology.

Introduction

In an era of diminishing funding for educational technology, a focus on sustainability is important as institutions seek to make use of available resources for long-term benefit (Gunn, 2010). In the context of innovations in blended learning, these initiatives tend to be small scale projects (Hubbard, 2005) that have often failed to scale up to an institutional level (Owston, 2013; Gruba & Hinkelman, 2012). The lack of uptake not only indicates a waste of time and resources, but reinforces the idea that for blended learning initiatives to endure, there needs to be a focus not just on sustainability, but a view of such an important aspect at program level (Nworie, 2014).

Despite concerns about the long-term uses of technology in blended learning, little work to date has focused on the evaluation of sustainable practices in higher education (Gruba, Cardenas-Claros, Suvorov, & Rick, 2016). Accordingly, the aim of this paper is to evaluate the sustainability of the use of tablet computers in a blended language learning program. To achieve this aim, we forge a conceptual framework based on a synthesis of work from evaluation and sustainability (Blin, Jalkanen & Taalas, 2016; Gruba et al., 2016). Specifically, we conduct a study grounded in participatory action research (Patton, 2015; Somekh, 2006) within a program that prepares non-English speaking students for entrance into Australian universities. Following a review of the literature, we set out the details of our investigation, explain its outcomes and suggest an agenda for further investigation.

Developing an evaluation of sustainable blended learning

In higher education, the concept of sustainability can be viewed from two different perspectives (Cerone, 2014). Stepanyan, Littlejohn, and Margaryan (2013) distinguish the perspectives as either "education *for* sustainability" or the "sustainability *of* education" (pg. 94). Aligned with issues surrounding the environment, education for sustainability focuses on maintaining the 'economic, social and ecological well-being' of current and future stakeholders. In this context, sustainable development becomes a core aspect of the educational institution's course content, classroom practices and overall curriculum (e.g., Jones, Selby, & Sterling, 2010; Barlett & Chase, 2013). In contrast, perhaps, concerns can focus on the sustainability *of* education. Here, the focus turns to sustaining effective teaching and learning practices; in doing so, researchers seek to take into account how factors such as education, leadership and innovation can positively or negatively influence initiatives depending on how they are implemented (Davies & West-Burnham, 2003; Cerone, 2014). Our paper makes use of the second perspective.

To evaluate the sustainability *of* blended learning, we adopted an 'argument-based approach' that was first created for the purposes of test validation (Kane, 2006; Chapelle, Enright, & Jamieson, 2008). The argument based approach is a two-stage process which entails first developing an argument and subsequently appraising its validity (Kane, 2012). From this foundation, Gruba et al. (2016) proposed that an argument-based evaluation framework be extended to the broader context of blended language programs. Here, instead of a focus on validity of assessment scores, the interpretation and uses of the evaluation are applied to the claims made about a blended language program. To map out the evaluation, the first two stages of the argument based approach involve determining the level of focus (micro, meso or macro) as well as a consideration such as purpose, appropriateness, multimodality or sustainability (Gruba & Hinkelman, 2012; Gruba et al., 2016). Once the level, considerations and focus have been determined, the evaluator can then proceed to the four stages of developing the argument which are (1) planning an argument; (2) gathering the evidence; (3) presenting the argument; and (4) appraising the argument.

The planning stage of argument construction starts with explicitly laying out the claims which can be made at different stages of the evaluation. These stages refer to the network of five inferences which include domain definition, evaluation, explanation, utilization and ramification. Starting with the domain definition inference, a claim is then connected to the next inference, evaluation and so on until it reaches the final inference of ramification. It is within this network of inferences that claims are connected to each other. Claims are crucial in the process of argument building as they map out the direction of the evaluation and outline the kinds of evidence required to back each of the claims made (Chapelle, 2014).

In this paper, we employ an interpretative argument to test claims that are made by key stakeholders of a blended language program. For example, we would examine the claims made about sustainability through an interrogation of warrants, assumptions and evidence. After passing the evidence through a series of inferences, we would seek to determine whether the claims that are made are strong, moderate or weak (Golonka, Bowles, Frank, Richardson, & Freynik, 2014).

The second half of our conceptual framework is built on an institutional model of sustainable blended learning (Blin et al, 2016) and rests on four pillars: (1) Environments and tools for learning, (2) Pedagogical and professional development, (3) Community and knowledge building, and (4) Organisational structures as shown in Table 1.

Table 1: Four pillars of sustainable blended language learning

Component	Description
Environments and tools for learning	Sustainable practices are purposeful and tailored to the needs of students and teachers, learning objectives, classroom tasks and activities.
Pedagogical and professional development	Sustainable teaching is grounded in the capacity building of instructors.
Community and knowledge building	Working together and sharing resources amongst teachers enhances the sustainability of blended learning.
Organisational structures	Sustainability entails the involvement of the whole organization across all levels while being flexible and adaptable in light of unexpected outcomes.

Adapted from Blin et al. (2016)

Notably, all pillars are of equal importance and mutually influencing one another. While this model provides a useful starting point to investigate the sustainability of blended programs, as Blin et al. (2016) acknowledge, it is still in its initial stages and requires further development. Therefore, this study also seeks to apply this model to determine its usefulness as a conceptual framework for analysing sustainability; whether it offers a feasible model to articulate sustainability factors or alternatively whether further expansion of the framework is required.

Context of the study

The evaluation project was conducted through a case study of the English for Academic Purposes (EAP) course situated within a foundation studies program of a pathways college in Australia. Designed to prepare international students for entry into universities in Australia and around the world (Benzie, 2015) the popularity of pathway programs and colleges have risen in recent years (Lisciandro & Gibbs, 2016). Emphasising both depth and breadth of knowledge, the nine-month foundation studies program comprises three components which include EAP, two compulsory subjects, and three elective subjects in areas which include Commerce, Science, Arts, Media and the Environment. The EAP is a hurdle subject taken by all students regardless of what subject area they are taking and necessitates a minimum pass of 50% to fulfill university entry requirements. The course is offered in various intakes throughout the year and is led by an EAP subject head and taught by approximately 30 academic staff.

Divided into two semesters, EAP classes are conducted twice a week with a duration of 90 minutes for each session. The overall emphasis of the EAP course is on developing academic literacy in two aspects: 1) understanding and engagement with academic texts 2) expression of opinions in both written and oral forms. The primary assessment methods are academic writing assignments, oral presentations, and exams. In the first semester students develop their academic writing and presentation skills through a guided, process oriented research project, working collaboratively in groups to produce an argumentative essay. Building on these skills, students will subsequently apply them in the second semester where they work individually on a project-based written and oral task. Similar to the first semester, students are required to conduct research, write an argumentative essay and then conduct an oral presentation based on what they have written. Blended learning is emphasised throughout the college where for the past five years all students and staff have been allocated tablet computers to be used for educational purposes. Accordingly, the teaching of EAP is implemented through traditional face-to-face sessions as well as technology integrated components in the form of tablet computers, Google Docs and Google Drive, a Moodle based learning management system (LMS) and the EAP website developed through Google sites.

Methodology

In line with Chapelle (2014), our evaluation project consisted of planning an argument, gathering and analysing evidence to support it, presenting the argument and appraising it. In the initial stages of the project, we collaborated with key stakeholders to set out the overall argument (Figure 1). The planning stage provided an opportunity to clarify program goals, identify potential weaknesses, set the schedule, and to determine possible sources of data including relevant documents, people and events. We saw the levels as distinguished amongst those at the (1) macro (institutional, policy), (2) meso (departmental), and (3) micro (classroom) levels (Gruba et al., 2016).

An awareness of levels influenced our choices in research techniques. For example, discourse analysis may be used for documents at the macro level, interviews for meso level members of an academic department, and classroom observations to gather information at the micro level of a program.

Returning to key stakeholders, we again sat down with key stakeholders to discuss what was learned in the data collection stage, showed how we understood the results, and considered what actions might be considered to build sustainability. Finally, we made an appraisal to determine if the overall argument, used to evaluate the sustainability of tablet device uses, was weak, moderate or strong. A weak argument, for example, would be based on anecdotal evidence that had little triangulation with other sources of data. A moderate argument contains verifiable and empirical data from two or more related sources. A strong argument extends the results of empirical analysis to confirmations in the literature or related evaluation projects.

Combined, then, an argument-based approach to blended program evaluation takes into account the structure of the institution at three levels, recognizes focal considerations that are important to stakeholders, and is conducted in four distinct stages that conclude with a reflective appraisal of the argument itself. We further explain the process in detail.

Participants

As the evaluation study is focused on the meso or organisational level, the key stakeholders included the EAP subject head and five full time teachers teaching in the same intake. A summary of the participants can be seen from Table 2. To safeguard the anonymity of participants, pseudonyms have been used as the evaluation may raise potentially sensitive issues regarding the implementation of blended learning at the institution. In addition, any details which might lead to the identification of the respondents was removed or modified accordingly. In addition, Palikat who was a part-time teacher at the same intake was also involved as a participant observer; contributing an additional layer of interpretation to the data collected.

Table 2: Summary of participants

Participants		Position
1.	Richard	EAP Subject Head
2.	Alice	EAP teacher
3.	Karla	EAP teacher
4.	Kristen	EAP teacher
5.	Patricia	EAP teacher
6.	Rachel	EAP teacher

Planning the argument

Our discussions with key stakeholders resulted in sketching out a set of the warrants, claims and underlying assumptions (Figure 1) that form an overall argument for the evaluation project.

Inference: Warrant	Claims and underlying assumptions (numbered after each claim)
E. Ramification	*Attention to concerns of sustainability can inform the promotion and evaluation of blended learning.*
↑	1. The project is transferable to other blended learning programs.
	2. Outcomes are disseminated in professional forums.
	3. The evaluation project interests the broader community.
D. Utilization	*The stakeholders make use the evaluation to enhance sustainability.*
↑	1. Outcomes resonate and stimulate action from stakeholders.
	2. The outcomes identify areas for improved sustainability.
C. Explanation	*The findings align with the program and are consistent with an understanding of sustainability within the context of the evaluation.*
↑	1. Blended approaches are sustainable with the available resources.
	2. Sharing, reuse and repurposing are goals of the institution and program.
B. Evaluation	*The analysis identifies departmental attitudes and instances of device uses concerned with the sustainability in blended learning.*
↑	1. The analysis is trustworthy and dependable.
	2. Program stakeholders provide insights into the use of devices.
	3. Effective device use is required in sustainable blended approaches.
A. Domain definition	*Key stakeholders, primarily teachers, make use of devices in ways that enhance sustainability in blended learning.*
↑	1. Sustainability is important to the viability of blended learning.
	2. Blended learning is a key pedagogical design in tertiary institutions.
	3. The widespread and integrated use of technology makes blended learning possible in higher education.

Figure 1: Meso-level warrants, claims and assumptions

Of note, the process of sketching out various drafts of the argument helped stakeholders to understand the overall goal of the program evaluation, a point that may lead to the adoption of outcomes (Patton, 2011).

Gathering and analysing the evidence

After negotiating site access and human research ethics approval, we first began with an interview with the EAP subject head to understand the history and context of blended learning implementation within the program. In line with Cowie (2009), Palikat then made extensive field notes of both her own and other teachers' classes in an online reflective journal. After each class, she reflected on the content and delivery of the lesson noting her thoughts and observations on what went well, what didn't go so well and future improvements to be considered. Similarly, observations of five other teachers' classes focused on the affordances and limitations of implementing blended learning, as well as the influence of technology integration on classroom dynamics. This was followed by interviews with each of the instructors.

Documentation was also collected such as literature on the EAP program, prospectus and other related marketing material. For additional insight into the academic aspects of the EAP, the institution's learning management system, website, curriculum and syllabus documents, teachers' lesson plans and course materials were also analysed.

The analytical strategy employed in this study is based on the multi-methods of data collection used. Recorded data collected from interviews were transcribed in full and analysed. This data, along with those from field notes and observations were coded through thematic analysis (Fereday & Muir-Cochrane, 2006) by categorising them to the four pillars of sustainable blended learning (Blin et al, 2016) where further sub-themes were identified. To reduce potential bias and corroborate the data from interviews and observations, content analysis (Bowen, 2009) of related documents was done for data triangulation (Kress, 2011) purposes.

Pillar 1: Environments and tools for learning

In the first pillar, Blin et al. (2016) argue that the learning environments and tools used by a blended language program be purposeful and tailored to the needs of students, teachers, learning objectives and activities. In terms of learning environments, based on analysis of the EAP syllabus and teachers' lesson plans, the EAP's main focus was on collaborative and individual writing. Thus, the use of a tablet computer to deliver the course content greatly influences the kind of learning environment created.

An interview with the subject leader (Richard) revealed that too many platforms were used (applications, LMS, Google Sites and Google Docs/ Drive) which lacked integration and was 'overwhelming'. Interviews with teachers confirmed this with one teacher commenting that "on the tablet computer switching back and forth from Google Sites to LMS to other documents is frustrating as I need to get out of the website and then into the LMS… easier if all the materials were centralised" (Rachel, Int.01-Oct., Lines 41,46). In addition, field notes and observation data also show the tablet device's lack of multi-window functionality make it difficult for students to carry out essay writing tasks which require referring to other documents such as research articles, lesson materials or rubrics. This has led to the use of additional devices where both teachers and students have been observed using additional laptops and even mobile phones to carry out class activities.

In terms of using the tablet as a learning tool, data from interviews, field notes and observations revealed that the tablet device's limitations can be categorised into both hardware and software. For hardware, the tablet's limitations were reported to be its small screen size, touch screen feature and lack of a keyboard. A stakeholder remarked that the tablet's design made tasks such as reading "…tedious and takes the joy out of reading" (Richard, Int.01-Sept., Line 40). The small screen also means that both students and teachers are required to do a lot of scrolling, making it difficult to view documents at a glance. As the EAP is largely a writing based course, this means that the touch screen feature makes editing tasks such as highlighting, copying and rearranging words, sentences and paragraphs quite frustrating as revealed through field notes and observations of Palikat's and other teachers' classes. The lack of a keyboard also affects writing tasks where tapping on the tablet device is not as efficient as typing on a keyboard. Thus, this can explain why students in the classes observed have added an additional keyboard to their tablets or brought laptops to address this problem.

Also, due to the tablet computer's limitations, it has been used more for consuming (e.g. following lessons, accessing course materials, going through recommended readings etc.) rather than creating content (e.g. writing, doing audio/ visual recordings). This is consistent with findings from other research (Green, Naidoo, Olminkhof & Dyson, 2016). The second type of limitation relates to the tablet device's iOS software which is incompatible with Android based computers and systems. Interviews with teachers revealed that some were using Android computers which makes working from home and switching between devices difficult. In addition, by opening Google Docs/ Drive which are Android based programs, the tablet device doesn't have complete functionality compared to the desktop version. An interview with EAP teacher, Karla, highlighted this issue as she noted that "…many times the students aren't with documents able to do as much as they probably would have if it was using a laptop" (Karla, Int.01-Oct., Lines 32-33). Clearly, the conflicts in mixing two operating systems weakened the sustainability of the use of the tablet computers.

Pillar 2: Community and knowledge building

The second pillar underscores the need for collaboration and for teachers to continuously evolve and adapt their teaching views and practices, together with the corresponding tools and environments for learning. Thus it can be seen that this pillar can have a direct effect to the first pillar covered previously. Interview data revealed the need for greater collaboration both internally and externally. For internal collaboration, teachers expressed the need for EAP teachers to work together, know what other teachers are doing, and share their expertise. For external collaboration, this involves both knowing about what other foundation studies teachers are doing as well as working to see how the knowledge students gain from EAP can support other subjects. Thus, there is a need to lessen the silo effect between EAP and the other subjects in the foundation studies program. This collaboration in turn can facilitate knowledge building, where greater alignment with other subjects could benefit both teachers and students. For teachers, this can lead to awareness of selecting more authentic and relevant class materials. For students, this may build on the knowledge gained from EAP by relating it to the other subject areas they are studying. The benefit of this collaboration can be seen from the following interview response:

> I'm a fan of using authentic material, authentic texts and if we're making it up then we're not preparing them for realistic application of those skills. In that sense, we need to know what everybody else is doing so that we can relate to them and prepare students to be able to do that in real time, in those subjects and then later on be comfortable enough to perform those functions at university. (Karla, Int.01-Oct., Lines 59-60)

Another aspect of sustainability under this pillar is the need to adapt and evolve according to the changing needs of teachers, students, as well as the EAP course itself. The importance of continuous course refinement was highlighted in teacher interviews. All five of the teachers interviewed expressed a general satisfaction with the EAP curriculum but felt that constant revisions were needed after identifying the course's strengths and weaknesses. However, adaptions and modifications on a more micro level were evident through analysis of teachers' lesson plans and the EAP website. For each of these resources, many of the lesson content presented included more simplified tasks to cater for lower level students and extension activities for higher level classes which teachers could modify as they saw fit. The adaptation of these resources was apparent from both field notes and observations done on classes of different levels, and appeared to influence sustainability.

Pillar 3: Pedagogical and professional development

The third pillar on pedagogical and professional development acknowledges teachers' roles as change agents of new teaching initiatives. As such, sustainability of blended learning rests on their ability to continuously adapt their teaching practices in line with changing classroom environments. Interview data show that teachers do recognize the importance of technology in teaching, especially the role that it plays in online collaborative writing which is central to the EAP curriculum. However, it was found that teachers displayed varying degrees of technology resistance due to "…insecurity, and lack of confidence in trying to manipulate new kinds of skills…" (Kristen, Int.01-Oct., Line 40). Among the skill areas which teachers felt needed further development include methodology of teaching, materials development in the online format and exploring programs/ tools which can facilitate class activities. The following interview response reflects this third concern:

> So for example, if you were not aware that certain programs exist… say you're doing a language quiz where you want them to choose certain answers and get some feedback (a) you've got to know that there are programs that can do that, (b) you've got to have the time to set it up the first place. (Alice, Int.01-Oct., Line 18)

In general, teachers have expressed the need for continuous, and targeted professional development and training on the pedagogical reasoning and application of the tablet computer in relation to the EAP course content. At present the focus of teacher professional development has been more on the technical aspects of setting up and using the tablet computer as well as exposure to educational applications that teachers can use in the classroom. Much less attention has been on demonstrations featuring how teachers can design lessons and tasks to create lessons that 'work' in the online format. Similar conclusions on the lack of training on the pedagogical applications of technology use have been reported in the literature (Kennedy & Levy, 2009).

Pillar 4: Organisational structures

The final pillar relates to how change should be implemented across all levels in relation to broader institutional objectives, and being able to adjust to possible unexpected outcomes in the process. Interview data revealed the need for a top down approach to implementing blended learning initiatives. A teacher's interview response further elaborates this:

> So that means as an organization higher up - they do have a vision. I mean they know what kind of approach they're using and then that message needs to be communicated to the teachers and the students. (Kristen, Int.01-Oct., Line 22-23)

Currently there is a lack of policy to formalise blended learning and the use of technology at the college. This was confirmed through interviews with the subject head and teachers, as well as a document analysis of the college portal and website. Interviews with teachers revealed that at present there is a strong encouragement from the upper management to use technology and the tablet computer for teaching. However, the lack of a formal policy on technology use can prove to be problematic as a key factor for blended learning program sustainability is staff ownership as revealed from an interview with subject head, Richard. Without a formal policy, embedding blended learning into the culture of the institution could be a challenge as teachers may not be aware or share the college's vision of more advanced teaching practices using technology.

Another aspect of organisational structures revealed through interview data is the fluidity of different organisational roles that make up the foundation studies program. For example, the subject head of the EAP functions in the dual roles of management as well as teaching. This was revealed through an interview where he describes how useful it was to first design an EAP lesson and then be able to trial it in class. By playing the same role as teachers, the subject head was able to view the implementation of EAP from their perspective. In this way, mandates or directives from the upper management can then be filtered through this perspective to determine whether the decisions made would best serve the interests of both teachers and students.

One additional role of the subject head related to sustainability is the promotion of blended learning where he has shared what has been done in the EAP course to other teachers and departments; for example, the administration. This in some ways could inspire other departments and foundation studies subjects where they can have a look at the online resources created and ask questions. The positive outcome of this sharing process is revealed in the following interview response:

> There has been positive feedback from other departments after having seen some examples of what the EAP has done and inquiring whether a similar approach could be done for their courses. (Richard, Int.01-Sept., Line 27)

Additionally, the subject head can also serve as the 'voice' of teachers by forwarding their concerns to stakeholders at the upper management level. In this way, should teachers have problems or concerns with the use of the tablet computer, these issues can be brought to the attention of the upper management who then can address them. As a result, if the emerging issues with tablet computer use are continuously resolved, then teachers would be more motivated to continue using it as an educational device.

Presenting the argument

Working with key stakeholders, we presented our evaluation of the sustainability of tablet device usage learning in a way similar to the argument structure we had mapped earlier. The domain definition inference is founded on the warrant that key stakeholders, primarily teachers, make use of devices in ways that enhance sustainability in blended learning. A central assumption here is that the widespread and integrated use of technology makes blended learning possible in higher education. To provide backing for the warrant, we used a combination of literature reviews, interviews and document analysis to support the claim. Through these techniques, the domain definition inference was met accordingly, and the analysis allows for a transversal to the next inference of evaluation.

The inference of evaluation is based on the warrant that the analysis identifies departmental attitudes and instances of device uses concerned with the sustainability in blended learning. The central assumption is that program stakeholders provide insights into the use of devices. An additional assumption, that effective device use is required in sustainable blended approaches is needed.

The explanation inference is based on the warrant that the findings align with the program and are consistent with an understanding of sustainability within the context of the evaluation. The key assumption for this inference is that blended approaches are sustainable with the available resources.

As shown in the findings of this case study, the assumptions were not backed by the evidence: that is, ideas to foster sustainability were tentative despite years of tablet computers being used at the institution.

The utilization inference rests on the warrant that stakeholders such as the administration, academic staff, and curriculum design team members make use of the evaluation to enhance sustainability. This warrant is based on two assumptions: (1) Outcomes resonate and stimulate action from stakeholders and (2) Outcomes identify areas for improved sustainability. Potentially, recommendations that may lead to enhanced sustainability, and an expected improvement, could include:

1. A clear institutional stance on blended learning and pedagogical technology use through the establishment of policies surrounding tablet computers use and corresponding applications in teaching and learning.
2. Greater recognition in policies and initiatives on the need to foster pedagogical patterns.
3. Spread of sustainable practices, such as repurposing and reuse of lesson materials.

To justify such recommendations, evidence can be drawn from document analysis and member checks. At this point, this case study is primarily for research (that is, as a pilot study to check the utility of an argument based approach) and not for evaluation. Without deeper consultations and actual use, however, the utilization inference cannot be supported through our work for this case study.

Not all program evaluations, particularly those designed for an internal audience only, can meet the ramification inference that attention to concerns of sustainability can inform the promotion and evaluation of blended learning; thereby attempting to connect the project to broader practical implications. To transfer this argument to another educational context, the college could be seen as a case study representative of higher education institutions that are well resourced with contemporary educational technologies. Two assumptions are required: (1) Outcomes are disseminated in professional forums and (2) The evaluation project interests the broader community. Due to the scope of this case study the ramification inference cannot be supported at this time.

Appraising the argument

The claim that the use of tablet devices is sustainable in the EAP program is weak; that is, an idea that the devices enhance sustainable practices could be rebutted as it has not been fully met at this time. In line with the effort by Golonka et al. (2014) to set out a rubric to evaluate the strength of claims, any suggestion that key stakeholders, primarily teachers, make use of devices in ways that enhance sustainability in blended learning would be ‘moderate’. That is, although the first two inferences of observation and analysis were met, neither explanation nor utilization inferences could be fully supported. Regarding the inference of explanation, for example, matters of sustainable practices at the case study institution appeared to be at aspirational stages and are yet to be fully developed. For utilization, this limited case study cannot assert that institutional stakeholders will incorporate any of the findings in their future work.

As with other institutions offering pathways programs in Australia, the college has seen tremendous growth (Lisciandro & Gibbs, 2016) which has put pressure on available facilities and human resources, particularly academic staff, who have had to cope with changes in rising student numbers and changing teaching approaches. In this climate, and in line with studies of educational technology policy, academic staff saw little connection between their own efforts and college initiatives (Zhao & Lei, 2009). Most perceive blended learning more as a means to facilitate class management, and cut down on the use of paper, rather than enhancing pedagogy. Teachers agreed that it would take time to properly integrate new initiatives in their own approaches to blended learning and teaching.

Discussion

Years ago, work by Zhao and Lei (2009) pointed out that the “public, policy makers, and educators are in desperate need of rigorous research to guide their technology decisions and technology project implementations” (p. 688). One outcome of this case study evaluation is that such a need still exists, but there appears to be an increasing alignment of institutional strategies and resources allocated to support blended approaches. More research is needed, however, to bring together the many strands of evidence that could be the basis of a strong argument. Learning analytics can shed some light on program evaluation (Bollenback, 2015) but it is advisable to take into account a wider range of contextual issues beyond the immediate design and teaching environment (Huber & Harvey, 2016).

Perhaps not surprisingly, our evaluation demonstrated that the use of tablet computers in this blended learning program is not sustainable; that is, the claims made by the key stakeholders were not supported: the tablets did not meet the pillars of sustainability for environments and tools for learning, community and knowledge building, pedagogical and professional development or organisational structures (Blin et al, 2016). Our work in evaluating the sustainability of blended programs will now focus on technology as a *system* rather than a device. From a system point of view, technology is seen as a complex network of inter-related components that form a unified whole (Banathy & Jenlink, 2004; Ison, 2008); a clear example of which is an LMS. Therefore, the focal technology to be investigated will shift to the LMS utilised in the college, where a similar approach will be undertaken through a qualitative case study. The focus will be centered at the meso, or departmental, level and then continue to investigate classrooms at the micro level. A multi-level approach, combined with differing considerations and methodologies, allows us to undertake a longitudinal investigation of the blended learning initiative that will no doubt continue to change in the coming years.

During our discussions, we have begun to think that there is a need to take into account design practices that could be seen as making up a much more local, or nano, level. Tentatively, we defined the nano level as one that would focus on design practice themselves in line, perhaps, with the work of Phillips, McNaught, & Kennedy (2012). At this level of argumentation, pre-implementation designs as well as inevitable ongoing changes in blended materials could be taken into account within an evaluation. By doing so, the project could seek to show how well the use of learning objects, for example, was done in light of sustainability. Other considerations such as purpose, appropriateness, and multimodality as well as others could be brought to greater scrutiny. One value of the argument is that is creates a narrative that can be understood by all those involved along the continuum of developing and enacting a blended approach to learning throughout an entire university course.

Another consideration, alignment, also is on our agenda: Across an entire blended learning program, how much do policy and institutional initiatives align with other levels? How is policy put into practice, for example, in the creation of a lesson plan? By bringing in alignment as a key consideration, an evaluation team can have a stronger warrant for work across programs and the disciplines; on a related note, curriculum design teams could better defend their pedagogical patterns with a footing both in policy and educational theory. Further evidence, too, could be brought to issues surrounding the value of learning outcomes (Havnes & Prøitz, (2016) in the appraisal stages of the evaluation. Combined in a single pattern, work on alignment may enhance the work in the eyes of the institution as well as throughout the wider fields of practice in educational technologies.

To conclude, an argument-based approach to the evaluation of programs rich in educational technology appears to be feasible. Importantly, because they use the same structure and reasoning, an argument-based approach may allow for the comparison of one classroom to another, one discipline to another, and one institution to another and so on until a comprehensive picture emerges regarding the efficacy of blended learning approaches. Across Australia, for example, such an evaluation would help to improve the use of limited educational resources.

References

Banathy, B. H., & Jenlink, P. M. (2004). Systems inquiry and its application in education. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (2nd ed., pp. 37-57). Mahwah, New Jersey, London: Lawrence Erlbaum Associates.

Barry, S., Murphy, K., & Drew, S. (2015). From deconstructive misalignment to constructive alignment: Exploring student uses of mobile technologies in university classrooms. *Computers & Education, 81*, 202-210. doi.org/10.1016/j.compedu.2014.10.014

Blin, F., Jalkanen, J., & Taalas, P. (2016). Sustainable CALL development. In F. Farr & L. Murray (Eds.), The Routledge handbook of language learning and technology (pp. 223-238). London: Routledge.

Bollenback, D. (2015). A Learning Analytics Approach to Academic Program Assessment in Higher Education. *Distance Learning, 12*(3), 29.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal (RMIT Training Pty Ltd trading as RMIT Publishing), 9*(2), 27-40. doi:10.3316/QRJ0902027

Chapelle, C. A., Enright, M. K., & Jamieson, J. M. (2008). Test score interpretation and use. In C. A. Chapelle, M. K. Enright, & J. M. Jamieson (Eds.), Building a validity argument for the Test of English as a Foreign LanguageTM (pp. 1-25). New York, NY: Routledge.

Cowie, N. (2009). Observation. In J. Heigham & R. A. Croker (Eds.), *Qualitative research in applied linguistics: A practical introduction* (pp. 165-181). Basingstoke, UK: Palgrave Mcmillan.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1), 1-11.

Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: a review of technology types and their effectiveness. *Computer Assisted Language Learning, 27*(1), 70-105. doi:10.1080/09588221.2012.700315

Green, D., Naidoo, E., Olminkhof, C., & Dyson, L. E. (2016). Tablets@university: The ownership and use of tablet devices by students. *Australasian Journal of Educational Technology, 32*(3), 50-64.

Gruba, P., Cardenas-Claros, M. S., Suvorov, R., & Rick, K. (2016). *Blended language program evaluation*. Basingstoke, UK; New York: Palgrave Macmillan.

Gruba, P., & Hinkelman, D. (2012). Blending technologies in second language classrooms. Basingstoke, UK; New York: Palgrave Macmillan.

Gunn, C. (2010). Sustainability factors for e-learning initiatives. *ALT-J: Research in Learning Technology, 18*(2), 89-103. doi:10.1080/09687769.2010.492848

Havnes, A., & Prøitz, T. (2016). Why use learning outcomes in higher education? Exploring the grounds for academic resistance and reclaiming the value of unexpected learning. *Educational Assessment, Evaluation & Accountability, 28*(3), 205-223. doi:10.1007/s11092-016-9243-z

Hubbard, P. (2005). A review of subject characteristics in CALL research. *Computer Assisted Language Learning, 18*(5), 351-368.

Huber, E., & Harvey, M. (2016). Project evaluation in higher education: A study of contextual issues. *Evaluation Journal of Australasia, 16*(1), 19.

Ison, R. (2008). Systems thinking and practice for action research. In P. Reason & H. Bradbury (Eds.), *The SAGE handbook of action research: Participative inquiry and practice* (pp. 139-158). Los Angeles, CA: SAGE.

Kane, M. (2006). Validation. In R. Brennen (Ed.), *Educational measurement*, 4th ed (pp. 17–64). Westport, CT: Praeger.

Kennedy, C., & Levy, M. (2009). Sustainability and computer-assisted language learning: factors for success in a context of change. *Computer Assisted Language Learning, 22*(5), 445.

Kinash, S., Brand, J., & Mathew, T. (2012). Challenging mobile learning discourse through research: Student perceptions of Blackboard Mobile Learn and tablet computers. *Australasian Journal of Educational Technology, 28*(4), 639-655.

Kress, G. (2011). 'Partnerships in research': Multimodality and ethnography. *Qualitative Research, 11*(3), 239-260. doi:10.1177/1468794111399836

Owston, R. (2013). Blended learning policy and implementation: Introduction to the special issue. *The Internet and Higher Education, 18*, 1-3.

Patton, M. Q. (2011). *Developmental evaluation: Applying complexity concepts to enhance innovation and use*. New York: The Guilford Press.

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice, 4th ed.* Thousand Oaks, CA: Sage.

Phillips, R., McNaught, C., & Kennedy, G. (2012). *Evaluating e-learning: Guiding research and practice*. New York and London: Routledge.

Somekh, B. (2006). Action research: a methodology for change and development: Maidenhead, England; New York:Open University Press.

Stepanyan, K., Littlejohn, A., & Margaryan, A. (2013). Sustainable e-Learning: Toward a coherent body of knowledge. *Educational Technology & Society, 16*(2): 91-102.

Zhao, Y., & Lei, J. (2009). New technology. In G. Sykes, B. Scheinder, & D. N. Plank (Eds.), *Handbook of Education Policy Research* (pp. 671-693). Hoboken, NJ: Taylor & Francis.

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Using cultural-historical activity theory to describe a university-wide blended learning initiative

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Institution-wide evaluations of Blended Learning implementations are rare. Even less common are evaluations that report the sociocultural context of the implementation. Recently, an Australian university in the western region of Victoria embarked on an initiative to blend all course units over a three-year period. Stemming from a rigorous analysis of reporting documents and participant-researcher observations, an attempt has been made to describe the sociocultural context of this blended learning initiative through the lens of Engestrom's Cultural-historical Activity Theory (CHAT). This description, along with the challenges surfaced will serve as a precursor to the university-wide impact evaluation of this blended learning initiative. The objective of the analysis was to reify the complex processes, intricate relationships and dynamic environmental elements, which tend not to be captured by impact evaluations. Understanding what exactly is going on will enable the University to situate evaluation findings in the context of factors that might have helped or hampered the achievement of outcomes, and remediate process-related problems in a timely manner. Amidst the flurry of focused and coordinated blended learning activities, eight key process-related challenges emerged: Staff Capacity, Engagement, Deployment, Workload, Technological Issues, Project Management, Communication and Unit Stability. These challenges could potentially make or break 'the Blend' if not adequately addressed. This paper highlights the value of process evaluations for online and blended learning implementations and argues for such evaluations to be grounded in ontological realities reflected on accountability reports and observational data.

Introduction

Against a backdrop of falling student satisfaction, unsatisfactory course progression and rising attrition rates, much has been touted about the transformative potential of blended learning to deliver deep, meaningful and worthwhile learning experiences (Garrison & Kanuka, 2004). How can institutions then tell if their blended learning initiatives are delivering on its promise? The answer lies in a systematic, structured and periodic evaluation. Evaluating a blended learning initiative has several advantages. End-of-semester evaluations will enable institutions to re-assess the impact of financial and human resource investments on educational outcomes, possibly leading to modifications of strategic trajectories. An honest evaluation will surface areas for improvement, which can be addressed at subsequent iterations. Notwithstanding, identified strengths stemming from blended learning practices can be scaled across the institution thereby triggering higher returns on investments. Data-informed dialogues surrounding valuable pedagogical lessons at various platforms, such as at conference presentations, will also promote a culture of learning across institutions.

However, most evaluations of blended learning initiatives are summative in design and hence a heavier emphasis is placed on terminal outcomes, be they economic, learning, teaching or technological. One example is a study done by Bentley, Selassie and Parkin (2012) which aimed to evaluate the effectiveness of a blended MBA programme. Three surveys were administered to gather students' feedback on their level of satisfaction with the delivery of the programme. Based on feedback received from each survey, changes were progressively implemented. For example, a key finding reported by the study was the under-utilisation of the institution's Learning Management System. Citing higher access rates as evidence, the authors claimed that a restructure in the format of delivery had led to an improvement in its useability. However, the study does not delve into the reasons for the under-utilisation. Understanding the reasons for the lack of use of the LMS from the perspectives of staff, students and learning technologists will help to explicate the connection between the specific change implemented and the improvement in access rates. This explication would add even more value to the findings and hence enrich learning for the community of blended learning designers already grappling with a complex undertaking.

Indeed, blended learning is a ‘messy’ construct with both scholars and practitioners wrestling with issues of nomenclature. While there is consensus that blended learning necessarily includes both face-to-face interactions and one or more uses of technology, most authors either omit the manner of this combination or seem to wrestle with pin-pointing the modus operandi of this combination. Garrison and Vaughan (2008) refer to this combination as a “thoughtful infusion”, Torrisi-Steele (2011) calls it a “harmonious integration” and there are those in the tradition of Allen, Seaman and Garrett (2007) who attempt a more formulaic operationalisation of this combination by specifying the ratio of online to face-to-face investment in time or content (i.e. 30% online 70% face-to-face). Finally, Partridge, Ponting and McCay (2011) place the delivery of Blended learning courses on a continuum, “between fully online and fully face-to-face”. The challenge with the latter two operationalisations is that they exclude discourses in which the delivery of both face-to-face and online teaching co-exist. One example would be the use of a synchronous communication platform such as CoverItLive in a face-to-face environment to enhance interaction and student engagement. CoverItLive enables students to pose questions in real-time without interrupting an instructor’s lesson delivery. The questions are visible to all members of the class. At an opportune time, the instructor may identify questions and respond to them.

The lack of a widely accepted definition may lead to teachers designing units based on their own ‘folk theories’ of blended learning. One commonly observed ‘folk theory’ is the notion of blended learning being only about the technology. Many academics tend to use the term blended learning interchangeably with technology-enhanced learning tools. This results in the oft-observed “add-on” effect where academics preserve all face-to-face activities associated with learning and ‘throw’ in additional technology-related activities. This variant of blended learning significantly increases the workload for both instructors and students. The Blend is very much about the face-to-face discourse as it is about the technological tools aiming to enhance learning. It would therefore be beneficial to understand the processes of blending leading to the finished blended learning solution.

The aforementioned complexities of Blended Learning are exacerbated by the observation that the work of blending units at higher education is rarely a solitary endeavour, but a journey involving a community of stakeholders – College Librarians, Educational Designers, Academic Support Staff, casual academic sessionals, and even accreditation authorities. Educational Developers work with academics on curriculum matters such as the formulation of learning outcomes and assessment. College Librarians ensure that students and academics are well supported by readily available high quality materials. Academic Support Staff complement teaching and learning efforts through the provision of personalised coaching to ensure every student succeeds regardless of their aptitude, circumstances or academic background. Clearly, these roles overlap leading to a blurring of ownership boundaries in the blending process. The lack of insight into what exactly is going on may lead to errors of attribution. In a blog post entitled “The Attribution Error and School Reform”, Larry Cuban cites the example of Union City where gains in academic test scores had been attributed to “student use of computers” (Cuban, 2017). However, Cuban reports less is known about the district’s system-wide reforms in “curriculum, teaching, and accountability” in the 3-5 years leading up to the integration of technology and the facilitation of its use. The importance of systemic strategies had been underscored with technology being elevated as The Silver Bullet in being able to deliver student-related outcomes. The lack of insight into what exactly is going on may have led to such errors of attribution. Ultimately, the focus of evaluations must be on gathering lessons that can be feedforwarded to inform future initiatives. Without sufficient knowledge on the contribution of processes to outcomes and conversely, challenges that hamper the achievement of them, learning cannot take place.

Herein lies the value of Cultural-historical Activity Theory (CHAT) popularized by Engestrom (2000) as a useful tool to analyse blended learning processes as either a precursor or a complement to outcomes-based evaluations. A comprehensive understanding of the sociocultural context in which a university-wide blended learning initiative is embedded will lead to rich organisational learning opportunities.

Theoretical underpinnings of CHAT

Activity Theory has been hailed as “the best kept secret of academia” (Engestrom, 1993, pp 64, as cited in Roth & Lee, 2007). The origins of CHAT have been tied to 1920s’ Russian scholarship, and most notably the works of psychologists Vygotsky and Leont’ev (Yamagata-Lynch, 2010).

Vygotsky’s “classical mediational triangle” is often referred as the first-generation Activity Theory (Please see Figure 1). Vygotsky posited that higher mental functioning unique to humans are *mediated* by technical and psychological tools as indicated by the apex of the triangle (Hardman & Amory, 2015; Wertsch, 1993). Conversely, lower elementary operations are subconscious and acted upon directly on the object as indicated by the base of the triangle. For example, consider a lecturer who is the Subject, listing a set of instructions for a task on the whiteboard with the objective of being as clear as possible. We could say that the activity of communicating instructions is mediated by the whiteboard marker and whiteboard — as technical tools, and the genre of lists and language — as psychological tools. The actions of reaching for the marker, uncapping it and the movement of hands to write the instructions are cognitively triggered at a subconscious level. Vygotsky's Activity Theory represented a shift away from a view of human cognitive processing as residing in the atomic individual – as had been the dominant psychological perspective at that time – and towards a view, that recognises the distributive nature of consciousness. Intellectual processing is not restricted to neural activity within the boundaries of the brain, but a synchronised series of mind-body actions leveraging tools as mediatory artefacts.

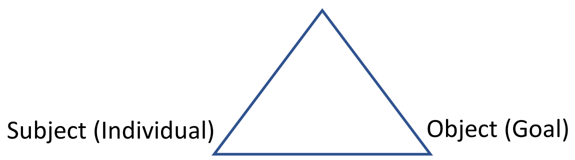

Figure 1: First Generation Activity Theory

Leont'ev, a student of Vygotsky, added the social dimension to Vygotsky's mediational theory. Leont'ev's model is regarded as the second-generation Activity Theory and is best illustrated through the primal hunting example he offers, and which I adapt. A person's involvement in a paired tribal hunting activity is stimulated by the motive of obtaining food. However, in order to achieve this motive of food, this person needs to perform actions with goals that may not be directly aimed at obtaining food. This person may yell at a boar (action) to scare it onto the path of the spear thrower (goal). This spear thrower may eventually be the one to kill the boar. Both 'Boar Chaser' and 'Spear Thrower' had been unified in their motive for obtaining food but each used a different set of actions with correspondingly different goals in the hunting activity to achieve this shared motive. Through this example, Leont'ev introduced the importance in the role of the community of hunters and, division of labour in achieving objectives. In the context of assessing a diagnostic task, a teacher may be the person responsible for evaluating a learning outcome through a diagnostic task. However, this teacher's actions associated with evaluating the task is supported by an orchestra of different members from both the home and school. One of the stakeholders at school may be the school principal who constantly communicates high standards of achievement to students and another, the Head of Department who set the task. All three of them are united by a single motive, which is to take stock of student learning.

Over the past 20 years, Vygotsky's Activity Theory model has been extended by Engeström through the inclusion of Leont'ev's Activity Theory model. The resulting framework is referred to as the Cultural–historical Activity Theory (CHAT) (Engestrom, 2000), which I have adopted to describe the Blended Learning Initiative in the next section.

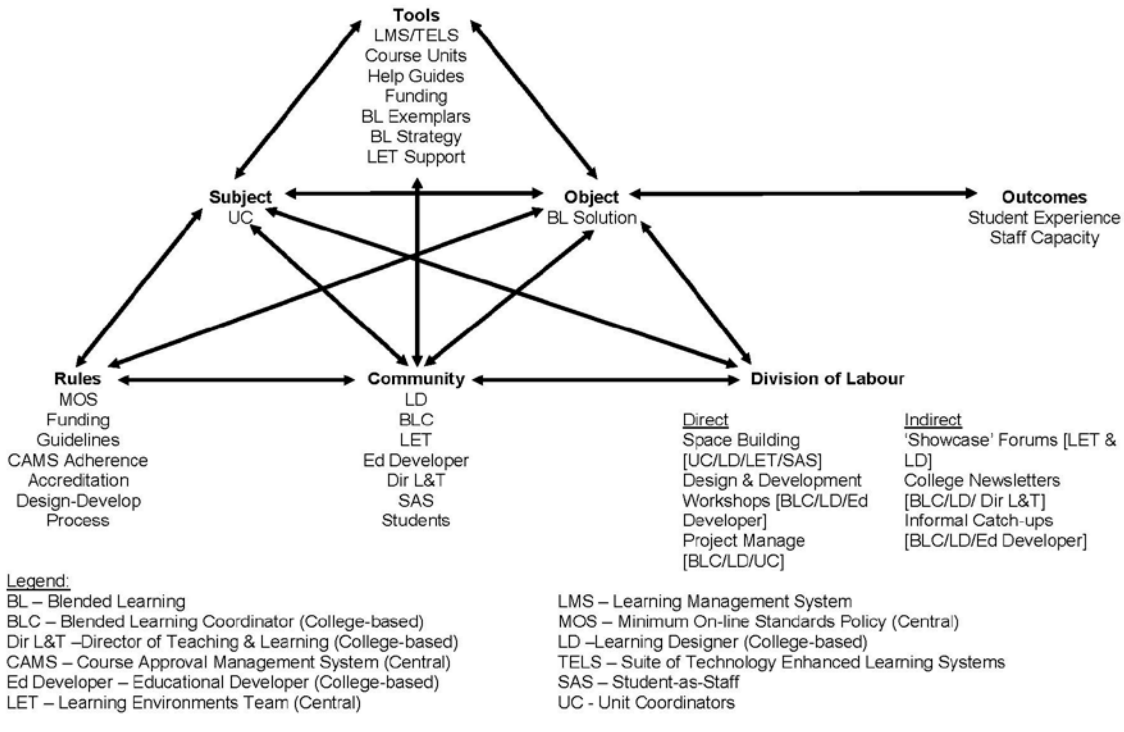

Figure 2: CHAT of the Blended Learning Initiative

The Blended Learning Initiative

In 2016, our University embarked on a Blended Learning Initiative with a quest to have all courses blended over a three-year period. A university-wide evaluation involving 86 course units from across all colleges will be completed by October 2017. The focus of the evaluation is on the evaluation of students' experiences, staff capacity and the impact of technology-enhanced learning systems on students and staff.

As a precursor to the evaluation, Engestrom's Activity Theory framework was adopted as a theoretical lens to understand what exactly is going on. This would enable us to not only measure the impact of the evaluation but to also understand it in the context of environmental issues and challenges.

Method

To obtain an ontological perspective of the Blended Learning Initiative, content analysis was performed on 40 reporting documents with the aid of NVivo software. Documents were first analysed in an attempt to identify the elements of CHAT i.e *Tools*, *Community*, *Division of Labour*, and *Rules*. In addition, risks, problems, deviations, concerns, and 'blockers' were coded as challenges. Reporting documents include newsletters and progress reports from June 2016 to March 2017. Apart from my role as the Chief Investigator of the evaluation, I also worked as a learning designer with one of the colleges. Therefore, this analysis has also been informed by personal observations and conversations with other stakeholders.

The evaluation is guided by an Evaluation Reference Group (ERG) comprising senior staff from across the University. The group meets periodically to discuss the progress of the evaluation. The challenges from this analysis were shared with the ERG. In addition, findings from the process evaluation have been communicated to College Directors, Blended Learning Coordinators and Learning Designers.

Results

Figure 2 depicts CHAT for the Blended Learning Initiative. With the Activity of focus being the work of blending, the *Subject* of the Activity are Unit Coordinators who take ownership of blending the units beyond their teaching, research and other administrative duties.

Object

The *Object* of the Activity is the Blended Learning Solution. This includes both the face-to-face component and the technology that complements it. The *Outcomes* targeted through the Blend are student experience and staff capacity. The impact evaluation aims to measure these outcome indicators. It is important at this juncture to highlight a controversy surrounding the use of the word "object" amongst CHAT scholars (Yamagata-Lynch, 2010). The Russian word for "object" may have several meanings. It may refer to the goal of an activity, the motives for participating in an activity, or a physical entity developed by participants through an activity. Our Blended Learning Solution interestingly matches all three possible uses. The goal of Unit Coordinators is to have a blended version of their units. This goal motivates them to engage in the on-going blending process. The Blended Learning Solution includes both a virtual delivery space with online activities on the LMS and face-to-face activities.

Tools

To help them develop their Blended Learning Solution, Unit Coordinators have access to a variety of *Tools.* The primary tool is the Unit itself comprising content knowledge, learning outcomes, and modes of assessments. For the first year of implementation, first-year course units with larger enrolments had been recommended to the colleges. However, the final decision on the choice and number of units was left to the discretion of colleges with a shared understanding that by 2020, all units in the university would be in blended mode. The work of blending the units takes place a year before the implementation. For example, 2016 Units refer to units blended in 2016 for delivery in 2017. On a par with the Unit as a *Tool*, is the University's Learning Management System (LMS), comprising the suite of technology-enhanced learning systems supported by the University. The LMS and the TELS reflect the online component of the Blended Learning Solution. Help Guides prepared by the Learning Environments Team (LET) offering advice and assistance on the use of the LMS and supported TELS are accessible via the staff portal. LET also conduct workshops, drop-in sessions and online / Phone-in consultations. Possibilities of the Blend are offered on the university's Blended Learning strategy documents and blended learning exemplars. Each Unit has additional funding attached, which Unit Coordinators may tap into to support them in their blending work.

Rules

Unit Coordinators' work of blending the units is governed by a set of *Rules*. The minimum expectation of the online component is set by the Minimum Online Standards (MOS) policy. Broad Funding Guidelines direct the use of these funds. Unit Coordinators may choose to 'buy-out' their time using the funds. Sessionals may be hired to take on their marking load, for example, while Unit Coordinators focus on blending their unit. Unit Coordinators might also choose to use the funds to engage specialist help to create additional resources, for example, professional videos. There is also a broad Design-Development model, which requires Unit

Coordinators to participate in the following phases: Phase 1: Kick-off to contribute to initial conversations on the blended learning work and learning issues targeted by the Blend. Phase 2: Unit Stock-take to share the current state of Units and the value proposition aimed for by the Blend. Phase 3: Design Workshops to re-imagine existing units. Phase 4: Development Workshops where staff learn from and work with college-based students-as-staff and Learning Designers to translate their designs into Unit Spaces on the LMS.

Community and Division of Labour

Unit Coordinators are supported by a Blended Learning *Community* comprising a Director of Teaching and Learning, Blended Learning Coordinator, Learning Designer, Educational Developer, and Students-as-Staff. The *Division of Labour* varies from college to college. Guided by a hub-and-spoke model, the Blended Learning *Community* report back to the Learning Environments Team (LET), which oversees the Blended Learning Initiative across the University.

The Blended Learning Project is best characterised as a flurry of activity with each and every member identified as part of the Blended Learning team participating actively. Blended learning project activities include the facilitation of key phases of the unit design and development processes, the wide array of informal and organised PD sessions and, technology support and troubleshooting. These activities have been categorised into two themes: direct support, which affects the blend of the Unit directly, and indirect support, which aims to raise awareness, scale good practices and build staff capacity in general. The Learning Designer and the Blended Learning Coordinator lead in the area of direct support. The spectrum of support is specified in Figure 2 under the "Division of Labour" node.

The analysis also unveiled challenges, which are an inevitable part of any project. Nevertheless, for lessons to be learnt and progress to be achieved, it is paramount that these challenges are addressed. However, to address them may require us to get to the root of the problem. CHAT offers a useful strategy to identify challenges through an examination of Contradictions, which I will discuss in the next section.

Discussion

An often "valorised" (Bligh & Flood, 2017) aspect of CHAT is its potential to surface 'knots' in the system. These 'knots' are referred to as Contradictions (Engestrom, 2000). Contradictions 'disturb' the Activity System. For the purposes of this analysis, I have operationalised contradictions as challenges. Surfacing contradictions will assist project administrators isolate sites of conflicts so that efforts to address them can be appropriately channelled in a strategic and efficient manner.

According to CHAT, there are four levels of contradictions. Each of these contradictions will be discussed in the context of the challenges reported. The discussion here is not meant to be exhaustive but rather to highlight the value of CHAT in being able to surface contradictions. Likewise, prematurely proposing solutions to these contradictions is not the intent of this phase, which is meant to be precursory.

Primary Contradictions

Primary Contradictions are contradictions that exist within each and any node of the Activity (Engestrom & Sannino, 2010). They appeared to be most obvious within the *Division of Labour* node. It was evident that Unit Coordinators were very well supported by the wide array of activities. However, from an analytical standpoint, there seemed to be a lack of clarity in which member of the Blended Learning Community was doing what. This lack of clarity in boundaries was more apparent in the distribution of labour between the Blended Learning Coordinator and the Learning Designer. For example, at one college, the Blended Learning Coordinator had led in the Design-Development workshops. At another college, it was led by the Learning Designer. In addition, there were colleges without Blended Learning Coordinators for extended periods leading to other members of the team re-organising their roles to 'cover' additional duties. Project Management (monitoring of timelines, budget, scheduling, etc.) seemed to be an implied role of the Blended Learning Coordinator, and a challenging one at that. The bulk of the stress associated with contradictions in this node appeared to have been shouldered by the Blended Learning Coordinator, an academic hired on a part-time load based on a position description with significant overlaps with duties typically performed by a Learning Designer. This may have led to further challenges in workload, communication and project management.

Secondary Contradictions

Secondary Contradictions are openly manifested between two or more nodes within the Activity. There were two main types of Secondary Contradictions identified. The first contradiction coded as Staff Deployment challenges was between Unit Coordinators and Units. This arose when a Unit had been without a Unit Coordinator either indefinitely or for extended periods. The lack of input from a content expert made it seemingly very difficult for a unit to progress beyond the superficial elements (e.g. college banners and placeholders for modules) of the Blend. The second contradiction identified was between the Unit Coordinators and the Community leading to the challenge of Staff Engagement. The active and deliberate engagement of the Unit Coordinator is crucial, and a Unit Coordinator's lack of involvement often prevented the Blended Learning project team from making progress. One possible reason was staff workload with Unit

Coordinators not being able to commit at times due to conflicting priorities. In addition to being involved in the Blending Learning Initiative, Unit Coordinators are also involved in a variety of other college-related work. A secondary reason could be ripple effects from Quaternary Contradictions (discussed below). Both Staff Deployment and Staff Engagement contradictions break the Activity system since the work of blending is dependent on the purposeful participation of the Unit Coordinator.

Tertiary Contradictions

Tertiary Contradictions exist between a newly established mode of the Activity and remnants of the previous mode. Against the background of copyright infringement issues, an online system for curating readings such as journal articles was implemented sometime after the work of Blending had commenced and shortly before the start of the semester. This led to modifications in work processes by the Blended Learning Community and Unit Coordinators in two ways. Firstly, there was a need to learn how to operate the new system and embed it in the LMS. Secondly, they had to ensure that readings previously stored on Unit Spaces were removed and linked to a central repository through the online system. Limitations with the new system (i.e. the inability for readings to be 'peppered' according to weeks of delivery) led to resistance. Another tertiary contradiction was due to the merger of two colleges. This led to significant re-adjustments for two colleges in all areas and in particular, the ways in which the two college-based Communities collaborated. This may have resulted in Unit Stability issues i.e. the "chopping and changing" of both units and unit coordinators that often paused the blending of units or required the team to restart the blending process.

Quaternary Contradictions

Contradictions between a neighbouring Activity and the Activity in focus are known as Quaternary Contradictions. There was news of a major initiative that would significantly affect staff deployment and the first year units across the University the following year. This either slowed down or seemed to cripple the blended learning work at all colleges because of the shroud of uncertainties: Would work invested in blending a unit be wasted should the unit not be delivered or require re-designing? Would the Unit Coordinator still be around to deliver the Blended Learning Solution?

Table 1 lists a summary of the challenges, which surfaced from the analysis. Using CHAT, I have attempted to map these challenges to Contradictions. Figure 3 depicts the proportion of these challenges relative to one another.

Contradiction	Key Challenge Reported	Example
Secondary [Subject<->Object]	Staff Capacity	Staff lacking in understanding of Blended Learning
Secondary [Subject<->Division of Labour]	Staff Engagement	Staff member indicating that they do not wish to participate
Primary [Division of Labour]	Communication	Lack of clarity surrounding "Costing queries"
Primary [Division of Labour]	Project Management	Unit development running behind schedule
Quaternary [BLP <-> FYC]	Unit Stability	"Chopping and changing" of units
Secondary [Subject<->Tools]	Staff Deployment	No Unit Coordinator attached
Secondary [Subject<->Tools]	Staff workload	Concern with work and effort required
Secondary [Subject<->Tools]	Technological Issues	Perceived shortcomings with online tools
Tertiary [e.g. Upcoming Major Initiative]	Staff Engagement	Staff members lacking in motivation to prioritise the work of blending a unit that may need to be re-designed.

Table 1: Challenges Reported

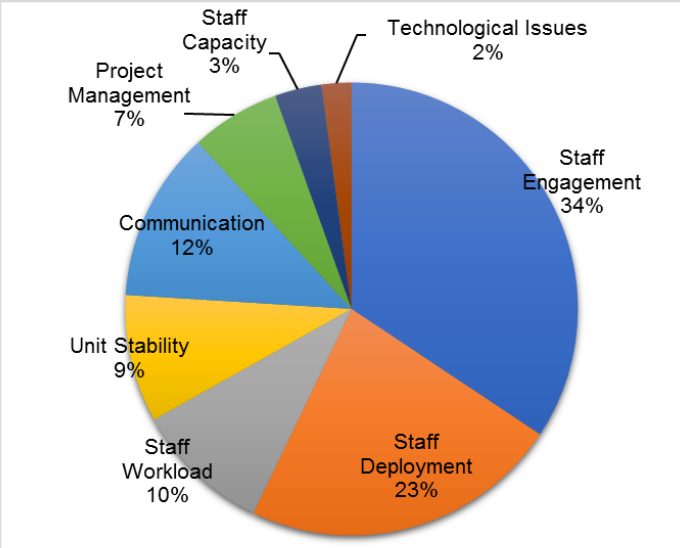

Figure 3: Proportion of Challenges Reported

Conclusion and future directions

This paper has reported on the use of CHAT to describe a university-wide blended learning initiative as a precursor to an evaluation that is currently ongoing. Reporting the sociocultural context of the initiative in conjunction with the results and findings from an impact evaluation will help the university to make better sense of evaluation findings. In addition to describing the initiative, this paper has also discussed Contradictions, a key tenet of CHAT in the context of the initiative. The identification of Contradictions will help the university to zoom in on these 'knots' and chart a way forward to untie them.

Upon conclusion of the impact evaluation, lessons and recommendations will be discussed in consultation with the Evaluation Reference Group and stakeholders of the Blended Learning Initiative.

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References

Allen, I. E., Seaman, J., & Garrett, R. (2007). Blending in: The extent and promise of blended learning in the United States. *Sloan-C Report*. Retrieved from http://www. blendedteaching.org/system/files/Blending_In.pdf

Bentley, Y., Selassie, H., & Parkin, E. (2012). Evaluation of a global blended learning MBA programme. *The International Journal of Management Education*, *10*(2), 75-87.

Bligh, B., & Flood, M. (2017). Activity theory in empirical higher education research: choices, uses and values. *Tertiary Education and Management*, *23*(2), 125-152.

Cuban, L. (2017, May 25). The Attribution Error and School Reform [Blog post]. Retrieved from https://larrycuban.wordpress.com/2017/05/06/the-attribution-error-and-school-reform/

Engestrom, Y. (2000). Activity theory as a framework for analyzing and redesigning work. Ergonomics, 43(7), 960-974.

Engeström, Y., & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational research review*, *5*(1), 1-24.

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The internet and higher education*, *7*(2), 95-105.

Garrison, D. R., & Vaughan, N. D. (2008). Blended learning in higher education: Framework, principles, and guidelines. John Wiley & Sons.

Hardman, J., & Amory, A. (2015). Introduction to cultural-historical activity theory and tool mediation. *Activity theory, authentic learning and emerging technologies: Towards a transformative higher education pedagogy*, 9-21.

Partridge, H., Ponting, D., & McCay, M., (2011). Good practice report: blended Learning. Australian Learning and Teaching Council. http://eprints.qut.edu.au/47566

Roth, W. M., & Lee, Y. J. (2007). "Vygotsky's neglected legacy": Cultural-historical activity theory. *Review of educational research*, *77*(2), 186-232.

Torrisi-Steele, G. (2011). This thing called blended learning – a definition and planning approach. In K. Krause, M. Buckridge, C. Grimmer and S. Purbrick-Illek (Eds.) Research and Development in Higher Education:Reshaping Higher Education, Gold Coast. (Vol. 34, pp. 360-371).

Yamagata-Lynch, L. C. (2010). Understanding cultural historical activity theory. In *Activity systems analysis methods* (pp. 13-26). Springer US.

Wertsch, J. V. (1993). *Voices of the mind*. Harvard University Press.

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Flipping diverse classrooms: Instructor experiences and perceptions

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Flipped Classroom is a pedagogical approach in which all or some of direct instruction is moved outside of the face-to-face environment to dedicate more in-class time to 'hands-on', experimental and engaging activities. Usually enabled by educational technology, the Flipped Classroom approach draws on the 'active learning' philosophy which implies that students must share responsibility for their learning with their instructors, resulting in more impactful learner behaviours. Considering university classrooms are increasingly diverse, with international students forming a significant cohort of learners, instructor perceptions of internationals students in Flipped Classrooms are of interest. This is particularly important because international students, especially those from Asian countries, can be perceived by instructors as 'passive' learners' regardless of students' actual skills, learning preferences and goals. This presumed 'passivity' may clash with instructors' goals, potentially creating tensions-filled dynamics between instructors and international students in Flipped Classrooms. The proposed article explores university instructors' perceptions of international students in technology-enabled Flipped Classrooms to understand how these perceptions may influence instructors' choices for the design of the flip. Findings demonstrate that while some instructors view international students as a barrier to impactful Flipped Classroom, others draw on their classroom's diversity, using it as a source of inspiration, and designing the flip with international students in mind.

Introduction

Flipped Classroom is a pedagogical approach in which all or some of direct instruction is moved outside of the face-to-face environment to dedicate more in-class time to 'hands-on', experimental, engaging and 'active learning' activities (Roehl, Reddy, and Shannon 2013). Flipped Teaching and Learning (FTL) principles and methodologies are of ongoing interest to various stakeholders in Higher Education (HE), as evidenced by the robust body of the FTL scholarship rich in evidence-based and experientially-driven studies documenting methods, benefits and challenges of 'flipped' classrooms (Du, Fu, & Wang, 2014; Hwang, Lai, & Wang, 2015; Kim, Kim, Khera, & Getman, 2014). With some exceptions, FTL classrooms are enabled by educational technologies (Elmaadaway, 2017).

Student perceptions of their academic environment must be considered in FTL research as those can influence student learning outcomes (Lizzio, Wilson, & Simons, 2002). With university student cohort composition increasingly complex (Parr, 2015), diverse student experiences and perceptions also factor into how students engage with FTL. However, a review of recent FTL literature suggests that diversity dynamics in flipped classrooms remain virtually unexplored. Specifically, considering the numbers of international students in English-speaking countries universities are increasing (Australian Universities, 2017; Chou, 2017; ICEF Monitor, 2016), research into how FTL classrooms with international students function is urgently needed.

At the same time, instructors' attitudes towards international students emerge as another important factor that might affect the success of FTL-enhanced classrooms, as instructors' bias and beliefs can shape their teaching interactions with students (De Hei, Strijbos, Sjoer, & Admiraal, 2015; Umbach & Wawrzynski, 2005). Such instructor bias can be exacerbated by the persisting discourse in the Australian media surrounding international students which continues to position them as a 'problematic' group (e.g., see Haugh's (2016, p. 727) examples of the routine use of such terms as 'cash cows', 'commodities', 'backdoor immigrants' and 'invaders' by media outlets when discussing international students). A number of persisting myths around international students' learning goals and abilities further paint this group (often referring specifically to Chinese students) as passive, reticent learners, struggling to adjust to the

Western ways of teaching and learning (Cheng, 2000; Kennedy, 2002). This state of affairs is particularly worrying as in Australian universities 25% of all students are international (Australian Universities 2017), with over 27% of them originating from China (Department of Education and Training 2016). When juxtaposed with the tenets of the 'active learning' philosophy behind FTL, international students' presumed 'passivity' may clash with instructors' FTL goals, potentially creating tensions-filled dynamics between instructors and international students in FTL classrooms. Further, as personal bias enacted against students by influential others (e.g., peers, instructors) can affect student behaviours and even influence their academic outcomes (Grunspan et al., 2016; Mantzourani et al., 2015), a better understanding of how instructors in diverse classrooms perceive their cohorts and make decisions about their teaching is timely.

Contextualised in the matters discussed above, the proposed research asks the following questions: how do university instructors (with HE lecturers and English as Second Language teachers comprising the sample) perceive international students in their FTL classrooms, and how these perceptions influence the instructors' FTL choices. The findings demonstrate that while some instructors continue to view international students as a barrier to impactful FTL, there are those who draw on diversity in their classroom, using it as a source of inspiration, and designing FTL with international students in mind.

Literature review

Flipped teaching and learning

Flipped Teaching and Learning approaches and strategies are wide-ranging, but are all shaped by the underlying goal of providing active learning opportunities for students (Baepler, Walker, & Driessen, 2014; Jensen, Kummer, & Godoy, 2015). A range of factors, such as colleagues' recommendations and perceived potential benefits to students, influence instructors' decision to 'flip' their classrooms (de Araujo, Otten, & Birisci, 2017). FTL classrooms are meant to re-shape the roles of instructors and students, with both groups sharing responsibility for learning: instructors transition from the 'transmission'-style teaching into more of a mentoring or learning facilitator role while students become more actively engaged in their learning decisions (Elmaadaway, 2017).

'Flipped' learning and teaching activities normally take place before and/or after face-to-face interactions but can also occur during class, hence either augmenting the 'traditional' lecture format or completely replacing it (Liu, Blocher, Armfield, & Moore, 2017). FTL activities designed to engage students outside of the formal instruction environment can include videos and/or audios of lectures, screencasts, and simulations (Elmaadaway, 2017; O'Flaherty & Phillips, 2015) while in-class FTL activities can be lectures, presentations, small-group discussions bolstering critical thinking and problem-solving, and self- or peer-evaluations (Kim et al., 2014). While instructors using FTL approaches utilise a range of technologies and digital devices to enable the flip (Elmaadaway 2017), flipped classroom also can be made possible without technology (Talbert, 2017). Gender, individual perceptions, course design and other factors can influence students' engagement with FTL (Chen, Yang, & Hsiao, 2015), while an array of assumptions and expectations that instructors might hold about students can in turn shape instructors' approaches to FTL. For example, such persistent neuromyths as 'digital natives', 'net generation' and 'learning styles' may dictate how instructors teach and how they design FTL classrooms (McCarthy, 2010).

Diversity in flipped classrooms

As outlined earlier, FTL classrooms tend to be powered by educational technologies, therefore students' digital skills and experience with technology can factor into their uptake of and engagement in FTL. Where international students are concerned, over the years, their digital skills and confidence have increased, suggesting that instruction methods may not need any modification to account for international students present in the classroom (Michalak, Rysavy, & Wessel, 2017). Further, when comparing self-rated digital skills proficiency between international and local students, only a few indicators differed by international status, GPA, age or parental education – in fact, such factors as discipline/area of study had far more influence on students' digital proficiency than their international status (Owens & Lilly, 2017).

While there are some examples of international students approaching learning differently when compared to their non-international peers (Eddy & Hogan, 2014; Savani, Alvarez, Mesquita, & Markus, 2013), when it comes to FTL, some studies suggest FTL may be better for international students than traditional lecture. For instance, a Canadian study comparing student achievement based on final grade between flipped and 'traditional' classrooms found that international students demonstrated a slightly higher increase to their grade than Canadian students (13.23% and 10.85% respectively) when compared to their corresponding groups in the non-flipped environment (Feledichuk & Wong, n.d.). However, others (Butt 2014) suggest that non-native English learners preferred traditional lectures to FTL formats.

If international student status does not appear to be a major factor in students' uptake of or engagement in FTL, instructors' attitudes and expectations where international students are concerned may play a bigger role in FTL experiences of these students. For example, in a personal narrative based study a lecturer identified international students as her “biggest challenge” to implementing flipped approach in her classroom (Howitt & Pegrum, 2015, p. 464), citing their preference for a “transmissive teaching style” over active learning. Further, because in addition to learning the content of the unit per se international students were also “learning how to learn” while at the same time struggling with the concept of social constructivism (seen here as critical to FTL’s success), these students were a barrier to impactful FTL (Howitt & Pegrum, 2015, p. 464). Instructors’ perceptions of international students as reticent, passive learners may be to a certain degree attributed to such factors as students’ language difficulties. However, it could also be that students’ silence and non-engagement could be shaped by their understanding of learning as a process occurring by the means of “discussion *following* acquisition of ‘knowledge’” (emphasis added), and can in fact be an “active process, socially positive and beneficial to higher level of thinking and to deepening understanding” (Trahar, 2007, p. 14).

Whether based on observations or beliefs, instructor bias towards international students can shape instructors’ FTL-related decisions. Studies exploring such bias found, for instance, that negative beliefs held about international students affect how well instructors can understand international student speech (Sheppard, Elliott, & Baese-Berk, 2017). Comparing the attitudes of staff teaching at HE level with those teaching foundational level English, those in the former group were more likely to hold negative attitudes towards international students and use such phrases as “without appropriate skills”, “diminishes the learning experience” and “ill-equipped” to describe the students (Sheppard et al., 2017, p. 48), even going as far as to argue that international students’ presence in the classroom disadvantaged other students. What is troubling, Trahar (2007, p. 17) warns is that “language fluency and intellectual ability are often conflated in people’s minds.”

Research into how instructor bias can affect their teaching approaches remains scarce (Mantzourani et al., 2015). However instructors’ perception of international students as unable to fully engage with teaching and learning activities (whether due to ‘cultural’ traits, language or other factors, imagined or real) can influence instructors’ decisions whether to use innovations in their teaching or not (Mantzourani et al., 2015). Mantzourani et al. (2015) also reports that majority of instructors (70% of their sample of 102) may feel it is not their job to accommodate international students in their classroom, shifting this responsibility elsewhere (e.g. the university or the students themselves), while some feel they are not prepared to teach diverse cohorts due to their lack of cultural sensitivity training. Where Chinese international students are concerned, the stereotypes of passivity, reticence and preference for a transmission-style learning continue to proliferate among instructors (Cheng, 2000; Kennedy, 2002; Lee, Farruggia, & Brown, 2013).

The study

This research project sought to explore the complexities of instructor perceptions of and experiences with FTL in the wider context of an institutional culture encouraging teaching innovation. A literature review undertaken to inform the study’s design and methods revealed that most of the recent FTL research was conducted using quantitative methods and focussing on student experiences and perceptions (Bishop & Verleger, 2013; O'Flaherty & Phillips, 2015). It was decided therefore to use semi-structured interviews to generate in-depth insights into the FTL phenomena from the perspectives of staff. Participants were recruited from the university’s wider cohort of academic staff with active teaching duties. Because the university is a dual-sector institution, participants were either from HE or from Vocational Education sector. Hence, throughout the article, participants are referred to as ‘instructors’.

After receiving ethical clearance, participants were recruited via an email invitation facilitated by faculty deans and by the researcher herself utilising a ‘snowballing’ technique. Main inclusion criteria were active teaching duties and the use of FTL. Participants’ gender was deemed irrelevant for the recruitment purposes as the study’s focus was primarily on the instructors’ complex experiences with FTL. On the other hand, participants’ academic discipline/field was deemed important and all effort was made to recruit from all faculties. However, as no staff from arts, social sciences, health and humanities responded to the recruitment invitation, the sample comprised two key groups of instructors: those teaching STEM subjects (including sciences, technology, engineering and mathematics as well as design) and those teaching accounting and commerce as well as a few instructors working in the Vocational Education sector. In total, 18 instructors participated, with interviews lasting 1-1.5 hours. Interviews were audio-recorded, transcribed and analysed using NVivo software to identify themes and trends. Of 18 participants, ten were women and eight were men. Of ten women, six were Anglo-Australian, one of Scandinavian background, two of Sri Lankan background, and one of Russian heritage. Of eight men, all were of Anglo-Australian background.

The interviews addressed various topics of inquiry relevant to FTL, such as instructors’ definitions, motivations and how-to techniques as well as various challenges associated with FTL. International students and diversity in FTL were not initially among this study’s topics of inquiry; however, this theme emerged as a concern shared by many and, thus, became another area of investigation.

Findings

Out of 18 instructors interviewed, 11 (over 60% of the sample) brought up international students and diversity in the context of FTL unprompted. Out of the latter segment of the sample, five addressed the topic on a surface level, while the rest dedicated a significant portion of the interview exploring it. Those who discussed the matter on a surface level were two Anglo-Australian men (one of them working in the Vocational Education sector), the Russian-background woman, one of the Anglo-Australian women and one female academic of Sri Lankan background. All of these (with the exception of the Vocational Education instructor) taught either engineering or commerce subjects and were appointed at either senior lectureship or associate professorship level. At the same time, among instructors who discussed the topic of international students in an in-depth manner were three Anglo-Australian women, one female staff of Sri Lankan background, one Scandinavian-background woman, and one Anglo-Australian male staff. Two participants in the latter group (male and female, both Anglo-Australian) were employed in the Vocational Education sector.

Instructor perceptions of diversity in flipped classrooms

When discussing international students in FTL classrooms, all instructors tended to follow similar narrative pattern, positioning international students as an important factor influencing the dynamics of the FTL environments, and putting the international student status in the same category of factors as students' year of study, their academic skills or motivation for learning. Various ideas instructors held about international students were arrived at as a result of their teaching experiences rather than based on strategically collected data. Main themes emerging from instructors' narratives around international students in FTL classrooms were challenges associated with international student presence in FTL spaces; the changing role of an academic in the diverse FTL classroom; and practical approaches to how to take advantage of diversity in FTL classrooms.

Challenges

Passivity

International students' alleged passivity as learners emerged as one of the key challenges to the impactful flip. As the FTL approach is based on the active learning pedagogy, which implies students are expected to share the responsibility for their learning with educators, instructors saw international students' perceived passivity as incompatible with the goals of FTL, regardless of the flip's design. In this context, international students were discussed as a homogenous group, constructed as the 'Other' and set aside as too different from their non-international peers (the latter cohort also seen as mostly homogenous). However, whenever learner passivity was mentioned, Asian students were singled out, the rhetoric hence perpetuating the stereotype of passive Asian learners, as highlighted by the relevant literature.

Instructors who discussed international student passivity on a surface level spoke of this group in terms of students' overall (presumed) preference for a particular mode of learning. The 'learning styles theory' was commonly mentioned as a justification of the instructors' belief that students from Asian countries preferred a 'transmission style of learning', associated with passivity and a lack of learner independence. For example, as one engineering instructor said, in his classroom "30% are international [students], usually from South East Asian countries where all learning is by transmission and… by getting a lot of information." The same instructor saw this 'cultural preference' as a barrier to successful FTL classroom because, he believed, these students were not likely to engage in an active way of learning that FTL demands. Furthermore, this instructor positioned 'learning style' as *a priori* phenomenon, something that must be taken into account when designing FTL, implying international students possessed a more passive style of learning.

A female instructor teaching a commerce subject also spoke about international student passivity as a 'given' trait: "a lot of the international students, especially in the early years don't get the concept [of flipped learning]" and therefore are likely to come to class unprepared, slowing down the dynamic flow of the FTL classroom. She elaborated: "[international students are] used to coming to class and being told what to do. They find [FTL] confronting, they think that we're being lazy by not delivering – '*You*'re supposed to be teaching *me*!'". Managing such a (perceived) expectation from international students in the FTL classroom was seen as a barrier, but at the same time "it's more enjoyable" that way", the instructor concluded, adding that she liked the "challenge".

Third instructor speaking about international students' passivity and their subsequent expectation of transmission-style teaching echoed the above ideas: "[students] never… like to see a teacher taking a really passive role and not giving them words and everything". She added that FTL is "not the structure they're used to" and therefore she would not 'flip' a classroom with many international students in it. Another instructor (a male working in the Vocational Education sector) reiterated the passivity stereotype by saying "students from Asian countries" preferred a certain way of teaching, "where it's basically one person talks and you just shut up and write down everything and then regurgitate in exam." However, instead of choosing not to teach in the flipped mode as his female colleague stated above, this Vocational Education instructor believed FTL was in fact a perfect way of teaching international students because it pushed them out of their comfort zone and engaged them in learning: he explained that FTL for these students was "a very different way of learning, where they have to discover, they have to think," and where "it's getting them to become a part of the process by actually thinking and asking questions, rather than just being talked at. They learn that way and they can ask questions and they can engage and interact, depending how you plan your class the next day after, after you've flipped… They quite like it." This instructor, however, also noted that being from the Vocational Education sector gave him far more chances to engage students in class compared to his HE colleagues because:

> *[Vocational Education] students have more [of] an opportunity to have discussions and seminars and things, based on what they've seen… And maybe I've just spent 15 minutes just filling in any gaps that they need to have – but I can get straight into [it], get them discussing things and whatnot, or doing some practical hands-on stuff that they have to do. They find it more engaging to speak and to interact with others than just to sit and listen to me while they're on their mobile phones.*

Like others in this study, this Vocational Education instructor mentioned the 'learning style theory' as something that guides his teaching: "I just try and think of all the different learning styles that students can have, and I try to develop things that meet a lot of those learning styles, which is pretty important". He elaborated that "students have different learning styles; maybe one class may be better at learning auditory rather than kinaesthetic, or rather than whatever, visual or things like that. So I just base it on the students reactions, how successful I've been or not." Finally, a female IT lecturer added to the chorus on passivity by saying that "[international students] want you to tell them exactly what to do. They won't trust what's written. They need to see it come from the tutor. Which is a bit frustrating, because sometimes my tutors are not always on track, on message." The latter issue, she believed, could be resolved by better investing into tutor training, and ensuring tutors routinely raise awareness amongst students as to the rationale and expectations of the FTL model. The same IT lecturer also felt it was harder to implement FTL in large and more diverse classrooms because of a higher number of competing student expectations and so by introducing FTL, she would risk receiving lower satisfaction ratings from students:

> *[Mine is] a core subject. I have your double-degree engineering students who are as bright as a tack, who do seem to like [flipped classroom], for the most part. I have international students 'straight off the boat'. I have postgraduate students, international and local. When you've got 300 of them, trying to make everybody like you enough to give you a nine-and-a-half rating [is hard]… But if you're working with 30 students and you can give individual [attention] – [that] impacts on any ratings for me.*

A sole critique of the international student passivity discourse came from a female Vocational Education instructor teaching English as a Second Language (ESL), who described passivity as an "unhelpful stereotype" and even contemplated whether it was to blame for international students' resistance towards the FTL approaches rather than their presumed inherent traits:

> *I think we like to think that international students, especially those from Eastern countries, have this very passive expectation the teacher is going to pour all the knowledge into the top of their head and they'll just sit there and receive it. I don't agree with that, I don't think that's necessarily true. I think there are students who just want to sit back and pretend that they're listening to what you're saying and hope that they'll get something by osmosis, I guess. But I think if you set up your classroom environment, and it's easier with smaller classes, if you've got 70 [students] in your workshop – I don't know what the sizes are but a lecture is completely different, that's another kettle of fish, but I think they learn to be interactive."*

This instructor was also aware that it could be cohort-determined how students responded to her active learning FTL activities: "I think [expectations of FTL] depend on your cohort of students. I think it's a personality thing. You can get some kids from China and Vietnam who will just sit there and want the teacher to do all the work, and you'll get others who are very feisty and want to chat. So it's just completely a personal thing."

Language

International students' English language difficulties emerged as another challenge to the impactful FTL. For instance, when a female Anglo-Australian lecturer teaching a third-year commerce subject assessed her experiences with flipping the content, she concluded, "no matter what I do, the students find this particular unit so difficult and challenging and boring. And no matter what I do, I don't think that's going to change… It can be really dispiriting." She believed that high failure rates in this subject were due to a high percentage of international students who struggled with English: "students can fail this unit three or more times because they just struggle with the language. It's really language problems! And yet we involve Learning and Academic Services. We have Learning and Academic Services come in and go through the assignment every time and they're on [Learning Management System, LMS] and they interact directly with the students as well and we'll see students to help with the assignment..." Based on her many years of teaching and convening this subject, the instructor believed that student disengagement had nothing to do with the mode of delivery but rather was due to students' level of preparation, specifically, their low level of English which, she said, was "a huge issue", asking "why aren't we sorting them out before third year?"

This third-year commerce instructor also outlined several techniques she tried out to engage her students. These included running 'trouble-shooting' synchronous online sessions and instituting an open-textbook policy during exams. Concerning the former, the 'trouble-shooting' endeavour failed to work due to consistent low attendance. As for the students who did 'show up' to the online sessions, those "who really need it, often… won't talk… because they're nervous about talking, about their own language skills." The instructor thought that for these students, "the best thing… is [to] go and get English assistance, which we offer through Learning and Academic Services", however "because of their visa requirements, they have to do so many units, so they really don't make that [support] a priority." Concerning the open-textbook exam policy, this instructor encountered another unexpected barrier in the form of the university's blanket 'no dictionary during exams' policy which was at odds with her open-textbook policy. She contemplated: "allowing a textbook in is one thing, but if [students] don't know what the words mean, even though there's a glossary in the textbook…" it renders the open textbook policy useless. She suggested the university "needs to rethink [its] dictionary [policy]" to better accommodate international students. She also stated that allowing textbooks during exams was an "effective tool" as it eliminated the need for content memorisation, an unhelpful practice she associated with passive learning.

The issues such as international students' (presumed) passivity and insufficient English language proficiency could be positioned within the wider context of deficit models commonly associated with the experiences of 'Others' in Western education systems (Valencia & Solórzano, 1997). While, as the article's second half demonstrates, many instructors envisage diversity-centric ways of engaging international students in FTL classrooms, the dominant positioning of international students as a 'challenge to be overcome' appears to be alive and well, affecting the narratives of impactful FTL.

Instructor's changing role in diverse flipped classrooms

Instructors teaching in diverse FTL classrooms tended to contemplate how their FTL experiences made them query a number of assumptions they held about their role as an academic. For instance, the female Vocational Education ESL instructor whose anti-deficit narrative was outlined earlier positioned herself within her FTL classroom in the context of student empowerment:

> *Whatever I do, I hope it empowers students to learn, I hope it empowers them to reflect, I hope it empowers them to succeed in whatever they want to do. So for me that's what motivates me – that wish to empower. I actually like imparting my knowledge and my experience as an example of possibility for them as a starting point, but I think in the end it's just providing rich meaningful opportunities for them to explore themselves, their world, to develop their abilities and to identify… their strengths and their gaps.*

She reiterated, "it's important to not always work from a deficit model, [on] what [students] *can't* do, and instead really celebrate what they *can* do and to build on that, and to get them to identify the gaps by setting up situations where they need a particular skill in order to do something and when they say, 'I can't do this because I don't know how to do that', they can actually teach each other or try and teach themselves." She concluded that the "autodidact" type of learner "is the new 21st century person.

However, this instructor also found she was learning to be flexible in her role as a FTL educator and that she had to become attuned to her students' needs and expectations and adjust her FTL approach accordingly. She said, "…sometimes when it's wintertime and they've been here for six months and they're missing their family, they lose focus… start to not come to class and things like that. So it's more than facilitating – it's actually motivating [them]. It's a bit more like a life-coach… than facilitator." While she acknowledged the situation may be different in HE, where such individualised support was not always possible, she saw her role as having to go beyond her teaching duties: "We all use this word, 'I'm a facilitator, I'm an instructor', but I actually think it's more than that, it's bigger because there's also that pastoral aspect. Maybe not so much for academics with big classes, but certainly in the [ESL] sector and in the smaller pathways courses – I know other teachers are the same. It's about really supporting students to achieve their goals."

When asked about the emotional burden of having to provide student care in addition to teaching, she replied in affirmative: "We always say, and we know this, that

[Vocational Education/ESL] is like kindergarten, I guess, or the training wheels before they get to university. And I think they often feel a little bit lost when they actually begin their course." She also acknowledged that in some ways the university attempted to ease this transition: "I think that's why they introduced the BBA degree which is the Bachelor of Business Administration. So the first year is within Vocational Education but they're involved in a Bachelor program, so that first year is really scaffolded." This structure of an undergraduate degree shared some similarities with other 'bridging' programmes, for instance those designed to facilitate Indigenous students' transition into HE (Pechenkina 2015). This ESL instructor saw it as part of her role to prepare students for a smooth transition into HE. The latter could be achieved in part by introducing students to "meta-cognitive training and meta-learning" and helping them understand "what works for them in terms of learning, and where their strengths are and where their gaps are". This instructor saw FTL as a perfect environment to achieve these goals as FTL has the potential to empower students and transform them into independent learners.

Engaging international students in flipped classrooms: Implications for design

Several instructors in this study discussed how they designed their FTL specifically to empower international students by drawing on the students' strengths and observed learning patterns. For instance, a female Anglo-Australian design instructor outlined her use of various digital technologies to enable FTL. After observing how international students engaged with certain technologies, she adjusted her own use of technology in the classroom to meet student expectations. For instance, after noticing her students used eportfolio application on their mobile phones to annotate her lecture slides, she introduced eportfolio as part of her teaching and assessment practice. She noted how learning about "different technology [preferences] across different cultures", for example, finding out that international students were "much happier using digital technology and emoticons [than interacting face-to-face]" was a revelation to her. She added that, specifically "emoticons are great, they really help" because they are a "universal language" and could help prepare international students for professional world where communication skills are instrumental to success. She said, "I see emoticons being used [in professional communications], and I see it [used by] people in employment. Because there is no tone in email, and therefore you can add a smiley face, and it's the tonality that's important." She went on, "because a sense of humour [is important…] – [in] America, [there's] no sense of irony. [In] Australia, self-deprecating, sarcastic humour is the rule of thumb." She recalled learning that "colour and tone mean very different things" in different cultures but "a smiley face was that universal [sign] of welcome and smiling". She relied on this knowledge to incorporate the use of emoticons into online components of her FTL to improve students' overall communication skills and boost their confidence.

Another female instructor (teaching ESL) used technology to transform her FTL assessments, (re)making those into active learning opportunities for students. For example, she instituted the use of various vocabulary builder mobile applications as self-assessment tools to challenge and augment the way students learned English grammar. She also utilised the collaborative affordances of LMS-based forums and ran synchronous collaboration sessions to enable peer assessment – with considerably more success than her HE colleague (discussed earlier) whose similar efforts failed to engage students. Further, the ESL instructor designed her FTL components by drawing on the produsage model (Bruns & Schmidt, 2011), in which international students would become (co)producers and users of their own learning artefacts, or in the case of ESL, "language artefacts". Students would then present these artefacts in class, allowing for gaps in understanding to become uncovered and discussed. Hence, by structuring her FTL approach around international students' strengths and capabilities, this ESL instructor challenged the deep-seated deficit-model assumptions around international students' passivity and alleged preference for learning by transmission.

In turn, the Anglo-Australian female commerce instructor whose internationals students showed little interest in the LMS-based online collaboration activities felt she succeeded in using FTL to engage international students by creating authentic 'real-life' learning experiences for them. For example, she 'flipped' her face-to-face content into case-study and scenario-based learning situations, built around the topics of (presumed) interest to international students, such as world politics, migration, and employment markets valuing international professionals. She explained her rationale for doing so by stating that international students were "not empty vessels, [but rather] they come with their own personal schemer, there's a whole world in there" – therefore it was crucial to give them more control over their learning by shaping FTL learning opportunities around their interests.

Active learning approach and produsage model were drivers of instructors' FTL aspirations, while technology was the main enabler of FTL. However, as one of the instructors using technology to facilitate FTL noted, educational technologies represent yet another skill international students might need to learn in order for them to embrace FTL. Otherwise, students may be resistant to technology and their resistance, in turn, could jeopardise their engagement with FTL. As this instructor observed, "initially [students] don't get [technology] and there's a resistance to it, but then they really get into it, and [other] things like the [LMS] discussion board." Though she reiterated that "all of these things need training in how to use, [and] it has to be very scaffolded – you can't just send them off to do it by themselves, so the flipped classroom. If we're going to use that model, [it] will only work with training."

Conclusion

This study explored how university instructors in a dual-sector institution perceived international students in FTL classrooms, and how these perceptions influenced the instructors' FTL choices. Mirroring previously articulated claims that international students were a 'barrier' to FTL (Howitt & Pegrum, 2015), this study found that the passivity stereotype and general deficit-skewed perceptions of international students in FTL classrooms were held by a significant number of participating instructors. Instructors' gender, ethnic or disciplinary backgrounds or whether they were employed in the HE or Vocational Education sector did not seem to matter in that regard. However, the sole critique of deficit-based approaches to international students came from a female Vocational Education ESL instructor, a finding reflective of studies reporting that ESL staff were likely to hold more positive attitudes towards international students than their HE colleagues (Sheppard et al., 2017).

Often emerging as a part of the same argument, international students' passivity was mentioned by some instructors as frequently as 'learning styles', both concepts existing as *a priori* state, that if, something to be expected – a finding reflective of literature (Kennedy, 2002; McCarthy, 2010). Some instructors even mentioned using the 'learning styles' neuromyth as a rationale for their FTL decisions, for example, to justify their resource creation patterns, where videos and/or audio lecture formats were deemed necessary to suit different 'learning styles'. However, Trahar (2007) and others warn against over-supplying students with learning resources without providing an overarching structure and giving students topical guidance on how to engage with these resources effectively.

Different from their colleagues viewing international students as somewhat of a barrier to impactful FTL, there were instructors who drew on student diversity in their classrooms as a driver of teaching innovation, designing FTL with international students in mind. These instructors used diversity-centric FTL approaches to 'push' international students out of their comfort zone and engage them in specially tailored content. For example, one instructor, after observing her students' use of technology, realised the usefulness of eportfolios and emoticons when communicating with her students and implemented both of those elements into her FTL design. A limitation of this study, the effectiveness of the FTL classrooms (e.g. impact evaluated based on students' final grades or their rates of completion, retention, or satisfaction) was not measured, leaving room for future research into impactful FTL practices in diverse classrooms. However, considering majority of HE instructors may not see the task of improving learning experiences of international students as their responsibility (Mantzourani et al. 2015), shifting the onus instead on the university or even the students themselves, it could be said that success of FTL in diverse classrooms largely depends on an instructor's individual efforts and their willingness to listen to students and augment their teaching accordingly.

The theme of training, for both instructors and students, where FTL and technology were concerned, also emerged as important. Tutors and lectures would need to train in FTL delivery to boost their own confidence in this approach and to help them raise FTL awareness amongst students. Inclusive of 'learning neuromyths busting', such training would need to be incorporated into various induction programs for staff new to teaching as well as into various postgraduate offerings available as professional development to all academic staff (e.g., certificates or diplomas in teaching and learning). Further, cultural sensitivity training instead of focusing predominantly on preconceived culture-based differences between students would need to inspire instructors to self-reflect and query their own beliefs and bias. Cultural sensitivity training could then draw on case studies and scenarios challenging unhelpful ideas about international students, such as their alleged passivity and preference for learning by transmission. Such training could potentially encourage more instructors to try out FTL and other innovative approaches in their teaching.

In conclusion, while the study helped reveal some persisting ideas instructors still hold about international students (some even seeing the students as a barrier to teaching innovation and FTL), there is definitely a promising shift towards using diversity as an asset rather than a burden. Considering how under-researched the area of race and diversity in the context of FTL and teaching innovation in general is, further studies on these topics are urgently needed.

References

Australian Universities. (2017). *Student numbers in Australian universities.* Retrieved from www.australianuniversities.com.au/directory/student-numbers/.

Baepler, P., Walker, J., & Driessen, M. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Computers & Education, 78*, 227-236. doi:10.1016/j.compedu.2014.06.006

Bishop, J. L., & Verleger, M. A. (2013, June 23-26). *The flipped classroom: A survey of the research.* Paper presented at the American Society of Engineering Education National Conference, Atlanta, GA.

Bruns, A., & Schmidt, J.-H. (2011). Produsage: a closer look at continuing developments. *New Review of Hypermedia and Multimedia, 17*(1), 3-7. doi:10.1080/13614568.2011.563626

Chen, S. C., Yang, S. J., & Hsiao, C. C. (2015). Exploring student perceptions, learning outcome and gender differences in a flipped mathematics course. *British Journal of Educational Technology*. doi:10.1111/bjet.12278

Cheng, X. (2000). Asian students' reticence revisited. *System, 28*(3), 435-446.

Chou, S. (2017). *The number of international students coming to the US has steadily risen. Will Trump reverse the trend?* Retrieved from www.pri.org/stories/2017-02-03/number-international-students-coming-us-has-steadily-risen-will-trump-reverse.

de Araujo, Z., Otten, S., & Birisci, S. (2017). Mathematics teachers' motivations for, conceptions of, and experiences with flipped instruction. *Teaching and Teacher Education, 62*, 60-70. doi:10.1016/j.tate.2016.11.006

De Hei, M. S. A., Strijbos, J.-W., Sjoer, E., & Admiraal, W. (2015). Collaborative learning in higher education: lecturers' practices and beliefs. *Research Papers in Education, 30*(2), 232-247. doi:10.1080/02671522.2014.908407

Du, S.-C., Fu, Z.-T., & Wang, Y. (2014, 12-13 April). *The flipped classroom: Advantages and challenges.* Paper presented at the International Conference on Economic, Management and Trade Cooperation, April, Xi'an, China.

Eddy, S. L., & Hogan, K. A. (2014). Getting under the hood: how and for whom does increasing course structure work? *CBE-Life Sciences Education, 13*(3), 453-468.

Elmaadaway, M. A. N. (2017). The effects of a flipped classroom approach on class engagement and skill performance in a blackboard course. *British Journal of Educational Technology*. doi:10.1111/bjet.12553

Feledichuk, D., & Wong, A. (n.d.). *The impact of a Flipped Classroom on international student achievement in an undergraduate economics course.* Retrieved from www.cloudfront.ualberta.ca/-/media/arts/research/april/flippedclassroom.pdf.

Grunspan, D. Z., Eddy, S. L., Brownell, S. E., Wiggins, B. L., Crowe, A. J., & Goodreau, S. M. (2016). Males under-estimate academic performance of their female peers in undergraduate biology classrooms. PlOS ONE, 11(2): e0148405.

Haugh, M. (2016). Complaints and troubles talk about the English language skills of international students in Australian universities. *Higher Education Research & Development, 35*(4), 727-740. doi:10.1080/03075070120099359

Howitt, C., & Pegrum, M. (2015). Implementing a flipped classroom approach in postgraduate education: An unexpected journey into pedagogical redesign. *Australasian Journal of Educational Technology, 31*(4).

Hwang, G.-J., Lai, C.-L., & Wang, S.-Y. (2015). Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies. *Journal of Computers in Education, 2*(4), 449-473. doi:10.1007/s40692-015-0043-0

ICEF Monitor. (2016). *Canada's international student enrolment up 8%.* International Consultants for Education and Fairs (ICEF). Retrieved from http://monitor.icef.com/2016/11/canadas-international-student-enrolment-up-8/.

Jensen, J. L., Kummer, T. A., & Godoy, P. D. d. M. (2015). Improvements from a flipped classroom may simply be the fruits of active learning. *CBE-Life Sciences Education, 14*(1), 236-243. doi:10.1097/ACM.0000000000000086

Kennedy, P. (2002). Learning cultures and learning styles: Myth-understandings about adult (Hong Kong) Chinese learners. *International journal of lifelong education, 21*(5), 430-445. doi:10.1080/02601370210156745

Kim, M. K., Kim, S. M., Khera, O., & Getman, J. (2014). The experience of three flipped classrooms in an urban university: an exploration of design principles. *The Internet and Higher Education, 22*, 37-50. doi:10.1016/j.iheduc.2014.04.003

Lee, B., Farruggia, S. P., & Brown, G. T. (2013). Academic difficulties encountered by East Asian international university students in New Zealand. *Higher Education Research & Development, 32*(6), 915-931. doi:10.1080/07294360.2013.806444

Liu, J., Blocher, J. M., Armfield, S., & Moore, E. (2017, 5 May). *Modified Flipped Classroom: A Project-Based Spiraling Curriculum Model to Support Learning Efficiency and Engagement.* Paper presented at the

Society for Information Technology & Teacher Education International Conference, Austin, TX.

Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Studies in Higher Education, 27*(1), 27-52.

Mantzourani, E. E., Courtier, N., Davies, S., & Bean, G. (2015). Perceptions of faculty in health care and social sciences on teaching international students. *Currents in Pharmacy Teaching and Learning*, 7(5), 635-644.

McCarthy, J. (2010). Blended learning environments: Using social networking sites to enhance the first year experience. *Australasian Journal of Educational Technology, 26*(6), 729-740. doi:10.14742/ajet.1039

Michalak, R., Rysavy, M. D., & Wessel, A. (2017). Students' perceptions of their information literacy skills: the confidence gap between male and female international graduate students. *The Journal of Academic Librarianship, 43*(2), 100-104. doi:10.1016/j.acalib.2017.02.003

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education, 25*, 85-95. doi:10.1016/j.iheduc.2014.04.003

Owens, J., & Lilly, F. (2017). The influence of academic discipline, race, and gender on web-use skills among graduate-level students. *Journal of Computing in Higher Education*, 1-23. doi:10.1007/s12528-017-9137-1

Parr, N. (2015, May 25). *Who goes to university? The changing profile of our students.* The Conversation. Retrieved from https://theconversation.com/who-goes-to-university-the-changing-profile-of-our-students-40373.

Pechenkina, E. (2015) Who needs support? Perceptions of institutional support by Indigenous Australian students. *UNESCO Observatory Multi-Disciplinary E-Journal in the Arts*, 4(1), 2-17

Savani, K., Alvarez, A., Mesquita, B., & Markus, H. R. (2013). Feeling close and doing well: The prevalence and motivational effects of interpersonally engaging emotions in Mexican and European American cultural contexts. *International Journal of Psychology, 48*(4), 682-694. doi:10.1080/00207594.2012.688131

Sheppard, B. E., Elliott, N. C., & Baese-Berk, M. M. (2017). Comprehensibility and intelligibility of international student speech: Comparing perceptions of university EAP instructors and content faculty. *Journal of English for Academic Purposes, 26*, 42-51. doi:10.1016/j.jeap.2017.01.006

Talbert, R. (2017). *No, you do not need to use video in flipped learning (and five alternatives).* Retrieved from http://rtalbert.org/flipped-learning-without-video/.

Trahar S. (2007) Teaching and learning: the international higher education landscape—some theories and working practices. Higher Education Academy. Retrieved from http://escalate.ac.uk/3559r]

Umbach, P. D., & Wawrzynski, M. R. (2005). Faculty do matter: The role of college faculty in student learning and engagement. *Research in higher education, 46*(2), 153-184. doi:10.1007/s11162-004-1598-1

Valencia, R. R., & Solórzano, D. G. (1997). Contemporary deficit thinking. *The evolution of deficit thinking: Educational thought and practice*, 160-210.

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A cross-disciplinary evaluation of digitally recorded feedback in higher education

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Research demonstrates that assessment feedback created using audio, video, and screencast recordings can offer advantages over text-based feedback. However, the majority of research and experience in this domain has largely been limited to a single disciplinary or cohort context. This project aimed to empirically investigate if recorded feedback (i.e. audio, video, and screencast) could be effectively implemented across different contexts, including disciplines. As part of this, teaching staff from five discrete subjects provided digitally recorded feedback to students on at least one assessment task. Assessment types included various forms of written assignments, completed by individuals or groups of students. This paper reports on survey data collected from 351 students who received recorded feedback or text-based feedback. Survey respondents were enrolled in five subjects across four disciplines (Education, Pharmacy, Engineering, and Management). To triangulate the survey findings, interview data from nine students are also included. Overall, the findings indicate that students in all disciplines found digitally recorded feedback to be more satisfying, more useful, and more engaging than text-based feedback alone. However, these outcomes differed across contexts; results tended to be elevated in subjects with smaller cohorts, and when richer audiovisual modalities were used. In two of the cases students', while still being overall positive, indicated that the feedback was less clear, usable and satisfying than indicated in other cases. These differences are explored and issues of teacher experience, cohort size, group assessment, and disciplinary cognate traditions are considered.

Introduction

Previous research has found that using digital recordings, such as audio, video, and screencasts, to provide assessment feedback can offer students and staff advantages over text-based feedback. Students have reported that digitally recorded feedback comments contain greater detail than text-based feedback comments, and are more supportive and personal. Students value the more detailed and conversational style of communication that digital recordings afford (Borup, West, & Thomas, 2015; West & Turner, 2016). Digitally recorded feedback comments have also been found to elevate students' perceptions of their relationships with their teacher (Anson, 2015; Knauf, 2016; Marriott & Teoh, 2012), as well as their levels of engagement (Crook et al., 2012; Hung, 2016; Morris & Chikwa, 2016). Educators also recognize the affordances of digitally recorded feedback, reporting that creating verbal recordings can save them time compared to writing text-based comments (Anson, 2015; Fawcett & Oldfield, 2016).

However, in general, the majority of research and experience relating to the use of digitally recorded assessment feedback has been largely limited to a single disciplinary or cohort context. As such, this project aimed to empirically investigate all three digitally recorded feedback practices across multiple disciplines. Contextual disciplinary differences have been found in a range of studies in higher education settings (for example, see: Hofer, 2001; Barzilai and Weinstock, 2015; Aditomo, 2017). The research goal of this study was to further explore the influence of context on students' perceptions of digitally recorded feedback comments, and to investigate if and how digitally recorded feedback could be efficiently and effectively implemented across disciplines and assessment types.

Method

A concurrent triangulation mixed methods design was used in this study, in which data were collected using an online survey and semi-structured focus groups. Ethics approval was received from the University's Human Research Ethics Committee before data collection took place.

Participants

As part of a wider study investigating the benefits of digitally recorded assessment feedback, an online survey was completed by a total of 372 students enrolled in six subjects across five disciplines: two from Education, one from Pharmacy, one from Engineering, one from Law, and one from Management. Survey respondents included 169 students who received digitally recorded feedback and 203 students who received text-based feedback only. It should be noted that responses of 18 students from one of the Education subjects were removed from the total sample, as their tutor failed to accurately follow the research procedure (Phillips, Henderson, & Ryan, 2016). Responses from all Law students (n = 3) were also omitted due to the fact that there were too few to include in the cross-disciplinary analysis. The final sample therefore included 351 students; however for the majority of analyses in this paper, the focus is on a subsample of 148 students who received digitally recorded feedback. Of these students, 55% were women and 51% considered English to be their first language. With regard to discipline breakdowns, 54 were Education students (100% women), 22 were Pharmacy students (73% women), 38 were Management students (66% women), and 34 were Engineering students (12% women).

Six focus groups were held with nine students who received technology-mediated feedback (eight from Education, and one from Management). The low student participation in the focus groups is potentially attributable to scheduling issues, as groups generally occurred at the end of semester when students may have been preparing for exams.

Materials

A 26 item online survey was used to gauge students' perceptions of the digitally recorded feedback, and the impact that it had. For the scope of this paper, data from six closed Likert-type questions are presented. These questions, referred to here as the *Feedback Attitudes Scale*, comprise two items related to the clarity of the feedback, two items related to the usefulness of the feedback for future work, one item related to the individualised nature of the comments, and one item measuring satisfaction with the feedback. A five-point scale measuring levels of agreement was used for the five items relating to the clarity, usefulness, and individualisation (1 = "Strongly disagree" and 5 = "Strongly agree"). The one satisfaction item used a 5-point scale measuring levels of satisfaction (1 = "Extremely dissatisfied" and 5 = "Extremely satisfied").

Semi-structured schedules were used to guide the focus groups with students. This included questions focusing on the impact of the recorded feedback, along with the students' consumption practices, perceived relationship with the tutor who created the feedback, and their perceptions of the suitability of recorded feedback in different contexts.

Procedure

Teaching staff from five disciplines were engaged in professional development activities designed to orient them to the use of digitally recorded feedback comments. They were then invited to provide feedback recordings to students on at least one assessment task.

Staff participating in this study were informed about the importance of timely and effective comments on assessment tasks and were provided with a recommended structure for the recordings, which included a salutation, relational work, a statement about the goal of the recording, evaluative summary of the assessment, textual issues, substantive comments with an emphasis on feed-forward, and a valediction and invitation to discuss the feedback further shown in Figure 1. In past studies, both students and teachers have commented on the positive benefits of recorded comments when this structure has been used (Henderson & Phillips, 2014; Phillips et al., 2016).

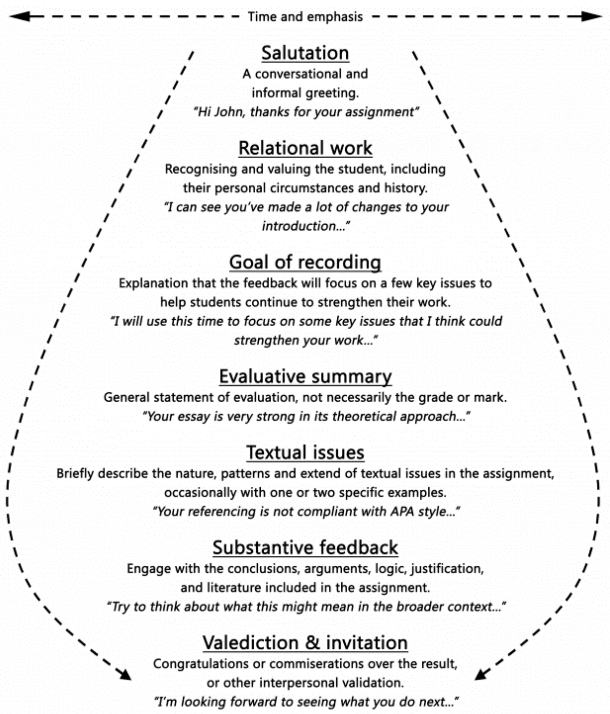

Figure 1: Structural Elements of Feedback Recordings (Henderson & Phillips, 2014)

Once the digitally recorded feedback had been returned, all students enrolled in the subjects under exploration were invited to complete the online survey through electronic notices placed on the learning management system of the subject. A question at the conclusion of the survey invited students who had identified themselves as receiving digitally recorded feedback to participate in a focus group.

It is important to acknowledge the use of digitally recorded feedback in each discrete subject were seen as situated and exploratory. Rather than assuming the methods of digitally recorded feedback previously tested in one context should be replicated elsewhere, this project adopted the point of view that each assessor in each discipline should be empowered and encouraged to adapt the methods to best meet their context. As such, each of the subjects involved in the trial, while conforming to the overarching principles of content structure and media use, had its own unique application of the digitally recorded assessment feedback.

Some of the contextual differences in this study included choices of hardware, software, variations to the structure of feedback content (see Figure 1), student learning needs, and teaching style. There were also a number of key design differences including the different assessment types, whether the task was for individuals or groups, and the mode of feedback used. These features are illustrated in Table 1. Each subject has been pseudonymised using an identifier derived from the first three letters of the subject discipline: EDU for Education, ENG for Engineering, PHA for Pharmacy and MAN for Management. The two Education cases are further identified as EDU1 and EDU2.

Table 1: Overview of key contextual factors between each subject in which students received digitally recorded feedback

Identifier	Discipline	Student Level	Number of teaching staff creating recordings	Number of students receiving recordings	Assessment task		Modes of feedback used
					Individual/ Group	Type	
EDU1	Education	Masters	3	39	Individual students	Written essay	Video Screencast
EDU2	Education	Masters	4	136	Individual students	Written annotated bibliography	Video Screencast Audio Text Rubric
ENG	Engineering	First year undergraduate	3	49	Groups of four students	Written lab report for a design project	Screencast Text Rubric
PHA	Pharmacy	Second year undergraduate	1	85	Groups of four students	Written lab report	Video Rubric
MAN	Management	Masters	7	250	Individual students	Written career portfolio	Video Audio Text Rubric

Data analysis

The survey used in this study collected ordinal data using Likert-type scales. According to Gravetter and Wallnau (2004), “most of the commonly used statistical methods such as the mean, the standard deviation, hypothesis tests with the t statistic, and the Pearson correlation are generally considered to be inappropriate for ordinal data” (p. 635). Both Field (2009) and Gravetter and Wallnau (2004) therefore recommend calculating ranked means for comparisons between groups. As the survey in this study collected ordinal data, ranked means are presented in the results section (for more information about this procedure see Field, 2009).

Results and discussion

Earlier studies have reported that tertiary students tend to prefer digitally recorded feedback in comparison to text-based feedback (Henderson & Phillips, 2014, 2015; Phillips et al., 2016). To test whether this was the case in the current sample, ranked means were calculated for students who received digitally recorded feedback and those who received text-based feedback only (see Table 2). The results revealed that students who received digitally recorded comments had higher ranked means for all survey items than students who received text-based feedback alone.

Table 2: Comparison of Ranked Means for Students Receiving Digitally Recorded Feedback (N = 148) and Students Receiving Text-based Comments Only (N = 203)

Theme	Item	Digitally recorded	Text
Clarity	The feedback used language that was easy to understand	186.26	167.62
	The feedback had a clear message	193.88	162.03
Usefulness	The feedback provided constructive comments that you could use to improve your work		
	The feedback improved your confidence for completing future assessment tasks	194.95	160.31
Individualised	The feedback gave individualised feedback relating to your own assessment	197.42	159.44
Satisfaction	How satisfied were you with the feedback?	202.48	155.00

Students in all disciplines in this study indicated a preference for digitally recorded feedback, mirroring the findings from previous studies situated in a Faculty of Education context (Henderson & Phillips, 2015). Despite this general preference, it is interesting to observe variations in student experiences of different ways in which digitally recorded feedback was designed, created and disseminated to students. It is important to reiterate here that the use of digitally recorded feedback in each discrete subject was seen as situated and exploratory and this project adopted the point of view that each assessor in each discipline should be empowered and encouraged to adapt the methods to best meet their context. The contextual variation across discipline areas is evident when examining the ranked mean scores for students who received digitally recorded feedback comments only, on questions relating to clarity, usefulness, individualization, and satisfaction (see Table 3).

Table 3: Comparison of Ranked Means for Survey Items across Subjects for Students (N = 148) who Received Digitally Recorded Feedback Comments

Theme	Item	EDU1	PHA	EDU2	MAN	ENG
Clarity	The feedback used language that was easy to understand	100.00	87.68	74.45	73.50	55.15
	The feedback had a clear message	94.50	84.48	79.92	67.88	59.97
Usefulness	The feedback provided constructive comments that you could use to improve your work	96.69	66.50	79.03	73.64	65.13
	The feedback improved your confidence for completing future assessment tasks	91.50	67.50	78.84	81.50	58.35
Individualised	The feedback gave individualised feedback relating to your own assessment	105.65	59.20	84.46	76.49	56.40
Satisfaction	How satisfied were you with the feedback	96.41	70.30	69.66	77.62	66.53

As can be seen in Table 3, students from ENG had the lowest ranked mean scores for all survey items. The remainder of this paper compares and contrasts the digitally recorded feedback in the ENG case with the other four cases, in an attempt to better understand the influence of contextual factors shaping student experience with digitally recorded feedback. Results from the survey are discussed below, and are triangulated with the qualitative data from the focus groups.

Clarity of digitally recorded feedback

While the majority of students who completed the survey ranked digitally recorded feedback as having a clear message and using language that was easy to understand, the ranked means of students in MAN and ENG were lower than the number of students in EDU1, EDU2 or PHA.

There are a number of contextual factors that might explain this difference. First, both the ENG and MAN cases had substantially larger numbers of students receiving the digitally recorded feedback compared to EDU1, EDU2 or PHA. Second, the two EDU cases involved teaching staff who had been using recorded feedback for a number of years. These staff were also working in these units as educational leaders and therefore had a direct influence on the practices of other teaching staff. During staff meetings and moderation processes, the structure outlined in Figure 1 was discussed and any variations on this were negotiated with the staff leading the unit.

The following quote is from an EDU student who mentioned that the digitally recorded feedback was easy to understand:

> *I think [the video feedback] just gave you that clearer detail than what you get if it's just a comment box on the side of a Word document. You understand what mean when they say something, just like instead of just a voiceless comment that you can't understand what the tone is or anything like that. (EDU1 student)*

With regard to the ENG case, the situation was quite different, as 25 demonstrators were required to work with students, many of who were sessional staff members. The staff leading this unit were enthusiastic and had lead large teams of staff in the past, however this was the first occasion that they had lead a team providing digitally recorded feedback. In contrast to the staff familiar with digital feedback in EDU1, EDU2 and PHA, the level of guidance and direction for teaching staff in ENG who were new to this form of feedback was not as high. The digital recordings created by teaching staff in ENG were longer than the recommended feedback design; averaging 12-20 minute-long videos rather than five minutes. While each of the subjects involved in this trial were encouraged to shape the feedback design to suit their own context, it is arguable that videos containing substantially more information in a longer format may have detracted from the clarity of the message.

Clarity of digital feedback can therefore be influenced by micro-level contextual factors such as the past experiences of staff, particularly those leading teaching teams. The challenge for future research is to consider other micro-level factors such as individual vs group tasks or written vs practical tasks and how these might be understood together with meso- and macro-level factors to better understand the interrelationships between teachers' knowledge, practice, identity on the effectiveness of digitally recorded feedback.

Usefulness of digitally recorded feedback

One notable component of Table 3 resulted from data produced by students when asked to consider whether the digitally recorded feedback they received improved their confidence for completing future assessment tasks. In this instance, data from ENG students produced the lowest mean ranked score (58.35). Similarly, data from ENG students produced the lowest mean ranked score (65.13) when students were asked to consider whether the feedback they received could be used to improve their work. While it was beyond the scope of this study to investigate this full range of contextual factors that may have contributed to these experiences, extant literature may provide some possible answers.

Streveler, Litzinger, Miller, and Steif (2008) highlight the many questions that relate to the forms of knowledge required by engineers and those studying to become engineers. In particular, those authors state that "'becoming an engineer' [involves] inter-disciplinary knowledge, identification, and navigation" (p. 291) and that the development of conceptual knowledge is a core part of this 'becoming'. The authors posit a number of questions about the developmental trajectory of conceptual knowledge in the transition from novice to expert and suggest that the development of expert conceptual knowledge may be reliant on the development of 'threshold concepts' (Meyer & Land, 2006) or core ideas that can act as portals for understanding a range of more complicated topics.

The ENG case in this study was a first year, 'gateway' subject that provided foundational knowledge which students could then use as they chose increasingly specialized engineering subjects. It may be that the lack of confidence students expressed about their capacity to complete future tasks after receiving the digitally recoded feedback was because the threshold concepts were introduced in the ENG subject but students were yet to be provided with opportunities to apply this knowledge and therefore had difficulties making connections between the feedback comments and their imagined future performance. Additionally, the group nature of the task for ENG students may have resulted in some students completing one part of the task and therefore not developing the requisite skills and confidence to be able to complete future tasks based on those skills.

On the other hand, students in the focus groups recognized that the recordings provided content that could be useful in the future. For example, one student from EDU1 stated, "There were some comments about my writing and how that could be strengthened and that's going to be a clear advantage too, going and doing other assignments." Another student from the same subject said:

> *One piece of feedback I had was in relation to my use of quotation marks, singular and double, and how they were being used. That piece of information will certainly be taken forward in other assignments, so that improves my writing. But that type of feedback given in that context makes it more digestible.*

Other students in the focus groups provided some interesting examples of why digitally recorded feedback may have more impact than text-only feedback:

> *A screencast forces you to connect with the feedback as a student and not just look at the mark and dismiss it and move on. You have to listen to five minutes or three minutes of feedback. So it's not just the mark flashing up at you on the screen, and the feedback's much more powerful in that format I found. (EDU1 Student)*

> *It's another learning phase. It's not just engaging with your mark and what was thought about the work, it's actually thinking about how the work could've been improved (EDU1 Student)*

These comments suggest that students were able to gain value from the recorded feedback by considering specific areas in which they could improve their future work. The reflective practices evident in these comments are skills that are developed as part of the transition from novice, pre-service teacher to expert, in-service teacher. Students studying to become teachers are often required to reflect on their own practices and those around them (for example, mentor teachers in schools) and this development of reflective practice continues for many teachers involved in action research, self-study, and narrative reports of pedagogical practice. This type of reflection is regarded as highly beneficial for students in Education subjects, even those in first year with limited teaching experience, as it helps them to develop the ability to self-regulate and to enhance their classroom practice. In contrast, the lower ranked mean scores produced by the ENG students suggests that these practices and the associated developmental skills may not be valued in the same manner in Engineering disciplines.

Data collected for this research does not allow more than speculation about these propositions; however, they do highlight the need for future research to not only focus on micro-level contextual factors such as the experience of teaching staff but also on meso- and macro-level factors such as the nature of knowledge and epistemic traditions in different cognate areas.

Satisfaction with digitally recorded feedback

Looking across the cases at students who received digitally recorded feedback, the ranked means of students from EDU1 and MAN were particularly high. The following comments from EDU1 students provides some insight as to why students may have been so satisfied with the digitally recorded feedback:

> *It was good information, it was helpful information and it sort of really connected to the piece of work which was great, which contextualised it in a more useful way because when you just read comments, they can be interpreted so many different ways. So this, with the video, you could see that he was really concerned about this part or he was really pleased about this part and that really helped. (EDU1 Student)*

The comment above highlights the connection between personalization and student satisfaction with digitally recorded feedback. In contrast to written comments that "can be interpreted in so many different ways" (EDU1 Student), the richness of the video recording allowed a stronger connection between teacher and student to be interpreted by the EDU student – "you could see that he was really concerned about this part or he was really pleased about this part" (EDU1 Student). In previous work (Henderson & Phillips, 2015) we have made connections between media richness theory (Daft & Lengel, 1986), clarity of message and student satisfaction in EDU units. Data from this study suggests that, despite contextual differences between the current five cases, student satisfaction with digitally recorded feedback is generally very high.

We suggest that the feedback content design (see Figure 1), with its emphasis on relational work and feed forward, would have contributed to the students' sense of lecturer sincerity and feedback integrity. This was indicated by one student who stated:

> *I almost felt like when I finished the video like I'd been in [my tutor's] office having a chat with him…it felt like I'd had like a connection and something really quite meaningful. And I guess too, I felt that he'd valued us as students because someone had taken the time to really go*

> *into my work and talk about it. I felt that it was a really rich experience. (EDU1 Student)*

However, the implications of this perceived authenticity, and the link to the media affordances and feedback design need to be further explored in future research which also take into account other contextual factors shaping student experiences of digitally recorded feedback.

Conclusion

Drawing on a long history of contextual references, Burke (2002) highlighted that context is a term that has become more common in research. Described by some as a “contextual turn” (Lawson, 2008, p. 584), a focus on the conditions and circumstances of events has resulted in refined understandings of many phenomena; however, the increased contextual focus has also led to a number of problems. For example, Burke (2002) suggested “there is a price to be paid … the inflation or dilution of the central concept, which is sometimes used - ironically enough, out of context - as an intellectual slogan or shibboleth” (p.152). More particularly, Turner and Meyer (2000) indicate that educational researchers “have developed a folk definition of context that we think we all understand but truly do not use coherently or cohesively” (p.83).

This study has opened the discussion of contextual influences on student interpretations of digitally recorded feedback. Results from five cases involving tertiary students from four discipline areas indicates that the majority of students in all cases are satisfied with the feedback and find it clear, useful, and individualised. Contextual differences can help explain variations between cognate areas and implications for educators have been highlighted and include:

- clarity of digital feedback can be enhanced by the development of individual educator-student relationships. Data from this study suggests this is easier to achieve in classes with fewer students. Future studies should investigate ways in which the development of individual relationships can be scaled for larger classes.
- the impact of digitally recorded feedback is enhanced when future oriented comments are provided to students.
- feedback content design with its emphasis on relational work and feed forward contributes to the students’ sense of lecturer sincerity, feedback integrity and overall satisfaction with digitally recorded feedback.

References

Aditomo, A. (2017). Epistemic beliefs and academic performance across soft and hard disciplines in the first year of college. *Journal of Further and Higher Education*, 1-15.

Anson, I. G. (2015). Assessment Feedback using Screencapture Technology in Political Science. *Journal of Political Science Education*, 11(4), 375-390. doi:10.1080/15512169.2015.1063433

Barzilai, S., & Weinstock, M. (2015). Measuring epistemic thinking within and across topics: A scenario-based approach. *Contemporary Educational Psychology*, 42, 141-158.

Borup, J., West, R. E., & Thomas, R. (2015). The impact of text versus video communication on instructor feedback in blended courses. *Educational Technology Research and Development*, 63(2), 161-184.

Burke, P. (2002). Context in context. *Common Knowledge*, 8(1), 152-177.

Crook, A., Mauchline, A., Mawc, S., Lawson, C., Drinkwater, R., Lundqvist, K., Park, J. (2012). The use of video technology for providing feedback to students: Can it enhance the feedback experience for staff and students? *Computers and Education*, 58(1), 386-396.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science*, 32(5), 554-571.

Fawcett, H., & Oldfield, J. (2016). Investigating expectations and experiences of audio and written assignment feedback in first-year undergraduate students. *Teaching in Higher Education*, 21(1), 79-93.

Field, A. (2009). *Discovering Statistics using SPSS* (3rd Edition ed.). London: Sage.

Gravetter, F. J., & Wallnau, L. B. (2004). *Statistics for the Behavioral Sciences* (Sixth edition ed.). Belmont, CA: Thomson Wadsworth.

Henderson, M., & Phillips, M. (2014). *Technology enhanced feedback on assessment*. Paper presented at the Australian Computers in

Education Conference 2014, Adelaide, SA. http://acec2014.acce.edu.au

Henderson, M., & Phillips, M. (2015). Video-based feedback on student assessment: scarily personal. *Australasian Journal of Educational Technology*, 31(1), 51-66.

Hofer, B. K. (2001). Personal epistemology research: Implications for learning and teaching. *Educational Psychology Review*, 13(4), 352-383.

Hung, S.-T. A. (2016). Enhancing feedback provision through multimodal video technology. *Computers & Education*, 98, 90-101.

Knauf, H. (2016). Reading, listening and feeling: audio feedback as a component of an inclusive learning culture at universities. *Assessment & Evaluation in Higher Education*, 41(3), 442-449. doi:10.1080/02602938.2015.1021664

Lawson, S. (2008). Political studies and the contextual turn: A methodological/normative critique. *Political Studies*, 56(3), 584-603.

Marriott, P., & Teoh, L. K. (2012). Using Screencasts to Enhance Assessment Feedback: Students' Perceptions and Preferences. *Accounting Education,* 21(6), 583-598. doi:10.1080/09639284.2012.725637

Meyer, J. H. F., & Land, R. (2006). *Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge*. New York: Routledge.

Morris, C., & Chikwa, G. (2016). Audio versus written feedback: Exploring learners' preference and the impact of feedback format on students' academic performance. *Active Learning in Higher Education*, 17, 125-137.

Phillips, M., Henderson, M., & Ryan, T. (2016). *Multimodal feedback is not always clearer, more useful or satisfying*. Paper presented at the ASCILITE Conference 2016, Adelaide.

Streveler, R. A., Litzinger, T. A., Miller, R. L., & Steif, P. S. (2008). Learning conceptual knowledge in the engineering sciences: Overview and future research directions. *Journal of Engineering Education*, 97(3), 279-294.

Turner, J., & Meyer, D. (2000). Studying and understanding the instructional contexts of classrooms: Using our past to forge our future. *Educational Psychologist*, 35(2), 69-85.

West, J., & Turner, W. (2016). Enhancing the assessment experience: improving student perceptions, engagement and understanding using online video feedback*. Innovations in Education and Teaching International*, 53(4), 400 - 410.

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Analysing the learning pathways of students in a large flipped engineering course

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Recent advancements in educational technologies (learning management systems, online discussion forums, peer-learning tools) coupled with new methods of course delivery (e.g. blended, flipped, MOOCs) provide significant opportunities for universities to deliver challenging, high quality, yet engaging curriculum for students. In this paper, we examine the variations and similarities of student's approaches to learning (learning pathways) by examining how well they performed in a large (N ~ 1000 student) first year engineering flipped classroom. The analysis focused on student's performance in their assessment (formative and summative) as well as their online interaction with a range of tools purposely built to support students through peer learning and acquisition of resources and expertise. Analysis using k-means clustering reveals that students do in fact adopt a variety of successful pathways through the course. The unique aspects of this work lie in the use of analytics algorithms that whilst perhaps routinely utilised in data mining, are not as well utilised in better understanding patterns (successful or otherwise) of student interactions within a technology enhanced active learning environment that integrates theory with engineering practice.

Introduction

There is a growing body of research about how students interact with online and blended learning pedagogies. These began with early understandings of the potential of distance education (Moore, 1989, 1990), to how online learning could foster a community of inquiry (Anderson & Garrison 1997; Garrison, Anderson & Archer 2000). However, what has sometimes been lacking is an evidence-based approach to learning analytics that supports learners and staff (Kruse & Pongsajapan, 2012; and that is based on learning design, and behavioural, social and cognitive measures of engagement. It also requires the development of learning analytics that tell us with useful information about students' progress through their studies (Long & Siemens 2011). The significance of this work is that it takes a more diverse view of learning analytics, built along solid learning design principles and utilises data generated during student learning activities to contribute to student facing learning analytics as well as providing meaningful data for staff. The following sections outline engagement, learning analytics and the learning design approach taken.

Literature review

There has been some criticism of learning analytics as favouring behaviourist measures over more complex and nuanced understandings of learning (Siemens and Long,). Mamun, Lawrie and Wright (2016) define *engagement* in behavioural terms as "student participation, effort, attention, persistence and positive conduct towards the learning activity" (p. 381). Defining student engagement in purely behaviourist terms is inconsistent with the approach proposed by Wiseman, Kennedy and Lodge (2016), where it is defined as "students' active involvement or deliberate investment of effort in their educational activities" (p. 666). Wiseman, Kennedy and Lodge (2016) reinforce the notion that engagement cannot be seen in strictly behaviourist terms and must comprise cognitive, affective and behavioural dimensions. This latter definition characterises the sense in which the term is used in this paper.

The learning analytics research tends to focus on how student interaction is linked to *performance*. Performance from a learning analytics perspective is usually seen in terms of retention or grade achieved (Davies & Graff, 2005; Yu & Jo, 2014) however it can be measured in terms

of course completion (Breslow et al., 2013). Davies and Graff (2005) found that there was little difference in performance (measured as grades) based on student participation in an online discussion forum. The exception to this was failing students, whose interactions were very low. Yu and Jo (2014) identified four variables that were predictive of student success or performance (time using the LMS; interaction with peers; regularity of access of LMS; and number of downloads). These four variables accounted for 33.5% of the variance in the final grade but tend to have a focus on behavioural analytics. Breslow et al. (2013) similarly used time spent on resources as a measure of student engagement leading to success (in this case obtaining a certificate of completion for a MOOC course). The resources investigated included videos, problem solving, online laboratories, and a discussion forum.

However, Kuo, Walker, Schroder and Belland (2014) found that learner-instructor and learner-content interactions were predictors of student success but learner-learner interactions were not. Additionally, Lam and Muldner (2017) found that cognitive engagement leads to better learning outcomes, especially where that task is collaborative. Viewing performance in narrow terms risks providing incomplete information to either staff or students about their possibility of a student doing well in the course of study. These findings seem to indicate that technology enhanced, active learning environments that seek to develop social skills may be ineffective if they do not sufficiently support the needs of student's collaborative efforts to complete assessment tasks.

On the other hand, Tempelaar, Rienties and Giesbers (2015) found that student performance on formative assessment tasks was a stronger predictor of student performance than time spent using the LMS (e.g. such as using clickstream data). Scheffel et al. (2017) found that the number of posts made in a discussion forum was a better predictor of performance than time spent online per se. Scheffel et al. (2017) advocate for the use of learning analytics that are skills based and that support learners whilst they are engaged in the course. This would lend itself to an approach where students are supported to learn interpersonal skills, intra-personal understandings and other practice based skills, whilst still linking them firmly with disciplinary practice. This leads to the necessity to identify suitable student-facing learning analytics and how best to present them (Verbert et al., 2014).

Providing students with information about their own learning practices and might enable them to make decisions regarding how to be successful themselves and how to gauge their current levels of success. This tends to support the (seemingly common sense) notion that the learning environment itself, and therefore the learning design may have a greater influence on the actions required for genuine success than a poorly thought out online learning presence. It also suggests that a range of measures are likely to be predictive of success and that there is a need to investigate more complex and nuanced ways of understanding student progress, particularly in authentic technology enhanced active learning oriented courses. This brief survey of the research literature leads to the identification of a range of indicators that might be provided to students in the form of dashboards and visualisations.

Learning context

Engineering Modelling and Problem Solving or ENGG1200, is a large (approximately 1000 students) second semester first year course, originally implemented in 2012. This course has been modified over the past 5 years in response to staff and student needs. The course is designed to introduce students early to the concept of what it is like to work as an engineer on complex, ill-defined problems. In this case students have the choice to complete either an aircraft prototype (such as a glider with landing beacon) or a process control system (treatment of water using a regent activated at a certain temperature).

The pedagogical design of the course is heavily influenced by the community of inquiry framework proposed by Anderson and Garrison (1997), and Garrison, Anderson and Archer (2000). An adapted version of this framework is presented in Figure 1. The course utilises a flipped classroom approach. Flipped classrooms can take a variety of forms. However, generally in class time is devoted to active learning and time outside of class is spent completing asynchronous tasks such as watching videos and completing practice quizzes. In adopting this model for ENGG1200, the course has no face-to-face lectures and consists of 5 hours of active learning workshops. Additionally students spend an equal amount of time (over the first six weeks of the course) completing online learning activities aimed at supporting students to engage with content (Materials Science) through videos, readings and Blackboard multiple choice (MCQ) formative and low stakes summative concept quizzes (McCredden, Reidsema & Kavanagh, 2017; Reidsema, Kavanagh & McCredden 2016; Kavanagh & Reidsema 2014). An added consequence and challenge of Blended or Flipped Classrooms at this scale involves solving the problem of motivating and developing what is termed "agency" or "self-regulation". Agency is not only a critical aptitude for success in academia as well as industry. A high level of "student ownership of learning" (Lave & Wenger, 1991) is essential in order to successfully navigate courses such as ENGG1200 where learning is "authentic" involving complex technological and interpersonal problem solving

(Mamum, Lawrie & Wright 2016). Student ownership of learning is a key part of ENGG1200.

Because there are no lectures a "digital ecosystem" has been developed to support student learning. Since 2013, we have trialled and incorporated Facebook for Schools but develop Casper Q&A, (a novel student mediated discussion tool) in an effort to mitigate the loss of social presence that might otherwise be provided by the lecture activity (Smith et al., 2013). Additionally, the consequences of this type of course design with such large numbers of students are that there is a loss of "feel" for how well students are engaging as well as performing in various elements of the course. The tools are also designed to support students to develop reflective writing and professional development goals (Reflection tool), critical thinking (MOOCchat), group work measured using the Peer Assessment Factor (through the PAF tool) and problem solving skills (PSS, which forms part of the group design project). The assessment incorporates summative and formative assessment tasks (templates, memo, online quizzes, mid semester exam, project report). The approximate relationship of the tools and assessment is shown in figure 1). Students can also make use of the Learning Pathway tool (Reidsema, Kavanagh, Fink, Long & Smith 2014) to keep track of their completion of tasks and assessments throughout the semester. The data gathered from these online tools, including clickstream data could be used to generate information of relevance to the large teaching team and to the students themselves. Currently, information is presented to students in the form of a dashboard.

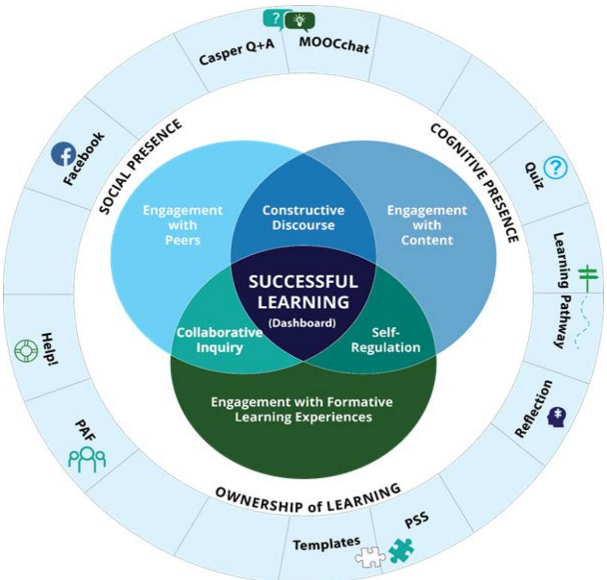

Figure 1: Integration of assessment aims and online support tools for authentic flipped learning

Methodology

Approach

Available scores capturing the class raw data of the 832 students registered in the course are presented in Figure 2. Students are graded on a seven-point scale where 7 is a high distinction, 6 a distinction, 5 a credit, 4 a pass and grades below 3 are failing grades. L_i represents available scores for students that have received a final grade of between 3 and 7. In addition, L is organised into 3 sub-tables: S with feature $S_1 \ldots S_s$, represent scores that illustrate performance of the students in summative assessments, F with features $F_1 \ldots F_f$, represent scores that illustrate performance of the students in formative assessments, and E with features $E_1 \ldots E_e$, represent scores that approximate students' engagement with different tools.

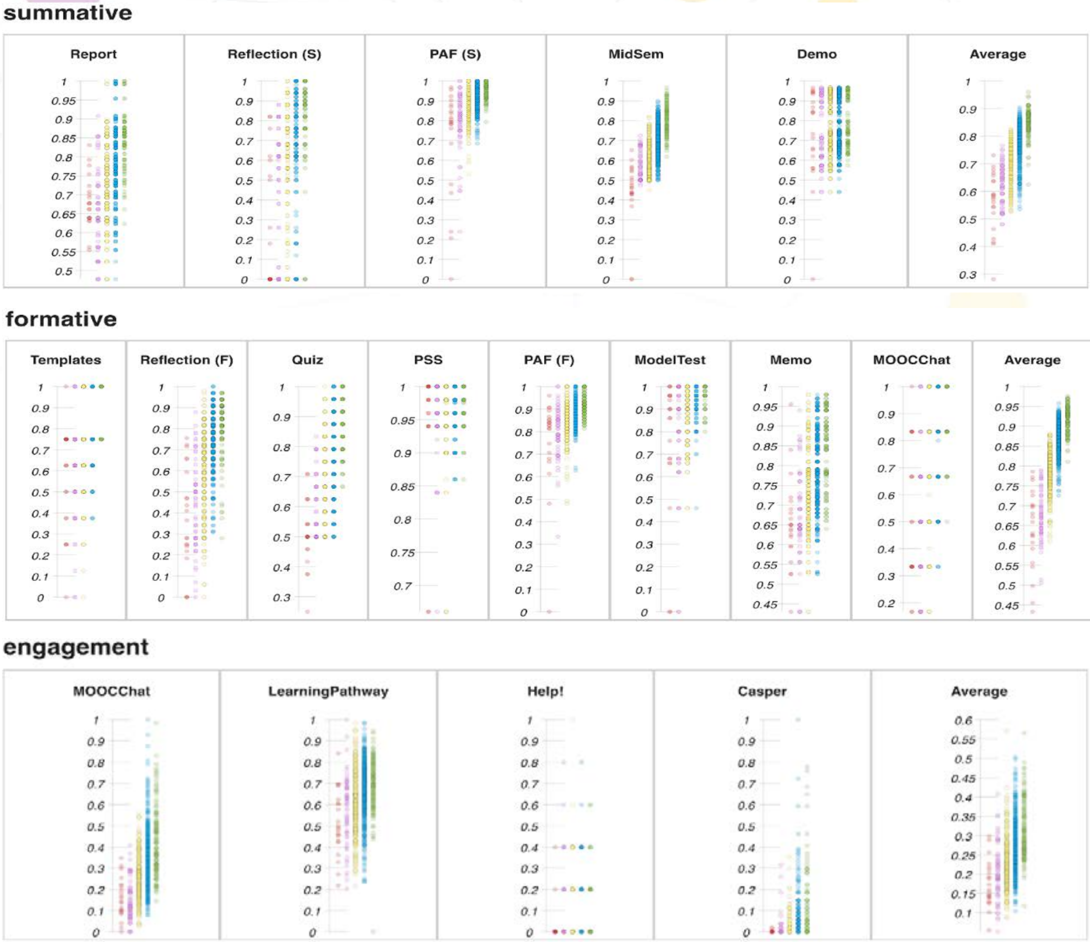

Figure 2 demonstrates a snap shot of the learning dashboard visualising the grade and engagement distribution of students with each course grade across different tools and assessments. In this dashboard, the following colour-coding is used for grades: green=grade of 7, blue= grade of 6, yellow= grade of 5, pink= grade of 4, and orange = grade of 3

Data organisation

Data from 832 students are included in this study. For each student, a total of 53 available scores are used to compute a set of 16 features. **S** features are organised into S_1 (Demo Day), S_2 (Reflections), S_3 (Mid-Semester Exam), S_4 (Final Report), S_5 (PAF 2). $S_{average}$ represents the average score across all formative features. **F** features are organised into F_1 (Templates), F_2 (Problem Solving Sheets), F_3 (Online Quizzes), F_4 (Moocchat), F_5 (Preliminary Memo), F_6 (Model Test), F_7 (PAF 1). $F_{average}$ represents the average score across all formative features. **E** features are organised as follows as E_1 (Percent of item accesses for each week in the Learning Pathway tool), E_2 (Number of posts in the MOOCchat tool), E_3 Number of tickets opened in the Help! tool, E_4 (Number of question views in the Casper tool. Al results were normalised to between and 1. $E_{average}$ represents the average score across all engagement features.

Results

Clustering

An established clustering algorithm, k-means (Khosravi & Cooper, 2017), has been employed to investigate and reveal patterns of learning and engagement in sub-populations of students with the same final course-grade. We determined values for the range of K using the "elbow" method (Khosravi & Cooper, 2017), which can be traced back to (Thorndike, 1953). This method aims to obtain the number of clusters by computing and plotting the sum of square errors (SSE) for a range [MIN..MAX] of values of K. The goal is to manually choose a K at which the marginal gain drops significantly, producing an angle (elbow) in the graph. To account for the random initialization of centroids in k-means, the recommendations of Ferguson and Clow (2015) are followed; for each value in the range, 100 executions of the k-means algorithm are run and the solution with the highest likelihood is recommended. (The high level code for performing this analysis can be found in Appendix 1.)

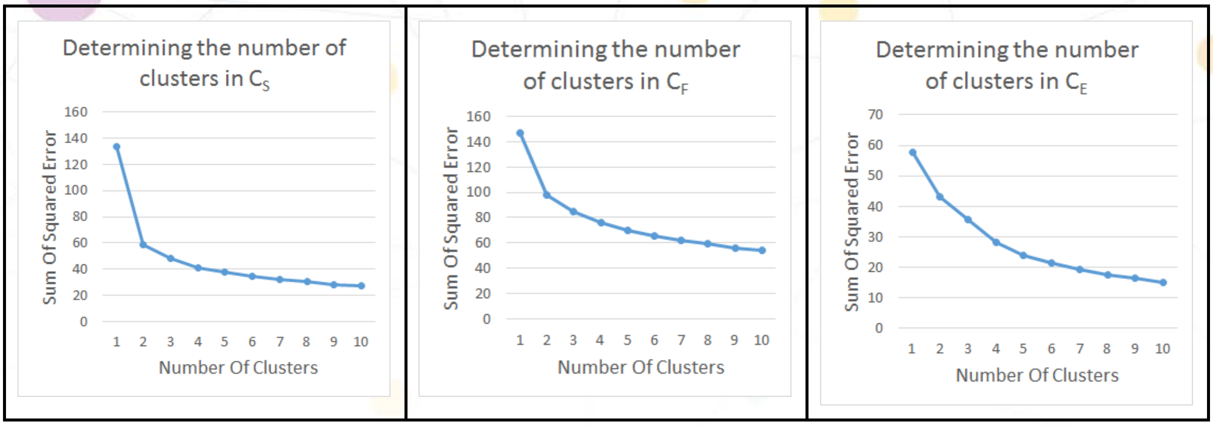

Figure 3: Using the elbow method for determining K_S, K_F, and K_E

Clustering Based on Summative Assessments

The results obtained from running k-means with four clusters identified as C_{S1}, C_{S2}, C_{S3}, and C_{S4} on **S**, which captures the performance of the students in summative assessments, are reported in table 2. Clusters are ordered based on $S_{Average}$, which captures the average performance of members of a cluster across all of the summative assessments.

Table 2: Using k-means to cluster the students based on their summative assessments. S_1 (Demo Day), S_2 (Reflections), S_3 (Mid-Semester Exam), S_4 (Final Report), S_5 (PAF 2), $S_{average}$ (average of S_1 … S_5)

Name	N	S_1	S_2	S_3	S_4	S_5	$S_{average}$
C_{S1}	229	**0.929**	0.769	0.692	0.793	0.907	**0.818**
C_{S2}	222	0.693	**0.829**	**0.756**	**0.797**	**0.925**	0.800
C_{S3}	174	0.668	0.669	0.594	0.720	0.863	0.703
C_{S4}	207	0.799	0.354	0.617	0.742	0.850	0.672

C_{S1} and **C_{S2}** could be said to be good all round performers (with 229 and 222 students in each of these clusters respectively). What distinguishes these two groups is their performance on the Demo Day, the Mid-semester exam and their PAF2 scores. These two groups have the highest performance based on $S_{Average}$ however, **C_{S2}** students appear to dominate teamwork sessions based on their higher S_5 (PAF) scores, they also score considerably higher than other students on their reflective pieces. The main factor that separates C_{S1} members from those in other groups is their high grades on the demo day (S_1). They are also doing well on S_4 and S_5; however, compared to members in C_{S2} who appear to be strong individual performers, their S_2 and S_3 grades are relatively lower.

The solid performers in C_{S3} consists of 174 students who have the second lowest performance based on $S_{Average}$. They have the lowest average grade on S_1, S_3, and S_4, suggesting that overall, they are performing poorly on both individual and team-based assessments.

C_{S4} consists of 207 students who have the **lowest performance** based on $S_{Average}$. Although their performance is better than members in C_{S3} on the majority of the summative assessments, their very low grade or failure to complete the Reflections (S_2) puts them in the lowest performing cluster. This cluster also has the lowest average grade on S_5, indicating that on average they are seen as the lowest contributors to the teamwork component.

Clustering Based on Formative Assessments

The results obtained from running k-means with four clusters identified as C_{F1}, C_{F2}, C_{F3}, and C_{F4} on **F**, which captures the performance of the students in formative assessments, are reported in table 3. Clusters are ordered based on $F_{Average}$, which captures the average performance of members of a cluster across all of the formative assessments.

Figure 3 demonstrates the sum of squares error for 1 to 10 clusters for C_S, C_F, and C_E (these clusters are described in more detail later in this section.) The elbow method attempts to find clusters that have the properties of internal cohesion and external separation. However it is challenging to find an appropriate number of clusters based on student populations that are scattered across the feature space, resulting in over-fitting or under-fitting the data. In this example, the recommended value for K_S, and K_F, is 2 and possibly 3 for K_E. However this results in an under-fitted data set. McKelvey (1975, 1978, cited in Ketchen & Shook, 1998) recommends considering as many variables as possible when using an inductive, exploratory approach as it is not possible to ascertain which variables will identify differences among observations. As such, despite the recommendation, since this is an exploratory study, we used the elbow method to give us a ballpark figure for the minimum number of clusters and chose 4 clusters in each case to have the ability to perform a more in-depth analysis.

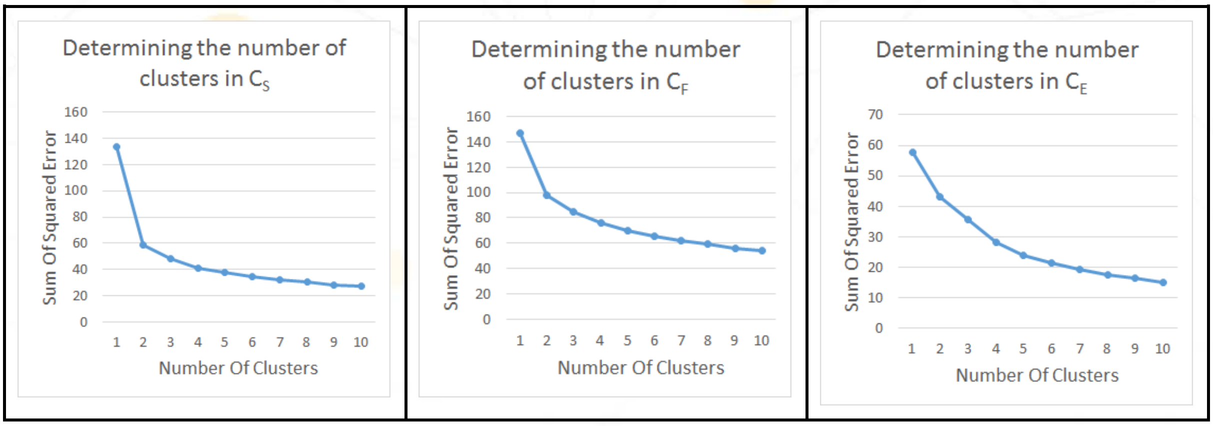

Figure 3: Using the elbow method for determining K_S, K_F, and K_E

Clustering based on summative assessments

The results obtained from running k-means with four clusters identified as C_{S1}, C_{S2}, C_{S3}, and C_{S4} on **S**, which captures the performance of the students in summative assessments, are reported in table 2. Clusters are ordered based on $S_{Average}$, which captures the average performance of members of a cluster across all of the summative assessments.

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C_{S2}	222	0.693	**0.829**	**0.756**	**0.797**	**0.925**	0.800
C_{S3}	174	0.668	0.669	0.594	0.720	0.863	0.703
C_{S4}	207	0.799	0.354	0.617	0.742	0.850	0.672

C_{S1} and **C_{S2}** could be said to be good all round performers (with 229 and 222 students in each of these clusters respectively). What distinguishes these two groups is their performance on the Demo Day, the Mid-semester exam and their PAF2 scores. These two groups have the highest performance based on $S_{Average}$ however, **C_{S2}** students appear to dominate teamwork sessions based on their higher S_5 (PAF) scores, they also score considerably higher than other students on their reflective pieces. The main factor that separates C_{S1} members from those in other groups is their high grades on the demo day (S_1). They are also doing well on S_4 and S_5; however, compared to members in C_{S2} who appear to be strong individual performers, their S_2 and S_3 grades are relatively lower.

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Clustering based on formative assessments

The results obtained from running k-means with four clusters identified as C_{F1}, C_{F2}, C_{F3}, and C_{F4} on **F**, which captures the performance of the students in formative assessments, are reported in table 3. Clusters are ordered based on $F_{Average}$, which captures the average performance of members of a cluster across all of the formative assessments.

Table 3: Using k-means to cluster students based on formative assessments. F_1 (Templates), F_2 (Problem Solving Sheets), F_3 (Online Quizzes), F_4 (MOOCchat), F_5 (Preliminary Memo), F_6 (Model Test), F_7 (PAF 1), $F_{average}$ (average of F_1…F_7)

Name	N	F_1	F_2	F_3	F_4	F_5	F_6	F_7	$F_{average}$
C_{F1}	368	0.992	**0.997**	**0.829**	**0.959**	**0.790**	**0.964**	**0.892**	**0.915**
C_{F2}	149	**0.995**	0.975	0.690	0.674	0.765	0.953	0.853	0.844
C_{F3}	215	0.690	0.970	0.691	0.813	0.764	0.930	0.859	0.817
C_{F4}	100	0.580	0.973	0.580	0.412	0.714	0.865	0.806	0.704

C_{F1} consists of 368 students who have the highest performance based on $F_{Average}$. Except for F_1, they have the highest average grade on all of the formative assessments. In particular, they have a much higher average grade in F_3 and F_4 compared to the other clusters.

C_{F2} consists of 149 students who have the second highest performance based on $F_{Average}$. They have the highest average grade for F_1 and the second highest average across most of the other formative assessments. An interesting note is that their average F_4 grades is much lower than both members from C_{F1} and C_{F3}, suggesting that these students do relatively well on all of the formative assessments except the online quizzes.

C_{F3} consists of 215 students who have the second lowest performance when averaged across formative assessments. Their lower F_1 and higher F_4 score seem to be their differentiating factor from members clustered into C_{F2}.

C_{F4} consists of 100 students who have the lowest performance when averaged across formative assessments. Except for F_2, they have the lowest average grade on all of the formative assessments. In particular, their F_1, F_3, and F_4 scores are significantly lower than members of all of the other clusters.

Clustering based on online engagement

The results obtained from running k-means with four clusters identified as C_{E1}, C_{E2}, C_{E3}, and C_{E4} on **E**, which approximates engagement of the students, are reported in table 4. Clusters are ordered based on $E_{Average}$, which approximates the average engagement of members of a cluster across all of the available tools in the course. Roughly 70% of the students have not used E_4 at all, and approximately 5% of the students have used it extensively, viewing many of the questions that are asked on Casper. This explains why average engagement with E4 is low in all of the clusters.

Table 4: Using k-means to cluster students based on engagement. E_1 (Learning Pathway), E_2 (MOOCchat), E_3 (Help!), E_4 (Casper), E_e (Average of E_1…E_4)

Name	N	E_1	E_2	E_3	E_4	E_e
C_{E1}	100	0.705	0.298	**0.316**	0.049	0.342
C_{E2}	168	0.699	**0.532**	0.024	**0.069**	0.331
C_{E3}	326	**0.714**	0.258	0	0.040	0.253
C_{E4}	238	0.466	0.227	0.018	0.008	0.180

C_{E1} consists of 100 students who have the highest engagement based on $F_{Average}$. They have the highest average engagement with E_3 and have the second highest average engagement with all of the other tools.

C_{E2} consists of 168 students who have the second highest engagement based on $F_{Average}$. They have the highest average engagement with E_2, indicating that most students in this cluster take a leading role in MOOCchat discussions. They also have the average engagement in E_4 and the second highest average engagement with E_3.

C_{E3} consists of 326 students who have the second lowest engagement based on $F_{Average}$. Despite their low overall engagement, they have the highest average engagement with E_1, indicating that most students in this cluster are pro-active on the Learning Pathway. Interestingly their average E_3 score is 0, illustrating that none of the students in this cluster have ever sought help!

C_{E4} consists of 238 students who have the lowest engagement based on $F_{Average}$. Apart from their overall low engagement, they also have the lowest average engagement on almost all, except E_3, of the individual tools, indicating that they mostly take a passive role in the course.

Analysing the learning pathways of students with a similar course-grade

Table 5 illustrates the membership of students with a similar course-grade (3 – 7) with reference to their associated clusters in C_S, C_F, and C_E, and Figure 2 demonstrates a snapshot of the learning dashboard visualising the grade and engagement distribution of students with each course grade across different tools and assessments.

Table 5: Membership of students with a similar course-grade with reference to their associated clusters in C_S, C_F, and C_E

L_i	Size	C_S				C_F				C_E			
		C_{S1}	C_{S2}	C_{S3}	C_{S4}	C_{F1}	C_{F2}	C_{F3}	C_{F4}	C_{E1}	C_{E2}	C_{E3}	C_{E4}
L_7	121	0.39	0.58	0.00	0.03	0.88	0.06	0.06	0.00	0.12	0.46	0.34	0.08
L_6	385	0.33	0.37	0.14	0.16	0.58	0.19	0.21	0.02	0.11	0.26	0.43	0.20
L_5	245	0.21	0.05	0.37	0.37	0.16	0.26	0.42	0.16	0.13	0.05	0.38	0.44
L_4	60	0.02	0.00	0.37	0.62	0.0	0.05	0.28	0.67	0.16	0.00	0.37	0.47
L_3	21	0.00	0.00	0.24	0.76	0.00	0.05	0.29	0.67	0.05	0.00	0.29	0.67

L_7 constitutes of 121 students (14%) of the class population. The highest achieving students have mixed patterns of engagement, and summative results, but more distinct formative result membership. Their distributed memberships to C_{S1} and C_{S2} show that they either perform extremely well on both their individual summative assessments and group summative assessments or mostly on their group summative assessments. The distribution of formative features shows a strong alignment to C_{F1}, indicating that the students in L_7 consistently achieve the best results in all formative assessment items. L_7 membership strongly aligns to C_{E2} and C_{E3}, with a small population belonging to C_{E1}, and less than one percent hardly engaging at all. The C_{E2} membership shows that 46% of these students taking a leading role in MOOCChat and are highly engaged with Casper. On the other hand the C_{E3} membership shows that 33% of these students primarily engage with The Learning Pathway without utilising the other tools. Interestingly, 11% of these students, despite doing extremely well, have reached out and asked for help.

L_6 constitutes of 385 students (46%) of the class population. Students in this cluster have mixed summative and engagement memberships, with less varying formative memberships. The distribution between C_{S1} and C_{S2} shows that some of these students perform extremely well on their respective group or individual assessment items, with the less prominent memberships to C_{S3} and C_{S4} indicating that there were students who have poorer team workload distribution, or worse individual assessment achievements and thus inferior summative assessment results. The divided memberships between C_{F1}, C_{F2}, and C_{F3} indicate that L_6 consistently perform well on the formative assessments, however the close split between C_{F2} and C_{F3} shows that some students drop marks on the *Templates* (Individual), but make up for these lost marks in *MOOCchat* (Team)*,* or vice-versa. L_6 has varied membership features, indicating that each student found their own pathway to success with the tools. C_{E1} membership indicates that these students had a good balance of using each tool, whereas C_{E3} membership shows that some students achieved with relative little use of the *Help!* tool. Membership to C_{E2} shows that 26 percent of students found success through leading discussions in *MOOCchat*, and not valuing the use of *Casper*. The remaining population in C_{E4} is indicative of students who had very little engagement, but still succeeded in the course.

L_5 constitutes 245 students (29%) of the class population. Summative student features in this cluster distribute mostly evenly between C_{S1}, C_{S3}, and C_{S4}. This is indicative that some students performed well on their group projects, but much poorer on their individual assessment and scaled team project marks as shown through the C_{S3} and C_{S4} memberships. Their formative results are spread out between C_{F1}, C_{F2}, C_{F3}, and C_{F4}, with their strongest membership being C_{F3}. The variance of the memberships suggests that students do not perform uniformly well on the formative assessments, but rather excelling in some activities and performing less well in others. L_5 engagement patterns vary a lot, with strong memberships to C_{E3} and C_{E4} and a weak membership to C_{E1}. The strong membership to C_{E4} indicates that these students had very little online engagement to the course, but still managed to achieve a reasonable grade. The slight C_{E1} membership shows that these students spent a lot of time utilising course-learning resources, and the remaining membership to C_{E3} indicates a neglect of use of the *Help!* tool, but good engagement elsewhere.

L_4 constitutes 60 students (7%) of the class population. The lower achieving students have distinct summative feature membership split between C_{S3} and C_{S4}. This shows that students in L_4 generally performed poorly on all summative assessment, and have relative poor team performance. L_4 formative results split have a distinct split between C_{F3} and C_{F4}. The majority of membership to C_{F4} indicates that poor achievement in most formative assessments, while the membership to C_{F3} shows relative average formative scores. Engagement patterns are divided between C_{E3} and C_{E4}, with a small membership to C_{E1}. These memberships indicate that there was a lot of variance in the way L_4 sought knowledge in the course. 36 percent of students in this cluster had high levels of *Learning Pathway* engagement, with relatively low *MOOCchat* engagement and time spent viewing questions on *Casper.* These students had no *Help!* engagement. Conversely, 46 percent of students in L_4 had extremely low engagement features and did not perform well. The remaining 16 percent of L_4 failed to achieve superior grades despite having high engagement across every tool.

L_3 constitutes 21 students (2.5%) of the class population. The failing students have a clear membership to C_{S4} and a slight deviation to C_{S3}. They have no association with the higher-performing clusters, C_{S1} and C_{S2}. Strong membership to C_{S4} indicates that the student teamwork was poor, and they performed very poorly on individual assessment. L_3 exhibits strong membership to C_{F4} and slightly less to C_{F3}, with almost no association to the higher achieving clusters C_{F1} and C_{F2}. The memberships to C_{F4} poor formative scores, and C_{F3} shows average formative scores. Engagement patterns are strongly aligned to C_{E3} and C_{E4}, showing that the students spent a lot of time seeking assistance in the *Help!* and viewing questions on *Casper*. Their lack of membership to C_{E1} and C_{E2} indicates they failed to absorb course content in the

Learning Pathway, and their MOOCchat participations were insignificant.

Discussion and conclusion

The main message to be drawn from this study is that students can take several paths through ENGG1200 in order to be successful. We can also say that students receiving a grade of high distinction have good formative assessment results, their engagement is high and that they do well on individually oriented tasks. They tend to be highly engaged in tasks requiring both on campus and online presence, including tasks that require strong participation.

Perhaps the equivocal findings in the literature on the role of attendance and participation relate to a more complex pattern of interaction and engagement overall than previous analyses and research has revealed for all students. Limiting learning analytics to purely behavioural measures, such as clickstream data, without considering cognitive or affective states would be a mistake. However we also need to be mindful of creating learning analytics that are so course specific they are not predictive or useful for judging success in other contexts.

Analysing the learning pathways of students in a blended course that uses a suite of online tools and support systems for delivering a more personalised learning experience is a challenging, open research problem. In this paper, we employed a novel technique, from the fields of data mining and visualisation to investigate the variations and similarities of student's approaches to learning against those who achieved similar final course grades. Analysis using k-means clustering reveals that students do in fact, adopt very different pathways through the course, suggesting that there are multiple pathways to success in this course.

Perhaps this indicates a shift away from focusing on narrow predictive measures of success to looking at how students can achieve the same overall measure of success in forms of grade, despite having different patterns of interaction with the course and the tools provided in the course. There are several interesting directions to pursue in future work. Our first goal is to utilise the results of the paper to make updates to the course to further enhance the learning experience of the students. A longer-term plan is to release the learning dashboard that was used in this research as an open-access tool, allowing other educators to investigate the learning pathways of students in their own courses.

References

Breslow, L., Pritchard, D. E., Deboer, J., Stump, G. S., Ho, A. D., & Seaton, D. T. (2013). Studying learning in the worldwide classroom: Research into edX's first MOOC. *Research & Practice in Assessment, 8*, 13-25.

Clow, D. (2012). "The learning analytics cycle: closing the loop effectively," *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge*, Vancouver, British Columbia, Canada. April 29 – May 02. 10.1145/2330601.2330636

Clow, D. (2013). "An overview of learning analytics," *Teaching in Higher Education*, *18*, 683-695.

Davies, J. & Graff, M. (2005). Performance in e-learning: online participation and student grades. *British Journal of Educational Technology*, *36*(4), 657-663.

Ferguson, R. & Clow, D. (2015). Examining engagement: Analysing learner subpopulations in massive open online courses (MOOCs). *LAK'*15, pages 51–58.

Kavanagh, L. & Reidsema, C. (2014). "The importance of narrative: helping students make sense of what they're learning", Paper presented at the *25th Annual Conference of the Australasian Association of Engineering Education (AAEE 2014)*, Wellington, New Zealand.

Ketchen D. J. Jr., & Shook, C. L. (1996). "The application of cluster analysis in Strategic Management Research: An analysis and critique". *Strategic Management Journal*. *17*(6): 441–458.

Khosravi, H. & Cooper, K. (2017). Using learning analytics to investigate patterns of performance and engagement in large classes. In: Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education. *SIGCSE '17*, Seattle, WA, United States, (309-314). 8-11 March 2017. doi:10.1145/3017680.3017711

Mamun, A. Lawrie, M. & Wright, G. (2016), Student Behavioural Engagement in Self-Paced Online Learning. *Proceedings of the 2016 Ascilite Conference*, Adelaide, 27-30 Nov

McCredden, J., Reidsema, C. & Kavanagh, L. (2017). Designing an active learning environment architecture within a flipped classroom for developing first student engineers, In (Reidsema, C., Kavanagh, L., Hadgraft, R., & Smith, N. (Eds.)*The Flipped Classroom - Practice and Practices in Higher Education* Singapore; Springer.

Reidsema, C. Kavanagh, L., Fink, E., Long, P. & Smith, N, (2014). "The Learning Pathway: Online Navigational Support for Students within the Structured Flipped Classroom," in *Proceedings of the AAEE2014*

Conference (AAEE 2014) Wellington, New Zealand, 2014.

Reidsema, C., Kavanagh, L. & McCredden, J., (2016). Project Design and Scaffolding for Realising Practitioner Learning in a Large First Year Flipped Classroom Course, *Proceedings of 27th Conference of the Australasian Association of Engineering Education* (AAEE 2016), Coffs Harbour, NSW, Australia. 4-7 December 2016.

Scheffel, M., Drachsler, H., Kreijns, K., de Kraker, J., & Specht, M. (2017, March). Widget, widget as you lead, I am performing well indeed!: using results from an exploratory offline study to inform an empirical online study about a learning analytics widget in a collaborative learning environment. In *Proceedings of the Seventh International Learning Analytics & Knowledge Conference* (pp. 289-298). ACM.

Siemens, G. & Long, P. (2011). Penetrating the Fog: Analytics in Learning and Education. Available: http://er.educause.edu/articles/2011/9/penetrating-the-fog-analytics-in-learning-and-education

Thorndike, R. L. (1953). Who belongs in the family? *Psychometrika*, *18*(4):267–276, 1953.

Verbert, K., Duval, E. Klerkx, S. Govaerts, & J. L. Santos, "Learning Analytics Dashboard Applications," *American Behavioral Scientist*, vol. 57, pp. 1500-1509, October 1, 2013 2013.

Wiseman, P., Kennedy, G., & Lodge, J. (2016) Models for understanding student engagement in digital learning environments. *Proceedings of the 2016 Ascilite Conference*, Adelaide, 27-30 Nov, 2016.

Appendix 1

Table 1: High-level code for the approach used in this study

S =	selectSummative(L) # features pertaining to summative assessments in S
F =	selectFormative(L) # features pertaining to formative assessments in F
E =	selectEngagement(L) # features pertaining to student engagement in E
K_S =	elbow(S) # determine the number of clusters to be used in clustering S
C_S =	kmeans(S, K_S) # cluster S using K_S clusters
K_F =	elbow(F) # determine the number of clusters to be used in F
C_F =	kmeans(F, K_F) # cluster S using K_F clusters
K_E =	elbow(E) # determine the number of clusters to be used in E
C_E =	kmeans(E, K_E) # cluster E using K_E clusters for (i=3; i<=7; i++) analyseRQ1(L_i, C_s, C_f, C_e) # examine and analyse the behaviour and performance of learners with course-grade i (L_i) with reference to their associated clusters in C_S, C_F, and C_E

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From how to why: Student experiences of a university's technology-enhanced learning over 5 years

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This is a longitudinal case study of student perspectives on Western Sydney University's strategic initiatives to promote technology-enhanced learning (TEL) from 2012 to 2017. The study analyses data from students throughout this period, and includes consideration of how the student experience is being shaped by academic and institutional support for TEL. Initially the University focus was on use of mobile technologies and 'blended' learning environments; as a platform for transforming pedagogy. In 2013, teaching staff and new undergraduate students were issued with tablet devices. As well as investing in the devices and supporting campus infrastructure, the institution also provided additional support for curriculum and staff development. For two years, students' feedback about the tablets was overwhelmingly positive about their value for learning. In 2015, most undergraduates had tablet devices and TEL was becoming business as usual. However, the evaluation feedback that year showed that use of tablets had begun to decrease and there was a corresponding increase in use of smartphones. For some activities, laptops were preferred. In 2016, multiple types of device were issued to students, with some disciplines choosing laptops and in 2017 the University provided free digital textbooks instead of devices. Students' use of different devices for learning activity has been shifting and evidence gathered internally from students and staff has played a role in adapting to this. While TEL strategies differ between universities, the analysis provides an example of how systematic evaluation evidence can support systemic adaptation as the learning technology environment changes.

Background and context

In late 2012, the senior management of Western Sydney University took a strategic decision to invest in substantially enhancing the use of digital learning technologies. The University has a higher than average proportion of students from low socioeconomic status backgrounds. It has six campuses across a region of culturally diverse and growing population. Students (and staff) often travel a long way to reach campus classes. Many students have paid work and family responsibilities while studying. So there are clear advantages in providing flexible learning options through access to digital activities and resources. As a key part of the digital learning strategy, the University decided to issue all new undergraduate students with a tablet device.

Accompanied by expanded campus wireless coverage and network capacity, these lightweight portable devices immediately gave new students easy access to download digital learning resources from any campus location, and to use them anywhere. A significant proportion of new students had no access either to a laptop or tablet. Others who had access to a laptop at home would be unable to bring it to campus. Lectures were already being recorded automatically and provided online. The Library was making digital readings available. There was growing use of the online learning management system, and widespread use of its basic functions. Until the tablet issue, many students would have to find a space at a desktop computer in a library or computer lab to access these digital resources and activities.

In 2012 the strategies and their rationale was only broadly defined in strategic planning documents; in terms of providing flexibility for students and with an intention to evaluate the pedagogy in more detail, for example:

Enable students to study in their own time, supported by ICT-enabled learning resources

… develop a suite of blended learning options within each course evaluated for effectiveness and mode of implementation, including online capability

… to ensure the most effective learning spaces are available to match the University's learning and teaching plan.

… each School will have a blended learning plan by September 2012 for implementation from 2013.

By 2015 the institutional strategic planning documents were much more specific about the value of TEL for the curriculum, and explicitly acknowledged the need to continue adapting in a changing environment:

… will continue to provide high-quality, inclusive, diverse and technology-enhanced learning environments. It will develop greater flexibility in the types and modes of delivery in on-campus, online and blended educational programs.

Students will be able to access learning in flexible and responsive ways, including through individual and peer learning spaces on campus, in workplaces, in international settings and in virtual environments. The University will adopt new technologies to respond to the emerging needs of students and employers. The University will offer a suite of flexible approaches to course delivery ….

The 2015 strategic plans explicitly link the use of TEL with curriculum innovation. Initially the focus of evaluation had been on tracking the impact of technology use on the student learning experience. A study across three universities in 2010 (Gosper, Malfroy, & McKenzie, 2013) provided a starting point. It identified three aspects of technology provision for learning: institution-led (infrastructure, learning management systems, helpdesk support etc.), academic-led (how teachers use technology with their students) and student-led (devices and activities that students choose to use for learning). There has been a dynamic interaction between these three aspect over several years. In the process, several other aspects of the University's operations also had to adapt, including the evaluation process itself.

Earlier short papers document the development of the University's internal evaluation strategy (Russell, 2014, 2015; Russell & Qi, 2013). A book chapter (Russell, 2017) describes the introduction of tablet devices as a systemic catalyst for curriculum transformation. This paper provides a longitudinal overview of all the institution's strategic TEL initiatives and includes analysis of evaluation data from 2016. It traces the development of the University's strategic positioning of technology-enhanced learning. While the data presented and the analyses focus on using technology to enhance the student learning experience, and on the associated curriculum development work, the interactions with, and changes in, other aspects of institutional support are also described – the bottom three levels shown in Figure 1.

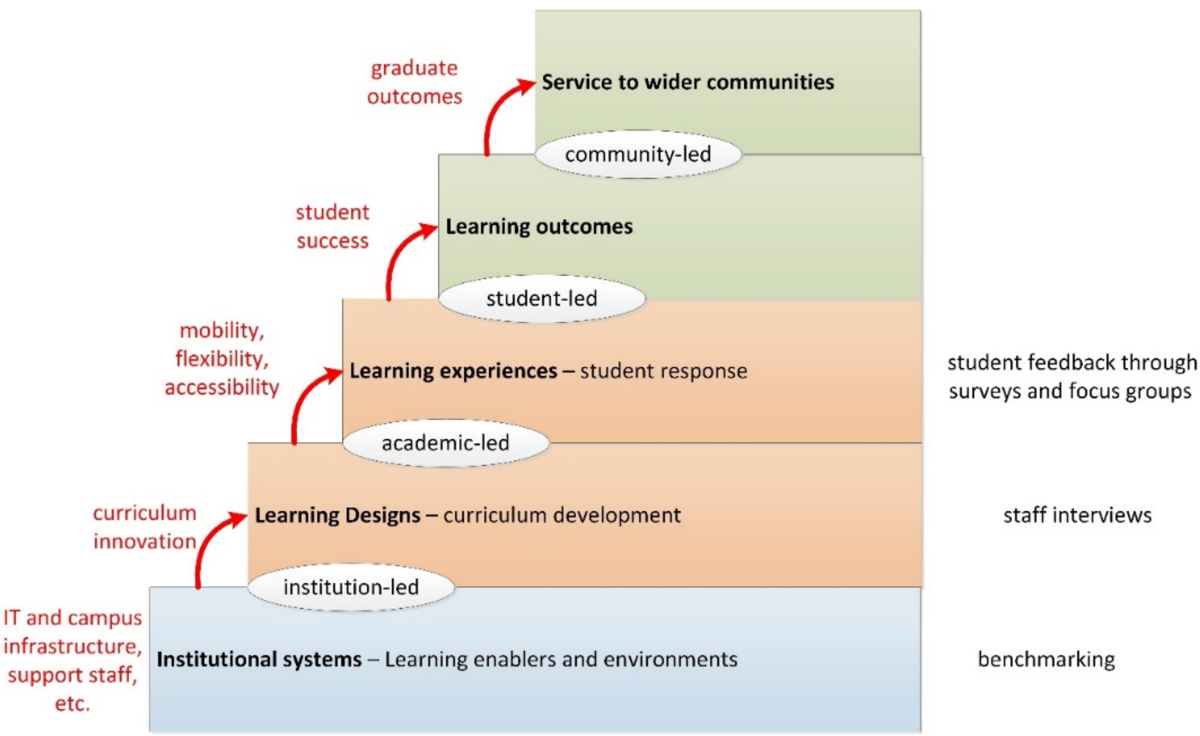

Figure 1: A conceptual model for evaluating institutional TEL support

Theoretical approach: complex adaptive systems

Barnett (2000) describes the ways in which universities are complex systems operating in a super-complex environment. Learning and teaching in universities is multi-dimensional and dynamic. There are diverse cultures and practices. Decisions and processes affecting the development of the whole system happen at multiple levels, from senior executives to individual teachers and students within each discipline. An international study of how large diverse organizations adapted to technological and other changes in the 1990s explains the adaptive process in terms of complementarity theory, which draws on mathematical game theory (Pettigrew & Massini, 2003). Any organizational system with distributed decision making, such as a university with devolved discipline-based planning systems, will have complementary subsystems that cannot be changed in isolation. Attempts to introduce a new technology or a new process without changing any of the complementary subsystems will usually fail. The other subsystems, especially if well established and optimized for the status quo, will suddenly become sub-optimal and will fight the change to protect their own operations.

This explains some of the continued resistance to technology-related change in university teaching practices (Hiew & Chew, 2016). Russell (2014) provides a specific example where resistance to the introduction of 'blended learning' among academic staff was based on a perception, and in some cases the reality, of academic teaching workloads being measured solely in terms of time teachers spend in the classroom. Some teachers believed that if they shifted a proportion of their teaching to online mode, this would not be counted and they would be allocated yet more teaching work. Changing other subsystems such as those for defining, measuring and planning teaching work is needed as well as curriculum development support and technology provision.

The analysis of student perspectives on institutional change around introduction of TEL initiatives is framed as such an adaptation process. It tracks student responses as TEL strategies developed and adapted to a changing environment. While the focus is on the student learning experience, there is also a need to analyse how the developing institutional systems and learning designs are supporting student learning.

Evaluation strategy

Scope and focus

The ACODE benchmarks provide a framework for further clarifying the scope and focus for evaluating institutional support for TEL. The 8 benchmarks cover:

1. Institutional policy and governance
2. Institutional planning and quality improvement
3. IT systems, services and support
4. Application of TEL in the curriculum
5. Staff professional development
6. Staff support
7. Student training
8. Student support

The main focus of this study is on the application of TEL in the curriculum, and on how this shapes the student learning experience. However, the University is a complex and highly interconnected system, where there are devolved decisions about discipline curricula supported by institution-wide infrastructure, policies and organisational processes. So even though the key evaluation questions centre on the student experience, it is necessary to consider other influencing factors. Qualitative analysis of the student comments from the 2010 survey cited above showed that students were often dissatisfied with their teachers' ability to use technology effectively to support student learning (Russell, Malfroy, Gosper, & McKenzie, 2014). Broader studies have reflected a similar pattern. A later US-based international study (Brooks, 2016, p. 6) noted that:

In addition to infrastructural considerations (i.e., reliability of Wi-Fi, network performance), students' technology experiences are shaped by their perceptions of the adequacy of their instructors' technology skills, their attitudes toward technology, and their belief that technology used in class will benefit them in their chosen careers.

Methodology and methods

The overall methodology for this longitudinal study is framed as action research, a well-established approach for evaluation in higher education, both at the level of individual practitioners and for institutional change (e.g. Bhattacharya, Cowan, & Weedon, 2000; Laurillard, 2008; Trevitt, 2005). Kemmis (2010) explores how action research shapes history by changing what is done. This longitudinal study is looking at the recent history of one university, through the lens of changing annual evaluation data from students and staff experiencing technology-related change in how they learn and teach. Action research involves cycles of action, planning, implementation and reflection on outcomes. For each year after 2012, there were cycles of gathering information, which varied depending on the main initiatives (and resources available) that year.

This was a mixed method study (Cresswell, 2009), collecting both quantitative data to identify broad patterns and qualitative data to find out about some of the underlying mechanisms and changes.

Table 1: Action research cycles aligned with institutional support initiatives

Institutional initiatives	Evaluation methods used
2013 Initial issue of tablets to new undergraduate students and permanent teaching staff. Institution-wide program of support for use of mobile devices, focusing on use in 1st year undergraduate classes initially Educational design support teams placed in disciplines.	Survey of all 1st year UG students, asking questions on device use and technology-enhanced learning (TEL) activities. Focus groups with a cross-section of 1st year undergraduate students. Interviews with a cross-section of staff teaching 1st year classes and/or preparing for teaching 2nd year in 2014.
2014 New undergraduate students again issued with tablet devices, and some also provided for sessional staff. Continued support for use of mobile devices and for educational design, including all study levels, centrally and within disciplines Investment in infrastructure (collaborative learning spaces, informal learning spaces, enhanced network and wireless capacity) Introduction of summer terms.	Survey of 1st and 2nd year UG students on TEL Additional survey questions (for all undergraduate students) requested by students on preferred study modes and flexibility needs. ACODE benchmarking: using benchmarks 1, 4 and 6.
2015 New strategic plan for 2015-2020 emphasises the student-centred goal, and clarifies the role of TEL in this Continued funding for discipline-based educational design support for further 3 years Continued enhancement of campus learning spaces and IT infrastructure. More fully online programs.	Survey of all UG students on TEL Interviews with a cross-section of staff similar to 2013 (including some previous interviewees for direct comparison of change) Student survey data available on institutional dashboard, with text analytics on comments.
2016 Disciplines choose which devices are issued to new students Pilot of new Learning Studios for a new campus.	Revised shorter survey focusing on how students were using each of their devices. ACODE benchmarking: using benchmarks 3, 4 and 8
2017 Instead of devices, students are all provided with free digital textbooks. New campus opened, with Learning Studios, no lecture halls.	Revised routine surveys on study units introduced, with question on TEL use. Learning Studio evaluation underway.

The qualitative methods showed why students and staff were responding in particular ways to the introduction of TEL. Table 1 lists the annual cycles, showing the main institutional initiatives each year to support TEL and the evaluation methods used that year.

Quantitative responses to survey questions were displayed graphically in reports and in 2103 and 2014 there was also a statistical analysis to find out whether there were any significant differences between disciplines in the responses. Qualitative data from survey comments, student focus groups and staff interviews were analysed thematically using NVIVO software. However, in 2015 the text analytics programming used to identify themes in the student comments routine student surveys was updated to search for new vocabulary around technology enhanced learning (drawing on earlier manual thematic analyses for this project). The results presented below are primarily the quantitative responses to multiple choice questions tracked across several years, along with data from student focus groups. A full description and analysis of the large volume of qualitative data from the survey questions will require a separate paper. However, to aid the analysis, a short summary of results from student focus groups and staff interviews is included, as is information from the ACODE benchmarking of institutional TEL support.

Results

The results of the study are presented here as a chronological summary of information gathered on the student experience. Also included are overviews of the academic and institutional perspectives to support an analysis of the student experience that includes the three lower levels in Figure 1.

Student experience

Student focus groups in 2013

Transcripts from focus groups with 42 first year students across different disciplines and campuses were analysed thematically. The themes identified were grouped under three categories: institution-led aspects of technology, academic-led use of technology and student-led uses of technology. Table 2 lists the number of comments coded for each of the major themes identified within each category.

Table 2: Thematic analysis of student focus group transcripts from 2013

Theme	sub-themes (most frequent 1st)	no of comments for theme (subthemes)
Institution-led technology use		
institutional systems	Online learning management system, wifi, computers on campus	60 (23, 22, 9)
tablet advantages	Accessibility, flexibility and mobility, portability	34 (14,11,8)
tablet disadvantages	incompatibility	22 (17)
Academic-led technology use		
teacher use of technology	video recordings and podcasts	42 (9)
teacher use of tablets	tablets in class, for content delivery, general usefulness	33 (11,6,6)
problems with teacher technology use	poor teacher skills, prefer classroom to online	22 (17,5)
Student-led technology use		
use of tablets	Notetaking, watching lecture recordings or live lectures, email, reading, Facebook for learning, organise study schedules, storing of learning materials, online quizzes, group work, classroom work	200(31,27,27,26,22,17,12,12,7)
use of other devices	where students don't use tablets, syncing files between devices, laptops, campus computers, file sharing with others, smartphones	99 (50,19,15, 10, 8,6)
discipline-specific technology use		42
students' own technology skills		14

2013 student survey

The survey run in 2013 used a subset of the questions used by Gosper et al. (2013), so that responses from this university could be compared with those in 2010. In this survey, first year undergraduate students were asked not only how often they used a range of technology-enhanced learning activities and technological tools, but also which type of device they used to access these. There were also some additional questions about the perceived value of the tablet devices they had been issued with. There were 740 responses, around 6% of the total population invited.

The responses to the questions about tablet use indicated that most students who have tablets were using them in all of their study units. They believed that the use of mobile technologies in their study help both their learning and their future careers. Many also believed the tablets helped with collaborative work. However, teacher use was variable. Some teachers were running activities in which students use tablets daily or weekly, while others are not using them at all.

The survey asked students how often they took part in 15 different online learning activities as a required part of their course of study. The most frequent activities were accessing Library resources, podcasts/vodcasts created by teachers, and social networking/sharing websites, with many students accessing these at least several times a week.

There was a difference in the devices they are using for these activities. Tablets were by far the most commonly used device for all activities except accessing library resources and creating web pages, where laptops or desktops were more often used. In questions about use of the online learning management system tools, again the tablet was the most frequent access device, apart from assignments and quizzes, which stood out as mainly done on laptops or desktops.

The survey also asked about use of online communication tools for study. Compared to 2010, students were using email much less in 2013, and had moved to social network sites, messaging and chat for communication with each other.

Comparison between disciplines showed some significantly different responses to question on teacher use of tablets, and on teachers' levels of skills with technology. In one case higher use and better teacher skills could be traced to a group that had issued teachers with tablet devices a year earlier than the rest of the University. In another there had been a new curriculum that had completely replaced large lecture classes with online activity, and had only small group tutorials and practical work.

2014 student survey

The same survey questions were used in 2014, and extended to both 1st and 2nd year students, to reflect the fact that the majority of both cohorts had been issued with tablets, and the curriculum changes were being rolled out to higher years. This time there were extra questions requested by student representatives, on preferences between fully online, face to face or blended study modes. There was also a question on what 'flexibility' means for students. All undergraduate students were invited to respond to the additional questions and there were 3141 responses, representing about 10% of the undergraduate population.

The responses on preferred study modes were ambiguous, in that there was a significant overlap from those responding positively to the 'face-to-face' only option and also the 'online only' option. Thematic analysis of the comments on flexibility gives some insight. The themes on flexibility were of two broad types: reasons for needing flexibility and types of flexibility. Paid work was the most frequent reason given for needing flexibility. Other comments mentioned time management in general or family responsibilities. The types of flexibility sought are consistent with the multiple choice responses, in that availability of both face to face and online options and ability to study any time were the two most common themes.

In the main survey for 1st and 2nd year students, the responses were broadly similar to those in 2013, apart from the fact that his time there were no significant differences between discipline groups, with previously lower groups now showing greater use and teacher skills with technology.

2015 student survey

In 2015 all undergraduate students were invited to complete the core survey questions (i.e. excluding those about study modes). This time there were 2366 responses, representing 6.3% of the total undergraduate population.

Figure 2 shows a summary over 3 years of the frequency with which 1st year students report using various types of online learning activity. Figure 3 shows the corresponding data on the devices used for these activities. While the use of online resources from the Library has increased, use of other online activity has decreased. The reduction in tablet use for study activities is mirrored almost exactly by an increase smartphone use (Figure 4).

The quantitative results are summarised in Figure 5. They show that students are using computers and smartphones more than tablets for daily study activities, and particularly for accessing the LMS. It also appears that most of the online activity is taking place through the LMS. Tablets and smartphones are still preferred for access to information, while computers are preferred for online and creating activities. For collaboration, phones are dominant.

2016 student survey

In 2016 the survey questions were reconfigured to shorten the survey, combining the various detailed lists of online learning activity types into four categories: accessing information, online activities, collaboration and creating. The shorter survey took about 5 minutes (rather than the previous 10 minutes) to complete and this time there were 3793 responses, or 10% of the population.

The quantitative results are summarised in Figure 5. They show that students are using computers and smartphones more than tablets for daily study activities, and particularly for accessing the LMS. It also appears that most of the online activity is taking place through the LMS. Tablets and smartphones are still preferred for access to information, while computers are preferred for online and creating activities. For collaboration, phones are dominant.

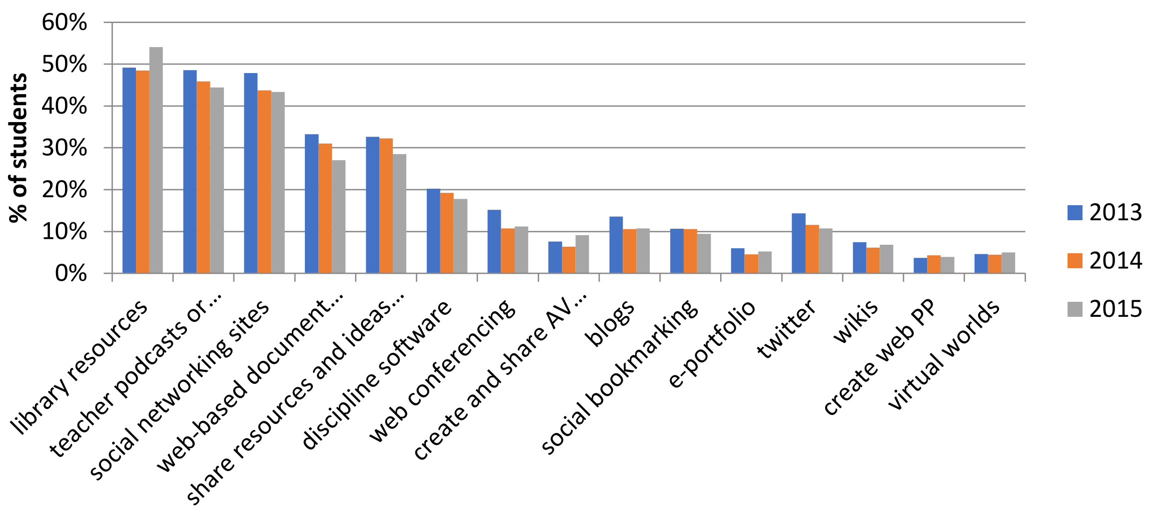

Figure 2: Percentage of 1st year students reporting use of different online activities at least a few times a week

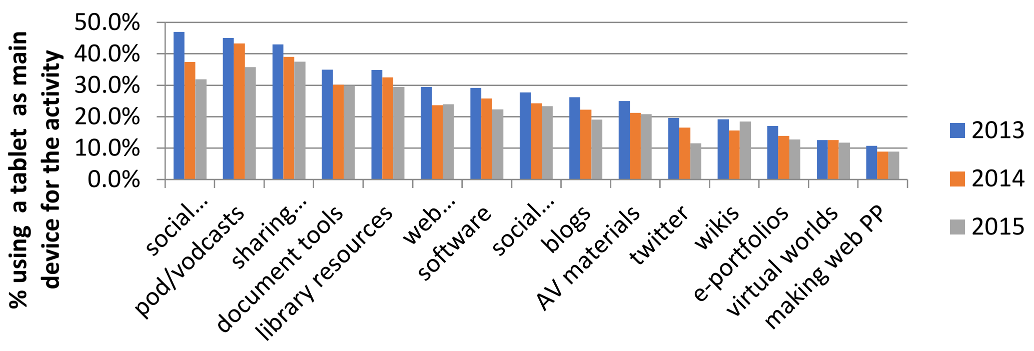

Figure 3: Tablet use for various study activities: changes from 2013 to 2015

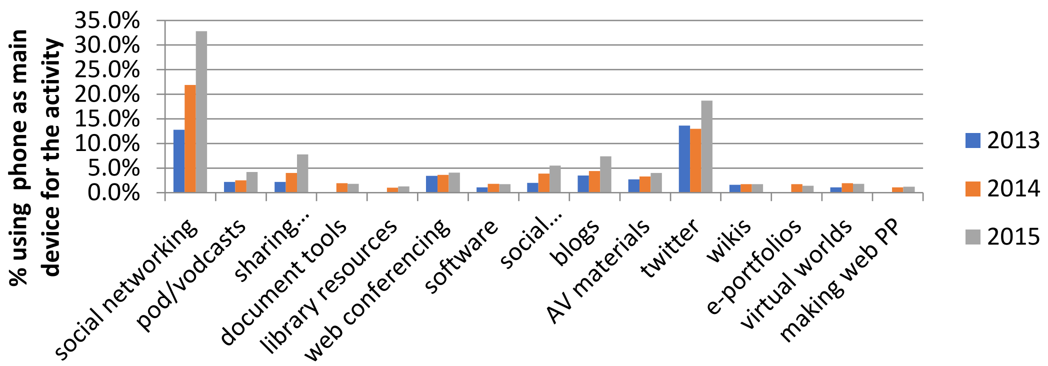

Figure 4: Smartphone use for various study activities: changes from 2013-2015

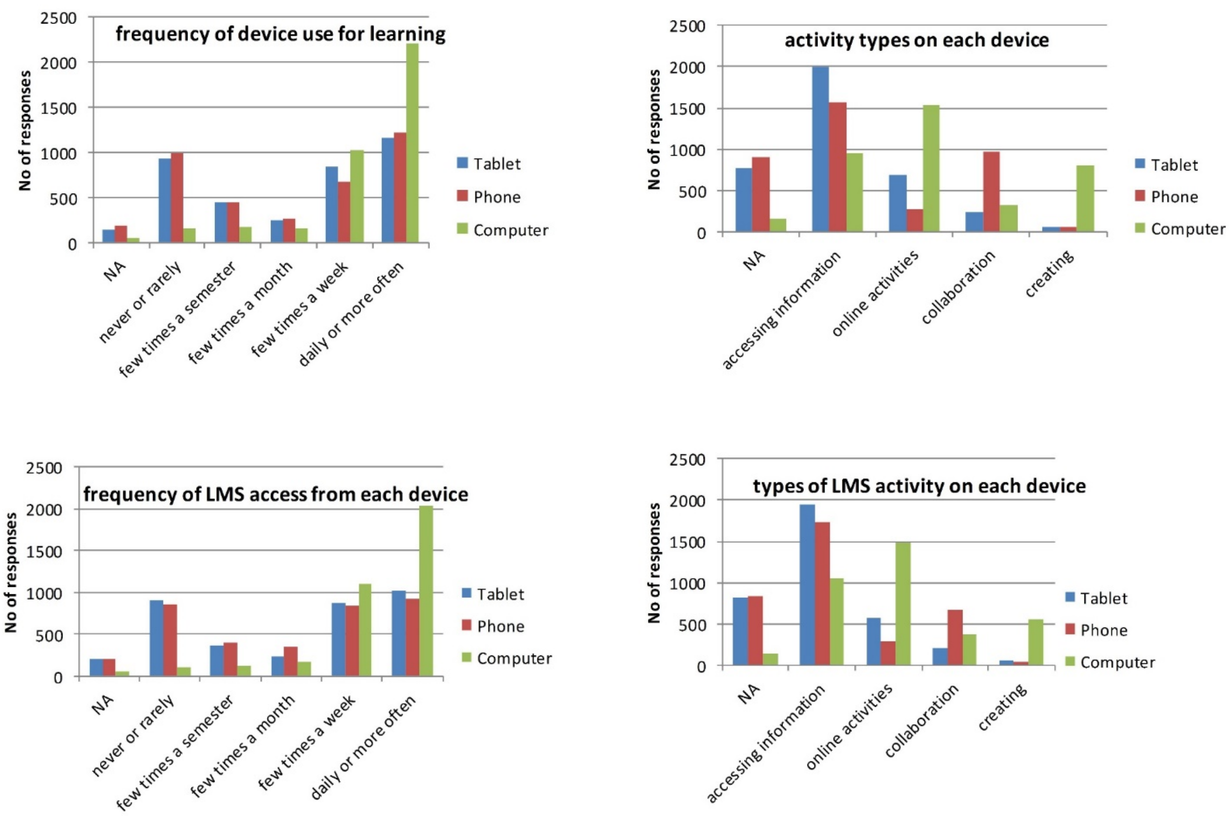

Figure 5: Device use for study activities (upper graphs) and accessing the LMS in 2016.

2017 student surveys

During 2016 there was a review and redesign of the standard student feedback surveys for study units. The questions were updated to match current approaches to teaching and educational design. The survey has been shortened and simplified, with the aim of improving response rates, and launched on a new software platform. The new survey was introduced at the beginning of 2017. One aim of the redesigned questions was to clarify feedback on the learning designs in each study unit, including use of technology. This may obviate the need for separate TEL survey questions, as mining of the large volume of data available from other routine surveys is now feasible.

Academic and institutional support for TEL

Academic perspective

Data on the changing perspectives of academic staff came from total of 19 semi-structured interviews with staff in December 2013 (end of the first year of the Blended/mobile learning strategy) and in mid-2015 (final year of the 3-year program). The data was analysed thematically under the same three categories as used for the student focus groups shown in Table 2 above: institution-led, academic-led and student-led technology use. Between 2013 and 2015 the academic-led themes shifted to show a greater emphasis on learning activity design and evaluation. Discussion of the impact of summer terms and fully online is also more frequent in 2015.

The analysis reflects a shift away from focusing on tablets (as a device) and staff development between 2013 and 2015. There are also fewer references to (external) curriculum development drivers and more to school-based support. This, and a rise in references to specific software and infrastructure services, may be related to the increased focus on designing learning activities. In other words, the results of the thematic analysis are consistent with a shift from individual teaching activities and devices to teamwork with support staff on learning designs using institutional tools. Staff reports on student activity have changed little except that the 2013 perception of students' lack of IT skills had disappeared in 2015.

Comparison of how repeat interviewees discussed the same themes in 2013 and 2015 reflects a more assured approach to teaching with technology, both online and with mobile devices in class. Staff development and school based support are being used to good effect, but are not always accessible. In 2015, both the summer terms and fully online options are driving curriculum change in campus-based semester teaching. However, teaching staff are still adjusting to the workload and skills involved. One continuing challenge is finding time to develop skills and practices further.

Institutional perspective

The ACODE Benchmarking exercise in 2014 confirmed that the university had a clear strategy for TEL support (benchmark 1) and was making progress on integrating effective technology use with curriculum development (benchmark 4). However, the review of staff support (benchmark 5) suggested that further evaluation of this would be useful. In 2016 the choice of benchmarks reflected the new strategic plans, and in particular the renewed and more explicit focus on providing a technology-rich and effective student learning experience.

The introduction of summer terms in 2014-15 (shorter and in many cases making more intensive use of the online environment) provided an additional impetus for redesigning the standard semester to include more blended study modes. Educational design support teams were able to help with this. Also during this period there was an institutional program to introduce fully online programs for distance/external students, as a separate initiative. While these programs are not directly experienced by the majority of the students, who were studying on campus in blended mode, some of the academic staff were teaching across the different modes.

An institutional strategy review in 2015 consolidated and clarified senior level commitment to continuing support for TEL. This was reflected not only in some specific strategic objectives, but also in continued funding for discipline-based educational design support teams.

By 2017, there had been a further shift in priorities, with the provision of new learning spaces – embodying the use of technology supported collaborative learning in the structure of new buildings. During 2016, pilot learning spaces for a new campus drove curriculum change to accommodate a shift away from lectures and towards greater use of technology-rich collaborative learning. Discipline-specific evaluations showed how these spaces could support new types of learning activity (e.g. Shrestha, Wang, & Russell, 2016). In 2017 there is a new institution-wide curriculum renewal project, aiming to simplify study pathways and clarify links to 21st century employability.

At the time of writing, a new institutional survey policy is being developed, to promote better use of data from institutional surveys and reduce the number of student surveys. It is hoped this will both improve data management and analysis and increase student response rates for institutional surveys.

Analysis and conclusions

The student feedback data over the five years covered in this study shows that the issue of tablet devices clearly worked well as a stimulus for curriculum innovation and a shift away from traditional classroom focused teaching practices towards use of online media for delivering information and more active work in class. However, the devices themselves became less important as the technology landscape shifted. More and cheaper tablet devices appeared on the market and smartphones became smarter and bigger. The trend to greater use of smartphones for learning is part of an international pattern in which students have access to multiple devices. The ECAR study in 2016 (Brooks, 2016, p. 6) noted that:

Laptops continue to be the academic workhorse for students. Academic usage of smartphones by students increased by 9 percentage points since 2015, but tablet usage continues to decline. … but wearable technology ownership more than doubled in the past year.

This longitudinal review of student feedback, has linked the student experience with associated academic and institutional changes that accompany each cycle of evaluation. It shows that considerable and continuing effort and resource are being dedicated to continued adaptation; to keep up with changing use of the available technologies by students. The provision of devices was a kick-start, but the devices themselves, and the accompanying IT systems (the 'how') have become less a focus of attention than the 'why', or the curriculum transformation. The evidence shows that students are now using multiple devices in different ways, and that one of the main uses is still to access information for study. Provision of free academic digital information sources has replaced provision of access devices. Technology-rich campus environments are promoting shifts towards more active learning models. Student use of technologies for learning is continuing to evolve.

For the University, continued adaptation to new learning technologies is becoming 'business as usual'. This is also reflected in the move towards evaluating TEL through the mainstream student surveys, rather than running separate surveys. Western Sydney University, like several others in Australia, would fall into the 'extra-large' category internationally. It has large-scale institutional support systems that are not always as easy to reconfigure as they might be in a smaller college. So adaptation to new technologies requires evidence to support the planning and investment required. The student experience data presented here is only one perspective on a large institution-wide systemic adaptation. The paper touches on a few of the other parts but does not fully describe them.

One clear message is that universities, especially larger ones, need continually to gather, analyse, disseminate and respond to evidence of changes in the way students are using technology to support their learning. The main challenges in evaluating and adapting university learning and teaching systems are in connecting evidence from the student experience with academic curriculum development activity. Without healthy feedback systems, the academic-led component of the technology provision will lag too far behind and become detached from students' use of technology.

References

Barnett, R. (2000). *Realizing the University in an age of supercomplexity*: Society for Research into Higher Education and Open University Press.

Bhattacharya, B., Cowan, J., & Weedon, E. (2000). Action Research: A Means to More Effective Teaching and Learning. *Innovations in Education and Training International, 37*(4), 314-322.

Brooks, D. C. (2016). *ECAR study of undergraduate students and information technology, 2016*. Retrieved from Louisville, CO

Cresswell, J. W. (2009). *Research Design: quantitative, qualitative and mixed methods approaches* (3rd ed.): Sage.

Gosper, M., Malfroy, J., & McKenzie, J. (2013). Students' experiences and expectations of technologies: an Australian study designed to inform design and development decisions. *Australasian Journal of Educational Technology, 29*(2), 268-282.

Hiew, F. C., & Chew, E. (2016). Seams remain in seamless learning. *On the Horizon, 24*(2), 145-152.

Kemmis, S. (2010). What is to be done? The place of action research. *Educational Action Research, 18*(4), 417-427.

Laurillard, D. (2008). The Teacher as Action Researcher: Using Technology to Capture Pedagogic Form. *Studies in Higher Education, 33*(2), 139-154

Pettigrew, A. M., & Massini, S. (2003). Innovative forms of organizing: trends in Europe, Japan and the USA in the 1990s. In A. M. Pettigrew, R. Whittington, L. Melin, C. Sanchez-Runde, F. A. J. v. d. Bosch, W. Ruigrok, & T. Numagami (Eds.), *Innovative forms of organizing: international perspectives* (Vol. 1st, pp. 1-32;). London, Thousand Oaks, New Delhi: Sage Publications.

Russell, C. (2014). Herding cats and measuring elephants: implementing and evaluating an institutional blended and mobile learning strategy. Paper presented at Rhetoric and Reality: Critical perspectives on educational technology. Proceedings Ascilite, Dunedin.

Russell, C. (2015). *Learning to swim in an ocean of student data.* Paper presented at Globally connected, digitally enabled, Ascilite 2015, Perth.

Russell, C. (2017). Growing a mobile learning ecology: a systemic university-wide strategy. In H. S. Farley, A. Murphy, & L. E. Dyson (Eds.), *Mobile Learning in Higher Education in the Asia Pacific - Harnessing Trends and Challenging Orthodoxies*: Springer.

Russell, C., & Qi, J. (2013). *Evaluating an institutional blended & mobile learning strategy*. Paper presented at the 30th ascilite conference, Sydney. Concise paper retrieved from

Russell, C., Malfroy, J., Gosper, M., & McKenzie, J. (2014). Using research to inform learning technology practice and policy: a qualitative analysis of student perspectives. *Australasian Journal of Educational Technology, 30*(1).

Shrestha, S., Wang, H., & Russell, C. (2016). *Student response to a technology-enhanced learning space*. Paper presented at AAEE 2106 Conference, Coffs Harbour.

Trevitt, C. (2005). Universities learning to learn? Inventing flexible (e)learning through first and second-order action research. *Educational Action Research, 13*(1), 5783.

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Women and rural people's participation in tertiary education through Internet resources in India: A narrative inquiry

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India has a large formal higher education system, however the enrolment of women and rural people in universities is not substantial. Women enrolment in tertiary education was reported only 41.5% of the total enrolment in the academic year 2010-2011 and only 7% population in rural areas have a higher education. Many socio-cultural barriers prevent people from accessing higher education in India. The integration of the Internet into the higher education sector has the potential to improve access to tertiary education in India regardless gender and area. Using personal narrative and interview data, this article explores how Internet resources can be used to enhance women and rural people's participation in tertiary education in India.

Introduction

India has a large formal higher education system (Ashish & Atanu, 2012) and higher education is imparted in Universities and other higher education institutions facilitated by both the government (Center and State) and private sectors in India. There are a total of 659 universities, 33023 colleges and 12748 diploma-awarding institutions (Central, State and Private) in India (Ernst & Young, 2012). In terms of number of institutions, India has the largest higher education system and the privatisation of the educational sector has increased the number of higher educational institutions in India (Ernst & Young, 2012).

Despite this, women's participation in tertiary education is low and women enrolment in tertiary education was reported only 41.5% of the total enrolment in the academic year 2010-2011 (Nath, 2014). In this context, Aneja (2015) described that there are many reasons that lag Indian women behind in terms of their participation in tertiary education. Firstly, Aneja (2015) described that gender disparity is an obstacle for women in achieving higher education. Gross Enrolment Ratio (GRE) of men in tertiary education is found higher (20.8%) than women (17.9%). Secondly, due to the lack of governmental higher education institutions, many women are unable to afford higher study expenses of private educational institutions. Therefore, the financial condition of some families is a problem that leads to the less women participation in tertiary educations. Thirdly, due the lack of travelling facilities, many of rural and urban women cannot attend tertiary education institutions. Lastly, Aneja (2015) demonstrated that women are considered as the subject of sexual and social harassment and due to this, women are not encouraged to access higher education.

Besides this rural people's participation in tertiary education in also low. GRE of rural people in higher education in India is only 7% of total enrolments (Chakraborty & Konwar, 2013). Also there are many reasons behind the low GRE of rural population. Firstly, Most of the higher education institutions are urban-centric (Chakraborty & Konwar, 2013) and secondly, the institutions situated in rural areas lack quality in their programmes. Thirdly, the inadequate mobility facilities are huge problems for rural people to access tertiary education in urban areas (Aneja, 2015).

All the above-discussed issues can be considered as socio-cultural and political barriers that lead to impediment of women and rural people's participation in tertiary education. To remedy these kinds of issues and barriers, it has been suggested that online courses could make tertiary education accessible to all (Balakrishnan, 2010; Bostus, Mear & Williamson, 2015). For this purposes, the Internet-based technologies should be established in Indian higher educational institutions. This article explores how Internet facilities can be used to improve tertiary education opportunities to women and rural people in India.

My background and dispositions, my theorising about the Internet and my practices on the Internet are integral to the conceptualisation of this article. In this context, it is important for the reader to know something of my demographic and educational background to understand why and how I came to conduct this research.

My personal narrative story: a glimpse

I am from a middle class family in a rural area of the Punjab state of India and I was schooled in the government education system during the 1990s. Except for my elder sister, none of my family members had gone to university and only a few of my year ten classmates had ambitions to pursue higher education. The rural background and lack of awareness about higher education always remained a barrier to people, especially to girls or women of my village undertaking higher education.

During my undergraduate period in India, there was no college or university near my village. Moreover, public transportation was not available. Usually, people walked twenty to thirty minutes to catch a bus or auto-rickshaw. Due to transportation difficulties, people avoided going to urban areas to pursue their studies. My father bought me a vehicle so that I could attend my college in the nearest large town. However, not all people can afford private vehicles. I had to travel one to two hours to attend my college. To remedy these kinds of mobility issues, online courses could make tertiary education accessible to all (Balakrishnan, 2010).

I had not used the Internet until the Master of Philosophy year. Moreover, computers or Internet facilities were not available to the students in my educational institutions. As I was enrolled in the Master of Philosophy degree, I had to write a minor thesis in the third semester of the degree. My guide (in India, a research supervisor is called a guide) suggested that I use the Internet to search for relevant material for my research project. I did not have Internet access at the University, so I accessed the Internet at a cyber café located near the university. I used the Internet for the first time in the Master of Philosophy degree in 2010. As I began to use the Internet, my interest developed. After my interaction with the Internet, I realised that Internet resources can be used to make tertiary education accessible to all regardless area or gender. This article describes the role of the Internet in enhancing tertiary education opportunities to women and rural people in India.

Research design and theoretical overview

This article mainly focuses on how Internet as a part of technology can be used to enhance participation of women and rural population in tertiary education. A number of theories have been put forward to explain the meaning of technology and its' (technology's) impact on society. Two such theories are technological determinism (Veblen, 1920) and the Social Construction of Technology (SCOT) theory of Bijker and Pinch (1986). The former theory considers technology as an agent of social change. Technological determinism stresses that dominant technologies mould societies' behaviours and interactions. It contends that technologies exert an impact on the world independent of human choice, and people seem unaware of their technological choices (Dafoe, 2015). Furthermore, the theory tends to assert that new innovations come into existence autonomously in order to exceed the power and utility of the previous technology.

Technological determinism could provide a conceptual framework for this study, where the Internet can be seen as a digital technology resulting in development in the field of access to tertiary education; however, the development of any society or specific field does not rely on technology only (Bijker, 1995), as society plays a significant role in technological development. Technological determinism does not take societies' perceptions into consideration when explaining the development of the societies through technology. The implementation of technology depends on people's perceptions about the technology that leads to further innovation of new technology.

Bijker (1995) argues that technological innovation is not an autonomous process based on designers' myths. Instead, it is a result of the implementation and use of technology by societies. The societies are the main actors that use the technologies and give meaning to the technology, which results in innovation of new technology and innovative uses of the existed technologies. In this way, the study of different individual's perspectives about technology enables a researcher to highlight the advantages/disadvantages of the technology, which can be useful in expanding the scope of the use of that technology.

On the other hand, this study is able to draw upon the SCOT theory of Bijker and Pinch (1986) as the conceptual framework to explain tertiary education students' perceptions about Internet use to enhance access to tertiary education in India. The SCOT framework suggests that both adoption and innovation of technology depend on an individual's perceived meaning about the technology, which further depends on the usefulness of the technology. A researcher should go beyond the internal functionalities of the technologies to consider the extent and manner in which the technology is being used by the societies (Carr, 2014). Hence, the SCOT theory presents an appropriate framework to examine the innovative uses of the artefact (e.g., the Internet, in this article) through analysing individuals' perceptions

Initially, the core formation of the SCOT theory consisted of four central concepts: relevant social group, interpretative flexibility, closure and stabilization, and wider context. In 1987, Bijker added and introduced the concept of technological frame for the first time. As the main focus of this article is to describe participating tertiary education students' views about the uses of the Internet in enhancing access to tertiary education in India, therefore only interpretative flexibility is employed to analyse and discuss the results.

Interpretative flexibility

The notion of interpretative flexibility is based on the first stage of the Empirical Programme of Relativism (EPOR) (Russell, 1986) that focuses on the social construction of scientific knowledge. In the SCOT theory, the EPOR demonstrates that the technological artefact is socially constructed and interpreted. A researcher examines all interpretations made by social groups in order to explain the various uses of that artefact.

Interpretative flexibility does not mean only to provide flexibility to individuals in describing how they think or interpret technological artefacts (Bijker & Pinch, 1986), but also there is flexibility in how an artefact is used differently by various social groups. There are different ways of using the same technology. For example, technological experts or skilled people use mobile phones differently to non-skilled people. Technologically skilled individuals may prefer to use mobile phones for online activities such as browsing, accessing e-mails, surfing on social networking sites and many more. On the other hand, technologically non-skilled people may prefer to use mobile phones for making phone calls and texting messages only. Thus, interpretative flexibility focuses on different use of the same technology. This article employs interpretative flexibility to explain how Internet resources can be useful to enhance access to tertiary education in India.

Research methodology

The qualitative research methods are used in this study as Bijker and Pinch (1986) considered interviews the most favourable tool for obtaining information about a phenomenon from social groups. Personal narrative and semi-structured interviews are employed as a qualitative data collection tool.

Sample

A total of six interviews (three men and three women) were conducted with Bachelor of Education students studying in different Bachelor of Education colleges of Punjab (India). A pre-set of semi-structured questions were prepared and used for the interview process. All names used for interview participants were pseudonyms and do not reveal the identity of any participant in this study. All participants were 20-30 years of their age.

There were a number of reasons for choosing only Bachelor of Education students. Firstly, Campbell and Kent (2010) described that use of the Internet has the potential to improve both teaching and learning opportunities. The Bachelor of Education students play a dual role, as a student and as future teachers. It was appropriate to examine how Bachelor of Education students as future teachers describe the role of the Internet in accessing tertiary education.

Secondly, Bachelor of Education students are trained for teaching and by the end of the degree it is assumed they will be starting to teach in schools. Examining Bachelor of Education students' perceptions about Internet use provided an insight into how useful/not useful they find the Internet for in tertiary education settings. Lastly, as this study was catalyst to my personal narrative, therefore, my narrative was used along with interview data.

Data analysis

The content of the textual data including verbatim interview transcriptions and personal narrative account were analysed employing interpretative flexibility component of the SCOT Theory's framework. I used content analysis to identify themes, patterns and categories contained within the text.

In the first stage of content analysis, themes were coded according to the frequency of occurrence of certain words and phrases. The words and phrases were coded based on the interpretative flexibility component in relation to the research questions in this study. At the second stage, all codes were alongside the same codes in the other interviewees' transcription to ensure similarity (authenticity) in my coding. For example, all participants mentioned that the Internet could be used to enhance the access to tertiary education in rural areas. The data was coded as "the Internet use and tertiary education access in rural areas".

At the third stage of content analysis, the main themes were highlighted and coded in my field text data (personal narrative). For example, in the field text I narrated my Bachelor of Education experience where I described that I did not use the Internet, I coded it as 'no Internet use'. Similarly, I coded themes in my field text data. At the fourth stage, I compared and contrasted all themes of interviews' coding to my field text data. If I found the similar themes in interviews' coding and my field text data, I coded them as 'same experience' and for opposite themes, I coded as 'opposite experience'. In this way, I checked all interviews' coding alongside the main themes of my field text data.

Use of the Internet in enhancing access to tertiary education in India

Despite having a larger educational system in India, many socio-cultural barriers prevent people from accessing higher education in India (Balakrishnan, 2010). Some people leave their studies because of their job priorities and sometimes, family responsibilities also do not allow them to continue their studies. In those cases, Internet sources can be used to provide them with online education. In line with my personal view, Neha expressed a similar opinion:

> *In a country like India, you sometime across people who don't have access to higher education simply because of some restrictions of culture and some family norms don't allow to go to the place of study or maybe there are some privacy issues or safety issues. So in that case these online modules and this Internet has been a boon in a sense because you are sitting on your own place, the condition that you should not go outside and study is also been fulfilled because everything is given to you by sitting on one place. You are been provided with the text, you are been provided with the online lectures there are. Whatever is happening in the real classroom happens in that virtual classroom.*

The access to tertiary education could be enhanced through using the Internet in India, regardless of time and place (Battacharya & Sharma, 2007; Dange, 2010). For example, Meena and Rahul reported that by using the Internet, they could get any relevant knowledge from any source at any time, which improved their learning. In this way, the students did not have to depend on the structured classroom teaching and learning system. The online courses require a different type of involvement from teachers, where delivery of the programmes happens in a flexible learning environment regardless of time boundaries (Bostus, Mears & Williamson, 2015). People, especially women, could enrol themselves in online teaching-learning classes to accomplish their tertiary education. How the Internet can play a role in enhancing tertiary education among women in India is another pertinent issue in my study, which follows next.

Women's participation in tertiary education through the Internet

The level of women's tertiary education needs to be improved, as the enrolment of women in tertiary education was only 41.5% of the total enrolment in the academic year 2010 - 2011 (Nath, 2014). This is not surprising, as I witnessed in my village that girls were not permitted to go to urban areas for their higher education. There were several reasons underlying this phenomenon, including lack of transportation and negative parental attitudes towards women education. Girls were generally much protected so that they would not bring shame to the family. There are whole sociological and cultural beliefs attached to this stigma that is beyond the scope of this thesis; however, it is important to note that creating opportunities for women to learn and earn qualifications in the safe confines of their homes is a way around this issue. Thus, I believe that Internet facilities in targeted rural areas have the potential to improve the level of tertiary education among women.

In line with my belief, all of the interview participants agreed that the Internet could have a great impact on tertiary education levels among women in India. For example, Aman articulated that in India, most of the parents did not allow their girls to attend educational institutions because of security concerns. Moreover, Neha described, "the Internet makes easy access for those girls, for those people, who cannot go through the normal process". The participants in this study voiced that an online education system could be very helpful in enhancing women's literacy in India.

Meena believed that if good Internet facilities were available at their home, then the girls and women could enrol themselves in online courses and accomplish their studies. Most women drop out of their studies because of their family responsibilities and due to the lack of provision of higher education institutions near their home (Gupta & Rao, 2006). I argue that Internet resources could enable women to pursue their higher education whilst simultaneously allowing them to fulfil their obligations and responsibilities as home-makers. Beyond their study aspirations, they can develop career opportunities by using the Internet. For example, Rahul explicated:

> *Women in our country, or everywhere in the world, they have more work at home. So, if they remain at home, they can't get the knowledge about their personality, career and all things. If you make them accessible to the Internet at home they can easily attach to the world, they can easily grow.*

Similarly, Aman explained if the Internet is available to women, they could update their educational level in order to enhance their knowledge area. Furthermore, Jot pointed out, "if they have a good Internet connection at their home then they can do the entire learning process in their homes than give an examination in corresponding course". Based on my own experience in obtaining an education, especially coming from a rural background, I am of the strong belief that Internet literacy is essential for women in order to enhance their educational standing. Like me, Komal has a strong opinion about educational opportunities available through the Internet for rural women:

> *I live in a village and there are many girls in my village who want to go for higher education, but because of expensive and old mentality of the people of villages or their parents, they are not permitted to go outside from their houses to have the higher education. The online education system or the Internet can help those girls to gain their Bachelor and Master degrees in their*

homes. So, online tertiary education can be promoted through the Internet.

However, furthering Komal's voice, the interview participants also added that optimum use of the Internet is key in enhancing access to tertiary education for rural people and women in India. In this regard, Goria (2012) described the Internet as having the potential to improve tertiary education in India by providing online distance learning opportunities to people, though this access needs to be used wisely.

If I had had Internet access, knowledge and skills during my own studies in India, I would have overcome the disadvantage of being a student from the rural part of India. The participants in my study, accordingly, found the Internet to be very useful for the people of rural areas and women to access tertiary education from the remote places they come from. The participants seemed to believe that Internet sources have the potential to improve tertiary education access among rural people. In the next section, the role of the Internet in enhancing rural people's access to tertiary education is explained.

Internet use and access to tertiary education in rural areas

According to the World Bank (2011), 68.70% of India's population live in rural areas. When I was studying my degrees in India, higher education was not adequately accessible to the rural population. As described earlier, I was born and grew up in a rural area of India. I remember that in my village, most of the people were illiterate and only a few of them had primary school education also only a few of my peers had a secondary school education. As described earlier, GRE in higher education in Indian rural areas is only 7% (Chakraborty & Konwar, 2013), which indicates that India has a low level of the tertiary education. If we examine the reasons behind this scenario, it is possible that inadequate tertiary education facilities contribute to this situation. In line with this argument, Chakraborty and Konwar (2013) reported that in India, most of the higher education institutions are urban-centric, whilst the institutions situated in rural areas lack quality in their programmes. This statement reflects the policy changes in India where the twelfth five-year plan of India (2012 - 2017) envisages improving the quality and access of higher education in rural areas (Shaguri, 2013).

It seems reasonable to suggest that if Internet facilities are provided in rural areas, it is more likely that rural students will have better opportunities to continue their higher education. Echoing this suggestion, this study's participants (Aman, Jot, Komal, Neha, and Roop) had the opinion that the provision of Internet facilities could create pathways to access tertiary education in rural areas. As the members of a social group, interview participants provided their different opinions on how the Internet resources could be used in enhancing access to tertiary education. For example, Neha stated:

> *Educational opportunities are opening up, plus when you are living in a remote area, you cannot go to the place to the educational institute far off. In remote areas if you provide such facilities like Internet or some online system definitely increase the educational opportunities.*

On how rural students could access tertiary education with the help of the Internet, Aman said that in rural areas, students could join online classes in order to pursue their studies. In addition, Jot articulated:

> *Here are many tuition centers, which are providing online lectures. So, if a student is living in a remote area, he can very easily get access to the lecture of a very eminent person, which otherwise infeasible for him who is living in a remote area.*

In this study, participating tertiary education students as a social group interpreted that the efficient use of the Internet in imparting tertiary education to people who dropped out of their studies due to barriers (rural background, family responsibilities, job priorities and so on) could make tertiary education accessible to them. It appeared that the participants had the strong belief that the rural tertiary education level might be upgraded through online distance learning. Online distance learning or online correspondence learning enables people to pursue their education without attending the educational institutions on a regular basis (Deane, Galyen & Moore, 2011). Thus, students can complete their studies at their home regardless area and gender.

Discussion

The concept of interpretative flexibility enables manufacturers to study the different perceptions of different social groups, which can result in improving the design of the technology so that all societies could benefit from the technology (Bijker & Pinch, 1987). The improved designs and provision of the technology to all societies could allow people to benefit from the technology. Therefore, the study of individuals' opinions on how a specific society can benefit from a specific technology is useful for manufacturers when analysing societies' needs. Similarly, with analysing the impact of Internet use on access to tertiary education, it can be concluded that the interview participants pointed out the need to provide Internet facilities to women and people who dropped out of their studies due to family responsibilities. In addition, Bostus et al, (2015) described that "online classes can prove to be less intimidating, and those students can experience a sense of flexibility when facing overwhelming daily challenges such as work or family demands" (p. 138). Bostus et al's comment is interesting as they have highlighted issues around the intricacies of accessing online education.

Also, the study highlighted the need to establish Internet resources in rural areas and provide online Internet facilities to who wish to continue their tertiary education. It indicates that the integration of the Internet into tertiary education systems and into rural areas could enable many more women and people to engage in tertiary education online.

Implications of the study

This study demonstrated that the quality and access of tertiary education in India could be improved by using Internet facilities. Indian tertiary education policymakers are recommended to equip tertiary education institutions with upgraded and free Internet facilities. The free access in tertiary education institutions can motivate students to use the Internet as an online learning practice.

In India women participation was found less as compared to men (Nath, 2014) and education policy makers aimed to enhance women tertiary education level in India. Policy makers can provide special Internet provisions to women students who wish to accomplish higher education. The Internet provisions can make women enable to complete their education from homes without scarifying their family and other responsibilities.

Indian tertiary education policy makers always aim to enhance the education level among rural population. For this, Internet resources can be used. The tertiary education policy makers are recommended to provide Internet facilities in rural areas which can solve travelling issues of rural population, which they face to attend tertiary education institutions located in urban areas. In addition, the provision of good Internet facilities in rural areas can help rural students to access the updated learning materials from online resources. In this way, online learning facilities can open new gateways of learning to rural students.

Limitations and suggestions for further research

The sample in this study was selected from tertiary education students who were doing a Bachelor of Education degree from education colleges in the Punjab state of India. The results of this study had to be cautiously interpreted against the educational colleges of India, as the bigger context of the study. Therefore, the interpretations of the findings are specific to the context of Bachelor of Education Colleges of the Punjab state in India that participated in this study.

In association with the limitations of the study, future research could extend the current study to include other states of India that encompass different contexts of Internet use within different Indian states. Moreover, future research could include other faculties (engineering, commerce, medicine and so on) besides education students to explore the role of the Internet in enhancing access to tertiary education in India.

Another area for further research could also be how Internet facilities may enhance the literacy rate of women in India, whether Indian women are literate to use the Internet, or whether Indian women have Internet skills or not. I am also interested in exploring how Internet facilities may improve rural education in India, and whether Indian rural people are sufficiently Internet skilled to benefit from online distance courses.

Notes

1. Tertiary education refers to higher education in any field, regardless of the specific subject area
2. For the purpose of this article, the term rural area is used for the areas that are located outside outside the cities and towns. See detail of rural area: https://en.wikipedia.org/wiki/Rural_area#India
3. In this study, the term Indian students refer to individuals who are Indian citizens and who study in Indian educational institutions.

References

Aneja, N. (2015). Women in Higher Education Management in India. *Research Journal of Educational Sciences 3*(8), 1-3.

Ashish, H., & Atanu, G. (2012). Enhancing the quality and accessibility of higher education through the use of information and communication technologies. *Department of Higher Education, India*. Retrieved from: http://education.nic.in/sector.asp/

Balakrishnan, M. (2010). Academic use of Internet among undergraduate students: a preliminary case study in a Malaysian University. *International Journal of Cyber Society and Education*, *3*(2), 171-178.

Battacharya, I., & Sharma, K. (2007). India in the knowledge economy-an electronic paradigm. *International Journal of Educational Technology, 21*(6), 543-568.

Bijker, W. (1995). *Of bicycles, bakelites, and bulbs: toward a theory of sociotechnical change.* Cambridge: MA: MIT Press.

Bijker, W. E. (1987). The social construction of Bakelite: Towards a theory of invention. In W. E. Bijker, Hughes, T. P & Pinch, T. J (Ed.). *The social construction of technological system: new directions* *in the sociology and history of technology* (pp. 159-187). The MIT press, Cambridge: Massachusetts London, England.

Bijker, W., & Pinch, T. (1986). Science, relativism and the new sociology of technology: Reply to Russell. *Social Studies of Science, 16*, 347-360.

Bostus, C., Mears, A., & Williamson, A. M., (2015). Reflection tools in teacher education classes: an analysis of implementation in online, hybrid, and traditional environments. *The Turkish Online Journal of Educational Technology, 14* (2), 138-143.

Campbell, C., & Kent, P. (2010). On using interactive whiteboards in pre-service teacher educators. *Australian Journal of Educational Technology, 26*(4), 447-467.

Carr, P. L. (2014). Reimagining the library as a technology: an analysis of Ranganathan's five laws of library science within the Social Construction of Technology framework. *The Library Quarterly: Information, Community, Policy*, *84* (2), 152-164.

Chakraborty, S. & Konwar, N. (2013). Status of higher education in rural areas of India. *Journal of Radix International Educational and Research Consortium, 2*(1), 1-13.

Dafoe, A. (2015). On technological determinism: a typology, scope conditions, and a mechanism. *Science, Technology, & Human Values*, 1-30.

Dange, J. K., (2010). Post graduate students' computing confidence, computer and Internet usage at Kuvempu university- an Indian study. *International Journal of Instruction, 3* (2), 1308-1470.

Deane, C. D., Galyen, K., & Moore, J. L. (2011). E-learning, online learning and distance learning environments: Are they the same? *Internet and Higher Education, 14*, 129-135.

Ernst, & Young. (2012). Higher education in India: Twelfth Five Year Plan (2012-2017) and beyond. New Delhi: Federation of Indian Chambers of Commerce and Industry, 199-206.

Gupta, V. P., & Rao, B. S. B. (2006). Low female literacy: factors and strategies. *Australian Journal of Adult Learning*, *46* (1), 85-95.

Goria, S. (2012). Role of consortia for effective use of e-resources in higher education: a practical approach in Indian libraries. *International Journal of Information Dissemination and Technology, 2*(3), 201-208.

Kharas, H. (2010). The emerging middle class in developing countries. Working paper no. 285. OECD.

Nath, S. (2014). Higher education and women participation in India. *Journal of Business Management & Social Sciences Research, 3*(2), 43-47.

Russell, S. (1986). The Social Construction of Artefacts: A Response to Pinch and Bijker. *Social Studies of Science, 16*(2), 331-346.

Shaguri, O. R. (2013). Higher education in India: Access, equity, quality. *Access, Equity Diversity and Inclusion in Higher Education*, 1-23.

The World Bank (2015). *Working for a world free of poverty*. Retrieved from: http://data.worldbank.org/country/india

Veblen, T. (1919). The place of science in modern civilisation and other essays. Brunswick, New Jersey, and London, UK: Transaction Publishers.

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It takes a village: Supporting the integration of digital textbooks in higher education

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Digital textbooks now incorporate various technological enhancements, and offer many opportunities for learning and teaching in higher education. Despite some enthusiasm for this medium, lecturers tend not to integrate the extra activities into their courses preferring instead to simply have them available as optional extra activities for students. One reason for this barrier to use is the time and effort required to integrate technology into the curriculum in a meaningful way, and lecturers may feel they lack the necessary knowledge to do this effectively. Despite the existence of institutional support to assist educators with technology enhanced learning, the services don’t always align with what faculty want or need. As a result, there have been calls to improve staff training and professional development. This paper presents a theorised inquiry into educators’ reflections on the integration of digital textbooks using Mishra & Koehler’s TPACK framework as an underpinning theory. The findings suggest the need for training and support that is individualised to instructors’ specific needs, and allows for increased collaboration between various stakeholders. It is concluded that professional development that focusses on the development of TPACK, and operates within a collaborative and context-specific learning community could support the increased uptake of digital textbooks in higher education.

Introduction

In 1923, noted educational psychologist Edward Thorndike commented that “If by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be managed by print” (p.165). This ‘book’ once imagined by Thorndike now exists in the form of an enhanced digital textbook that incorporates learning analytics and adaptive technology which allow for customised program adjustments to be made based on individual students’ demonstrated mastery of skills and knowledge as they progress through content. Even without the inclusion of these sophisticated adaptive technologies, digital textbooks can incorporate various enhancements (Dobler, 2015), and consequently offer many advantages over the traditional print textbook to both students and teachers (Hallam, 2012). The affordances of digital textbooks support new and emerging pedagogies (Sharples et al, 2012). Adapting to these new pedagogies and effectively using digital resources including digital textbooks requires lecturers to possess complex skills and capabilities (Gaffney, 2010), but teachers’ anxieties about their level of digital skills could create barriers to the adoption of digital textbooks (Hallam, 2012). On the other hand, if a top down approach is taken by the institution, and faculty are mandated for example to use adaptive learning technologies without consideration of how they fit in with curriculum or desired learning outcomes, there may be a considerable risk to student learning outcomes (Johnson et al, 2016, p.28). To overcome this, ongoing professional development is imperative (“Internet2 Textbook Spring 2012 Pilot Report”, 2012). Providing support to faculty to assist them with the instructional integration of information technology and to optimise the use of technology in teaching and learning was highlighted as “an enduring theme in the top 10 IT issues in higher education” in a report from the Educause Center for Analysis and Research (Dahlstrom, 2015, p.3). This report also suggested that the current institutional support may not meet the instructional needs of the lecturers, particularly with respect to less widely used technologies such as digital textbooks. This paper examines lecturers’ use of digital textbooks in higher education within the broader context of educational technologies. It will explore the scope for broader institutional support to assist individual educators more effectively integrate digital textbooks.

Definitions

Digital textbooks: The basic understanding of a digital textbook is consistent with Hamilton’s definition of a textbook: “a book that has been consciously designed and organised to serve the ends of schooling” (1990, p. 1). This understanding of a textbook presumes that the organisation and design of the content reflects pedagogical principles and aims. Applying this definition to the digital context, digital textbooks are a subset of the eBook format that are written for students, cover core course content, and published for use by educational institutions (UQ Library, n.d.), and can be “conceived as a platform for learning that combines e-learning and publishing technologies, and serves as a dynamic and interactive reading material, and as an interface for learning activities among learners and learner communities.” (Gu, Wu, & Xu, 2015, p.26). Digital textbooks are also referred to as ‘etextbooks’, ‘electronic textbooks’ and ‘eTextbooks’ in the current literature, and these terms may be retained to reflect the wording of the original source, and considered to be synonymous.

Adoption: In the user acceptance literature, adoption is generally defined using Rogers’ (2003) definition which is the decision to make “full use of an innovation as the best course of action available” (p.177). As will be seen, this definition may not completely apply to digital textbooks as there are varying levels and extent of use that occur. Therefore, this paper will refer to ‘adoption’ as the decision to use a digital textbook, and ‘use’ refers to the extent that the features are exploited.

Literature review

Educational publishers have been steadily increasing their offerings of digital resources including digital textbooks. Until recently, digital textbooks tended to be simply digital equivalents of printed books. There is now an increasing trend for digital textbooks to be born digital (UQ library, n.d.), and digital textbooks have become more sophisticated with the addition of interactive features including hypertext, video, audio, 3D models, and social sharing capabilities (Dobler, 2015). Another popular e-learning product is the ‘whole course solution’ (Hallam, 2012), an online program which integrates multimedia, online quizzes, collaboration tools, and personalised learning paths driven by analytics (Johnson et al., 2016). A consequence of the availability of these various products is that the boundaries of the definition of a digital textbook are becoming increasingly blurred as the line between digital textbooks and other digital products becomes less distinct (Hallam, 2012).

Early predictions of a widespread uptake of digital textbooks has not occurred to the extent that was initially predicted (Gu, Wu, & Xu, 2015). Various barriers to the adoption of digital textbooks have been noted, most commonly is an enduring preference for print (Baron, 2015). MacFayden (2011, pp. 2-3) posits that “people try to fit the experience of digital reading into mental models derived from print culture” and “the way users understand and describe their experiences of reading on digital devices are shaped by well-established cultural expectations about the abstract as well as the physical affordances of the print book”. This could be explained by the notion of functional fixedness, which explains how users perceive the relative advantage of an innovation according to a cognitive bias that limits them to using an object only in the way it is traditionally or habitually used (Eysenck, 2001). So, in this instance the functions of the digital textbook are perceived to be the same as the printed book, namely providing text-based content, only with the additional function that the digital version can be read on an electronic device. However, as digital textbooks move beyond simply being containers for text-based content, the reading and research practices associated with print books are superseded. Functional fixedness can impede creative uses of technology, so the affordances and constraints of the new medium need to be recognised (Koehler & Mishra, 2008).

It is important to consider digital textbooks within the wider educational technology landscape to better understand factors and beliefs that can create barriers to their adoption and use caused by the challenge of pedagogical integration. Digital textbooks are a digital tool, but are also characterised by the inclusion of numerous technological features. Using any educational technology effectively requires a certain level of digital fluency (Johnson, Adams, Becker, Estrada, & Freeman, 2014). In both the 2016 and 2017 editions of the *NMC Horizon Report, Higher Education edition*, improving digital fluency was cited as a significant challenge impeding the adoption of technology in higher education (Johnson et al., 2016; Adams et al., 2017). Furthermore, there are increased demands on educators using technology who must now assume new roles as part of their teaching. The 2017 *Horizon Report* also highlighted the changing roles of educators in the new era of technology-enabled approaches, and explains that teachers are expected to take on multiple responsibilities including employing various technologies, engaging in the online space, and leveraging active learning methodologies. They are also tasked with ensuring that students have the necessary competencies to use technology effectively. It cannot be assumed that students know how to engage with technology the way teachers require them to (Hallam, 2012). They have to be provided with explicit instruction even for the use of electronic texts (Dobler, 2015). Consequently, teachers must now think like designers (Goodyear, 2010), and act as guides and facilitators (Adams et al, 2017).

Many faculty believe that if they were more skilled at integrating technologies into their teaching they would be more effective instructors (Dahlstrom, 2015), but institutional support practices don’t always align with what faculty want or need. It has been argued that staff training needs to be improved (Johnson et al., 2014). Jones (2008) outlines challenges associated with implementing online learning and teaching including a lack of professional development and institutional constraints, which encompasses management's lack of support and understanding of resource implications. This is especially pertinent in the case where educators may want to incorporate less widely used technologies into their teaching. For example, data from Educause shows that while over 50% of faculty believed they could be more effective with etextbooks, only 20% of the institutions provide support for this technology (Dahlstrom, 2015).

The effective use of educational technologies that emphasise pedagogy within the curriculum is largely facilitated through comprehensive staff development and support (Lefoe, Olney, Wright, & Herrington, 2009). Research has identified different ways that staff can be supported including individualised training, a focus on how to use the technologies, and the utilisation of peer support (Jones, 2008). Lefoe et al. advocate a social constructivist approach that fosters collaboration as an effective framework for professional development in this space. They noted the benefits of staff training that occurs within communities of practice in which individuals share and co-construct knowledge through a process of mutual engagement and joint endeavour. It is generally agreed that training staff in technology skills in isolation of the teaching context is ill-suited to developing teachers' capabilities in the effective use of technology for pedagogy because "knowing how to use a technology is not the same as knowing how to teach with it" (Mishra & Koehler, 2006, p.1033). Therefore, staff training and professional development efforts need to consider the complexity of knowledge necessary for successful integration.

TPACK framework

A useful theoretical perspective that emphasises a designed-based approach to teaching, and clarifies the nature of the complex knowledge required in order to effectively integrate technology into pedagogy can be explained by the Technological, Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler in 2006 (Koehler & Mishra, 2008). As illustrated in Figure 1, the framework contains three components of teachers' knowledge: content knowledge, the knowledge of the subject matter to be taught or learned; pedagogical knowledge, the deep knowledge of processes and practices of teaching and learning; and technology knowledge, knowledge about using and working with technology. While each type of knowledge is important, more critical are the interactions of these components. Pedagogical content knowledge concerns the transformation of subject matter for teaching; technological knowledge refers to the understanding of the manner in which technology and content influence and constrain one another; and technological pedagogical knowledge is the knowledge of how teaching and learning can change when particular technologies are used in certain ways. Emerging from an understanding of all these interactions is TPACK, a complex knowledge which the authors maintain is the basis of successful teaching with technology (Koehler & Mishra, 2009).

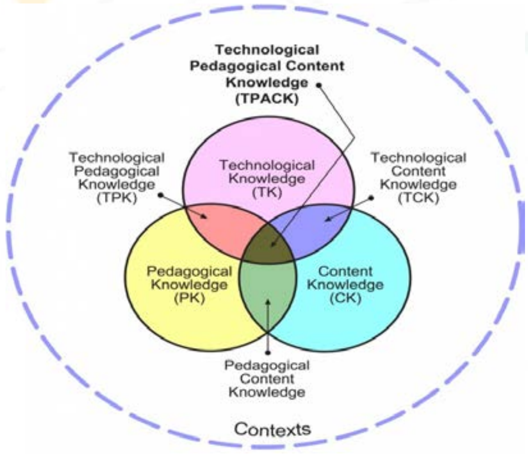

Figure 1: TPACK framework and its knowledge components
(Source: Koehler & Mishra, 2009, p.63)

Effective teaching is dependent on achieving a dynamic equilibrium between all three components, but a range of factors influence these connections. Not least of all is the fundamental understanding of technology (TK). This component is difficult to define because innovations evolve. Unlike traditional pedagogical technologies such as pencils and microscopes, which are characterised by specificity, transparency and stability, digital technologies are protean, unstable and opaque, all of which create challenges to teachers wishing to integrate these technologies into their teaching (Koehler & Mishra, 2008). This framework is designed to capture the essential qualities of teacher knowledge required for integrating technology into teaching (Gaffney, 2010), and can contribute to the professional development of educators and the creation of better learning environments (Koehler & Mishra, 2008).

Developing individual TPACK is challenging. Stover and Veres (2013) argue that professional development programs tend to be bifurcated in that they address these different types of knowledge separately rather than emphasising the interrelationship between them; therefore, the use of the TPACK framework in the design of technology professional development programs for teachers is important. Stovers and Veres (2103) report on an action research study in which they observed self-reported learning gains in TPACK of a group of graduate students enrolled in an online university certificate program in Instructional Design in Online Learning. Based on their findings, they recommend partnerships and learning communities which can bring together specialists in each of these domains to assist in the development of this knowledge. In a study by Jones, Heffernan and Albion (2015), six educators shared their experiences of attempting to effectively integrate technology into the online education of pre-service teachers on a group blog. After analysing the blog posts, it was found that the opportunity to engage in meaningful discussion with colleagues in the same context enhanced TPACK. The authors concluded that "situated collaborations helped overcome the limitations of organisational practices and technologies that were not always well suited to our context and aims" (p.19), and that there are significant limits to what teacher educators can achieve alone as TPACK is distributed across the individual, other persons, and tools, further supporting the argument for collaboration (Lefoe, Olney, Wright, & Herrington, 2009).

It is therefore considered that professional development which focuses on the development of TPACK and operates within a collaborative and context-specific learning community could support the increased uptake of digital textbooks. To explore this further, this paper will present a theorised inquiry into educators' reflections on the integration of digital textbooks. The inquiry is guided by the following questions:

- How do higher education teachers use digital textbooks?
- What challenges and barriers do higher education teachers encounter when using digital textbooks?
- What challenges and barriers do higher education teachers encounter when integrating technology into their teaching?
- How does the level of available professional support assist educators in integrating digital textbook and other technologies into their teaching in the higher education context?

Overview of the study

This paper is derived from a PhD project which has an overall goal of investigating higher education teachers' responses to technological innovation by inquiring into lecturers' motivations for using or not using digital textbooks, and collecting case descriptions of the ways in which educators use digital textbooks for learning and teaching. A qualitative approach was taken in order to gain deep insights into the individual experiences (Grbich, 2012). Data were collected through semi-structured interviews conducted between October 2015 and June 2016 with 17 lecturers teaching in various disciplines at four different types of Australian universities, based on categories from the Australian Education Network (2014). All participants except one were subject coordinators and had autonomy in choosing subject resources. Experience teaching in higher education ranged from 3 to more than 25 years. An overview of the participants is shown in Table 1.

Table 1: Summary of participants

Independent NFP university n=6 3 female 3 male	Group of 8 n=7 6 female 1 male	Regional n=2 1 female 1 male	Australian Technology Network n=2 1 female 1 male
Law Linguistics Australian Studies Communications Planning & Urban Design History	Spanish (2) History Public Relations Chemistry Biochemistry Biology	Physical Education Early Childhood Education	Planning & Urban Design Information Studies

A combination of sampling techniques was used. Initially, convenience sampling was used to recruit participants from the researcher's professional contacts at the different institutions. Thereafter, snowball sampling occurred as interviewees often recommended other colleagues they believed would have interesting contributions to make to the research project.

Research interviews are professional conversations "with a purpose of obtaining descriptions of the life world of the interviewee in order to interpret the meaning of the described phenomena" (Kvale, 2009, p.3). Throughout the interviews, which were approximately one hour long, lecturers were encouraged to discuss an array of issues associated with their teaching and use of technology, including digital textbooks. The same basic topics were pursued in each interview with participants asked for example to describe how they might use technology in their teaching, the benefits and challenges of integrating educational technology, their use of textbooks, and their understanding and perceptions of digital textbooks. By maintaining a semi-structured approach, there was scope to elucidate any emerging themes more fully (Patton, 2002). The interviews were transcribed verbatim, returned to the interviewees for verification, then coded both manually and with MAXQDA software following guidelines for coding and analysis set out by Miles, Huberman and Saldaña (2014). Emergent themes were then identified.

Results

This section presents a summary of findings that emerged from the interview data, and a selection of pertinent interviewee quotes to illustrate lecturers' perspectives on the understanding and use of digital textbooks, challenges and barriers to the adoption of digital textbooks, challenges and barriers to integrating technology into teaching, and the available support. To ensure anonymity, the interviewees are referred to by the codes L1-L17.

Understanding and use of digital textbooks

The understanding of what a digital textbook is varies amongst lecturers, and these different understandings can be seen to influence expectations and use of the digital textbooks. At the simplest level, digital books and print books are understood to co-exist as alternatives of the same product in terms of providing access to text-based content, thus reflecting a narrow understanding of a digital book.

> "Basically a book on a computer. That's what I would see it as. Is that a limited view now?" (L2)

While a number of the lecturers in the study had no knowledge of whether an electronic version of a prescribed or recommended text was available, they were not averse to students accessing an electronic version if it were available. *"I don't care if they buy it that way, I usually give them different possibilities"* (L4). In some instances, students were directed towards the digital version of a textbook for reasons of convenience or for cost, but ultimately the choice of medium remains optional. Students are often provided with links to digital books, or chapters, which are part of the recommended reading for their courses.

There is an increasing trend for publishers to provide a companion website as part of a textbook subscription package that offers extra resources including audiovisual content and interactive quizzes for use by both teachers and students, and which some of the lecturers suggested may be considered to be digital textbooks. Seven of the lecturers interviewed used these products, and for one, this was actually the reason for choosing that particular textbook as she was attracted to the availability of supplementary resources. In several instances, lecturers integrated some of the activities into the course, but for the most part, there was a tendency to just recommend them to students as optional resources, even though they were generally perceived to be of value.

Several of the lecturers were aware of the more sophisticated forms of digital textbooks as expressed in this definition of a digital textbook: *"My understanding of the term digital textbooks is that they are eBooks but they have a whole bunch of other content built into them. So they've often got extra activities for the students to do, and I guess they're for a particular topic, an introduction to accounting type set of content with I guess the additional resources that you would expect to get in a print textbook as opposed to a print monograph"* (L7)

One lecturer was using a textbook available only in e-format, and another at the time of the interview was preparing to switch the first-year subject from a book plus web companion site, to a total adoption and integration of an online textbook.

Challenges and barriers to the adoption of digital textbooks

Four main challenges and potential barriers to the adoption of digital textbooks were evident: a preference for print, perceived lack of value for learning, lack of availability of high quality digital textbooks, and the multiple platforms upon which they operate. It should be noted that challenges are not always barriers, and there is a complex relationship between the various factors which will be discussed briefly.

Many of the lecturers expressed a strong preference for reading in print; thus, for a reading experience, print books are generally preferred to digital books. Print is perceived to be more conducive to established academic reading practices such as skimming, annotating and extended reading of complex material. There were also concerns about screen fatigue. The following comments illustrate these perspectives.

> *"To me, the thought of reading a chapter of a book online makes me sick. I just wouldn't do it. Even though I'm an environmentalist, I'd still print it. I'd print it two per page, and double sided, like I do with everything. But I'd still print it. I hate reading online, can't stand it."* (L6)

> *"There is something about reading a hard copy document of any kind where you can cast your eye over more pages in hard copy, and if you have developed that capacity to scan and to absorb, not necessarily the detail but the general gist of things, that is a lot harder to do with the digital documents."* (L3)

> *"The tangible book is really important at times, to be able to scribble in and dog ear, and bastardise you know?"* (L9)

However, a personal preference for print does not necessarily translate to being a barrier to the adoption of digital textbooks in this study. Even those lecturers who expressed a strong preference for print were not resistant to students using an ebook as an alternative. In some instances, it was in fact encouraged as it was felt that facilitating students' access to texts by providing links to electronic readings on course reading lists may increase the likelihood of them reading required and recommended texts.

For others though, there is an understanding that ebooks and print books can offer different experiences as expressed in these comments from L1:

> *"I think that people do what I did for years, just download it and read a book, but it's not a book, it's an ebook. So, you can do a million things with it. It's in my view a totally new skill, a new*

reading skill, a new multi-digital reading skill that you need to know that if you click this you go there, and you can read this, or you can watch a movie that goes with it, or you can use an advertisement that goes with that. It's a completely different experience."

"I love that idea that it [a digital textbook] provides that overall experience the audio, visual, that is not just the presenting of the content, of the area of expertise…it's almost like a teaching tool."

Availability of good quality digital textbooks in particular subject areas is considered to be a barrier, as a number of lecturers expressed their disappointment with products currently available.

"I guess my responses are probably coloured by the fact that there aren't a lot of great e-textbooks….And the market's just stuffed. The e-book market in general, publishers can do whatever they want. And the suppliers can do whatever they want. And the thing is it's not even like they're supplying a good experience. The platforms are hideous. They're awful." (L7)

Digital textbooks currently operate on multiple platforms and this is also considered to be a barrier, particularly if there is a lack of seamless integration with the learning management system (typically Blackboard). In the following quote from one interview, the lecturer talks about what she believed to be a superior digital textbook to that which they were currently using, but which after consideration they decided not to adopt. This decision was based on several reasons including the need for students to negotiate another platform.

"In the end I think we decided, because we've got our sort of more interactive online learning which we do, that we'd leave it at that because otherwise it's another platform that they've got to learn. And that's I guess one thing which we hadn't foreseen going to an e-textbook, is that for the students, some of them have a lot of trouble getting their heads around the fact that we have a course website, we have a textbook website, we have an online learning website and they have a lot of trouble assimilating all the different things, the different platforms they need to use. Which is something we didn't foresee them struggling with, but some of them do." (L13)

There is certainly evidence of enthusiasm for digital textbooks, but there remains limited integration of their features. For many of the lecturers, digital textbooks and textbook companion websites contribute to their pool of resources, which can be drawn upon as required. For others, the resources are optional for those students who may need the extra help, or are driven to engage more fully with the content. Lecturers are very cognisant of the demands on students and are mindful of not increasing their burden by requiring them to undertake the extra activities in digital textbooks, particularly with activities that are not directly connected to assessment. While this is not a factor in the decision to adopt a digital textbook, it certainly impacts on how it is used, and the extent to which it is incorporated into the course.

"This course is already really packed. And it's a big course. It is content-heavy, but it's also conceptually difficult…And as soon as you start setting more online resources they start to panic and you're starting to push them to the point where they start to go, "is this examinable?" (L11)

"that will overload the students with time… we have to integrate those things and give them real value. If you want to watch a film, you can do it anytime, students can watch it on their phone whatever. There has to be a good reason to watch the video or the film." (L12)

Challenges and barriers to integrating technology

Besides the barriers specifically connected to digital textbooks, a number of challenges to the adoption of technology were highlighted through the interviews which could be applicable to the adoption of digital textbooks. Lecturers often expressed a lack of confidence in their skills with using technology.

"I'm not a digital native and I'm not overly confident with technology" (L17)

"frustrating because I'm not actually a technology whiz," (L3)

At the same time, lecturers also felt they were simply expected to know how to use technology.

"sometimes I feel like being an academic they expect us to be able to do everything, and to be honest I used to be much better at technology than I am now, and that's mainly because I don't have time to learn it." (L13)

"In the last five years or so there is an expectation that staff are on top of it., that teachers are supposed to stay ahead of technology" (L17)

A strong finding from this study was that lecturers avoid gratuitous adoption and use of technology. Lecturers are discerning in their choice of learning resources and a strong barrier to the adoption and use of any technology is the belief that it lacks a clear learning and teaching purpose. If a resource is judged to be inferior or inappropriate in terms of the content, potential learning outcomes, or student experience, lecturers will not use it.

> "The one thing I'm a bit concerned about is that we've got to be a little bit careful not to use technology for technology's sake" (L13)

> "I am not going to [use technology] if it doesn't fit" (L2)

> "I am very conscious that I'm not just going to jump on a bandwagon. Only if I can see the definite benefits for both myself and the students will I jump on and give it a shot" (L6)

> "I think you can over-technocise-Is that a word?" (L17)

> "my philosophy is that I won't put anything in just because it's groovy, funky or popular. …I wouldn't do it unless I know the students are benefitting and learning, so there has to be some sort of learning gain. So I always evaluate to see if there is, and I think if there isn't you've got to question is it really adding value to the learning?" (L14)

It was also noted that it is erroneous to assume that students have the necessary skills to use the technology to effectively leverage their learning opportunities. Even though students can appear to be comfortable with the technology, it was observed that they do not always use the tools in the way the lecturer intended.

> *"But the thing about technology is that although we might be engaging with it, the engagement of the students isn't necessarily in the same direction or at the same level."* (L10)

> *"I think a lot of students will use digital textbooks because they are cheaper, but sometimes it takes me to show them what they can actually do with it…I think what is really needed I believe is training yet again- how to use ebooks. And I think how to use ebooks for both teachers and students as well because I don't think people know how to use them really."* (L1)

However, providing this training and support creates another dimension to the educator's role.

"We're very much now more aware that we have to provide multiple ways of accessing the tools that we're using, and if a student can't access something we're using as part of assessment, they can contact us and we will troubleshoot with them until they can. That's a new layer to what we do in teaching I think." (L14)

The interviews revealed a widespread understanding that technology needs to be carefully integrated in a structured and meaningful way, which can create challenges.

> *"Technology's got to be sequenced and structured. Like all good teaching, it's got to fit in with it, you can't just plonk it in"* (L10)

> *"You know that as long as you're organised, and you're not just rocking up to class and throwing on a bunch of videos. As long as you've thought about the learning outcomes, and you've thought about how to create a nice reflective environment after you've showed the resource, then I don't think there's any risk"* (L6)

> *"I think that the challenges are of course the combination of the two, actually of the three in my mind- so it's the combination of technology, pedagogy and the content. So what do we teach, how do we teach it, and what sort of technology we can use to do it?"* (L1)

Effective integration of technology requires a significant time input at all levels: staying abreast of technological developments, choosing the most appropriate tool for the desired outcome, learning how to use the technology, and setting up the technology, all of which may involve changes to the curriculum.

> *"It's time. And expertise in the sense that we're very willing to learn, but I think in a sense that finding the right platform or tools because it's very specific to a context and I think that's the thing. So we know in our heads as academics what we want to achieve and how we think our students will do it. I think probably at the cross-institutional level they're very aware of the tools and how they can be helpful, but the connection between the coalface and the imagination is a different thing, and I think the hurdles generally come from that because it is about time, availability of people".* (L14)

While time was the most frequently mentioned challenge in the interviews, it was not always a barrier. If lecturers believed that a particular technology could create learning opportunities, they were prepared to invest whatever time it took to incorporate it. Thus, perceived learning outcomes were seen to mitigate time and effort as a barrier.

Supporting lecturers' use of technology

The availability of institutional support was acknowledged by the interviewees, although many of them reported not accessing it because they either preferred to work out the technologies themselves, or there were limitations to the support available. It can be difficult for academics to identify and locate the key people who can offer the support required: *"The support is out there, it's just knowing where to go for it"* (L9) and *"We struggled to actually identify who we needed to support going on to our online course. We knew we had the content, we were* *over that, but what's the best way to turn that into something useful for online learning?"* (L14). Sometimes the extent of support available may be limited and cannot meet the needs of the educator. *"But again the practicality of it is that you get there and it's, "Oh yeah we can help you with this little bit but not that bit", or "We can show you how to use the equipment but then you've got to do it yourself"*. (L13). Several of the lecturers use technologies that are not commonplace in educational practice, and there may not be the necessary support available in the institution. This means that lecturers are often working in relative isolation, learning how to better use technologies for their own individual purposes.

It was also noted that there are different types of support required for effectively integrating technologies: technical assistance, assistance with design, and pedagogical support.

> *"So there's the pedagogical help for the underpinning reason for doing what you're doing, and that's really necessary. So we've got a group of people that will help with that. And then you've got the help about setting up your study desk, making it look aesthetically pleasing."* (L9)

> *"I think going forward we need more people who actually understand the technologies and uses for it to guide the people who are doing the teaching as to, don't just do this because it's new....different things are going to be appropriate for different types of teaching I think."* (L13)

One way this is achieved is through the use of teams of experts. Two of the lecturers spoke of the benefits of such teams.

> *"what I'm doing now, I could never do it on my own because you actually can't do it on your own. I believe that you need other people, you need to be part of a team."* (L1)

Despite acknowledging that institutions provide avenues for support, there were a number of comments made about how institutions could make improvements in this area. It was suggested that there is a need for increased collaboration between faculty, the provision of targeted support, and greater investment into support services.

> *"What we need is increased educational discourse around how we use the new technologies to facilitate that learning"* (L3)

> *"Where I see a need in the University is with coordination of e-learning efforts. So there's lots and lots of technology. There's lots of terrific technology. There's lots of terrific people doing terrific things. And most of them don't know about what the others are doing. So it's really, really fragmented. I think the students get overwhelmed by the technology opportunities that are out there, and the academics get overwhelmed by the technology opportunities. And the University gets overwhelmed in terms of supporting all the different technology opportunities"* (L11)

> *"But there are ways that Universities could support this stuff to make it less time consuming. I don't need to be troubleshooting my own WordPress installations when I'm running a week-long gamification activity and spending the whole week plugging holes in the system. If there were options within Universities for different learning environments or learning tools that we could use and deploy and they were supported, then that stuff would be a lot easier."* (L7)

> *"I would like to see greater university resources directed toward the skills set development of teaching staff in my area particularly, so that we can stay ahead of the pack because to me teaching is constantly a balance between staying on top of the material and staying on top of the technology and both of them are full time jobs"* (L17)

> *"I think what we have to do is encourage fearlessness with technology rather than the skills, and that's very difficult,"* (L7)

With respect to digital textbooks, publishers have a vital role to play in providing support. This appears to be occurring to some extent as evidenced by lecturer E15, who at the time of the interview was preparing to fully integrate a digital textbook into a course she was responsible for. She spoke favourably of the support received from the publishing company and its representatives.

> *"they've been great, that's what I want to say, both the rep that deals with the orders, and the Tech Support. They both came to see me yesterday and we spent a good hour talking about things and the Tech support person was telling me that he can sit down with me once I have come up with my course outline with learning outcomes and learning objectives and so on, and he can guide me through some ideas. And the other rep said they also have some what they call best practice courses or gold standard courses, so the shell of what a really great course might look like on the Connect platform that I can have access to and borrow ideas from, even copy into my course some of the strategies they use an so on."* (L15)

Publishers may be able to contribute more to supporting educators in their use of digital resources in a rapidly changing space, as suggested by comments from L1.

> *"the basic training materials should be produced by the publishers, and maybe administered at some level by the university. I have no idea whether there are trainings when I've adopted textbooks, but it would be nice because we buy these books, and because publishers know that we are adopting these books because you've contacted publishers for the desktop copy, or I talk to publishers and say this is what I'm interested in.. it would be great to get an email saying this textbook is available in the etextbook form, because I honestly can't keep up with it. Very often students tell me that particular books are available as ebooks…But it would be nice to get an email from the publishers saying 'Hey this is available in ebook form, and there's a series of videos that you can watch with ideas of how to use them, and what tools are attached to them, and what these tools actually do"*

Discussion

The potential of digital textbooks

In the present study, it was found that some lecturers retain a narrow understanding of a digital textbook as an electronic version of a print book, and their expectations and use are based on their experience with the print medium, thus supporting the idea that cognitive bias based on prior experience can limit the use of new tools to established and traditional practices (Eysenck, 2001). There are however many lecturers who recognise the opportunities that digital textbooks offer, and are positive about this medium's potential for learning and teaching. While a number of the lecturers have decided to adopt them as a text for the course, they are rarely integrated. The raft of extra features, while acknowledged as being valuable, are often not used beyond being extra resources for those students who wish to engage further with the content. Knight (2015) argues that this kind of "bolt on effect" (Ellis & Goodyear, as cited in Knight), where digitalisation is used as a means of conveying textual information by simply bolting it on to existing course design, should be avoided. Instead he stresses that the potential and power of learning technologies should be harnessed to improve students' learning outcomes.

The applicability of the TPACK framework

Barriers often apply to the integration and use of digital textbooks rather than the decision to adopt them. There is a resistance to adapting existing curricula to incorporate digital textbooks in a way that optimises the learning opportunities they offer. One reason for this can be considered from the broader perspective of educational technology. Educators are aware that well-considered integration is imperative and will not use technology gratuitously without a clear and distinct learning purpose. However, achieving this requires significant investments of time and complex skills and capabilities that lecturers often do not possess. "Fluency in the digital realm is more than just understanding how to use technology. Training must go beyond gaining isolated technology skills toward generating a deep understanding of digital environments, enabling intuitive adaptation to new contexts and co-creation of content with others" (Adams et al., 2017, p.2). One way to achieve this is through the enhancement of lecturers' technological, pedagogical and content knowledge, the complex knowledge that sits at the intersection of all three specific domains of knowledge as explained by the TPACK framework (Mishra & Koehler, 2006) Studies into the use of TPACK support its viability as a framework for informing professional development in the digital space.

Institutional support and a distributive view of TPACK

While it was widely acknowledged that support is available to assist with technology use in universities, the lecturers in this study tended not to take advantage of it because it was perceived to lack value and specificity for their individual needs, particularly for those employing less mainstream technologies, a situation also highlighted by the literature (Dahlstrom, 2015). As a result, the lecturers for the most part are working in isolation when integrating technology. Notable exceptions to this were the two lecturers who developed their online courses with a team of colleagues who contributed different expertise. It is unrealistic to expect that any individual can possess such highly complex knowledge appropriate to individual contexts (Stover & Veres, 2013). A distributive view of TPACK (Jones, Heffernan, & Albion, 2015) suggests the need for partnerships. Lefoe, Olney, Wright & Herrington (2009) advocate for a social constructivist approach to professional development fostering collaboration between various individuals with different expertise, and this is further supported by Jones, Heffernan & Albion (2015). Teams of experts could potentially save lecturers time, and result in more innovative approaches to teaching and learning in the digital space. Other stakeholders also contribute to this learning community (Dahlstrom, 2015). Institutional managers responsible for decisions concerning the provision of staff support and training also need to be involved. The existing support structures are possibly limited in their scope as they are not targeted to the individual needs of the lecturers. The Educause report (Dahlstrom, 2015) argues that training and support must be meaningful to staff, so rather than adopting a one size fits all approach, institutions should seek to understand faculty and student interest in particular educational technologies for which support may not be readily available, for example digital textbooks, so they can make more informed decisions about investing in broader deployment of training services and support. Publishing companies also have a greater role to play in supporting lecturers adopting their digital textbooks and related resources.

"Technology and digital tools have become ubiquitous but they can be ineffective or dangerous when they are not integrated into the learning process in meaningful ways" (Adams et al., 2017, p.7). A lack of knowledge about how to effectively integrate digital textbooks into the curriculum, and a lack of relevant support to assist with this process may create barriers to their adoption and use in higher education. The findings of this study suggest that overcoming these potential barrier requires professional development and training that recognises the transformative potential of developing TPACK within a broader learning community.

Conclusion

Digital textbooks offer many opportunities in the new paradigms of learning and teaching in higher education which encompass online pedagogies. They can be distinguished from a print textbook as they offer a different experience, and this difference becomes more pronounced with the inclusion of advanced technologies such as adaptive learning capabilities. It is unrealistic and possibly risky to expect lecturers to have the necessary skills to effectively incorporate digital textbooks into the curriculum without appropriate training and support. Findings from this study together with a review of the literature suggest the need for institutional support that is individualised to instructors' needs, and allows for increased collaboration between various stakeholders. The TPACK framework could be useful in underpinning professional development efforts to support the effective integration of technology. By taking an approach that taps into the expertise of the broader group, there is the potential to develop the required knowledge and capabilities of the individual lecturers within a community of practice. Just as it takes a village to raise a child, so too does it take a village to support educators in optimising the learning opportunities of digital technologies including digital textbooks in higher education.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., & Ananthanarayanan, V. (2017). *NMC Horizon Report: 2017 Higher Education Edition*. Austin, TX: The New Media Consortium.

Australian Education Network (2014). *Australian University Groupings.* Retrieved from http://www.australianuniversities.com.au/directory/australian-university-groupings/

Baron, N. (2015). *Words onscreen: The fate of reading in a digital world*. New York, NY: Oxford University Press.

Dahlstrom, E. (June, 2015). *Educational Technology and Faculty Development in Higher Education*. Research report. Louisville, CO: ECAR, Retrieved from http://www.educause.edu/ecar

Dobler, E. (2015). e-Textbooks: A personalized learning experience or a digital distraction? *Journal of Adolescent and Adult Literacy*, 58(6), 478-487. doi:10.10002/jaal.391

Eysenck, M.W. (2001). *Principles of cognitive psychology* (2nd ed.). Philadelphia, PA: Psychology Press.

Gaffney, M. (2010). *Enhancing teachers' take-up of digital content: Factors and design principles in technology adoption*. Retrieved from http://www.ndlrn.edu.au/verve/_resources/Enhancing_Teacher_Takeup_of_Digital_Content_Report.PDF

Goodyear, P. (2010). *Teaching as design. HERDSA Review of Higher Education*, 2. Retrieved from www.herdsa.org.au/herdsa-review-higher-education-vol-2/27-50

Grbich, C. (2013). *Qualitative data analysis: An introduction* (2nd ed.). London, England: Sage Publications.

Gu, X., Wu, B. & Xu, X. (2015). Design, development and learning in e-Textbooks: What we learned and where we are going. *Journal of Computer Education*, 2(1), 25-41. http://doi.org/10.1007/s40692-014-0023-9

Hallam, G. (September, 2012). *Briefing paper on eTextbooks and third party eLearning products and their implications for Australian university libraries*. Retrieved from http://www.caul.edu.au/content/upload/files/learning-teaching/eTextbook2012report.pdf

Hamilton, (July, 1990). What is a textbook?. *Paradigm, 3*. Retrieved from http://faculty.education.illinois.edu/westbury/paradigm/hamilton.html

Internet2 eTextbook Spring 2012 Pilot Report (August, 2012). Retrieved from http://www."Internet2".edu/netplus/econtent/docs/eText-Spring-2012-Pilot-Report.pdf

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2014). *NMC Horizon Report: 2014 Higher Education Edition*. Austin, TX: The New Media Consortium.

Johnson, L., Adams Becker, S., Estrada, V., Freeman, A., & Hall, C. (2016). *NMC Horizon Report: 2016 Higher Education Edition*. Austin, TX: The New Media Consortium.

Jones, D., Heffernan, A., & Albion, P. (2015). TPACK as shared practice: Toward a research agenda. In L. Liu & D. Gibson (Eds.), *Research highlights in technology and teacher education 2015* (pp. 13–20). Waynesville, NC: AACE.

Jones, H. (2008). Pestering staff into online learning: An integrated plan for implementation. In *Hello! Where are you in the landscape of educational technology? Proceedings ascilite Melbourne 2008*. http://www.ascilite.org.au/conferences/melbourne08/procs/jones-h.pdf

Kvale, S. (2009). Interviews: Learning the craft of qualitative research interviewing (2nd ed.). Thousand Oaks, CA: Sage Publications.

Knight, B. A. (2015). Teachers' use of textbooks in the digital age. *Cogent Education*, 2(1), 1015812. https://doi.org/10.1080/2331186X.2015.1015812

Koehler, M.J. & Mishra, P. (2009). What is technological pedagogical content knowledge?. *Contemporary Issues in Technology and Teacher Education*, 9(1), 60-70.

Koehler, M.J. & Mishra, P. (2008). Introducing TPCK. In AACTE Committee on Innovation and Technology (Ed.). *Handbook of technological pedagogical content knowledge (TPCK) for educators*. New York, NY: Routledge.

Lefoe, G.E., Olney, I. W., Wright, R., & Herrington, A. (2009). Faculty development for new technologies: Putting mobile learning in the hands of the teachers. *University of Wollongong Research Online*. Retrieved from http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1078&context=edupapers

MacFayden, H. (2011). The reader's devices: The affordances of Ebook readers. *Dalhousie Journal of Interdisciplinary Management*, 7 (Spring). Retrieved from http://dalspace.library.dal.ca/bitstream/handle/10222/13823/MacFadyen%20-0The%20Reader%E2%80%99s%20Devices.pdf?sequence=1

Miles, M. B., Huberman, A.M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Mishra, P. & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054.

Patton, M.Q. (2002). Qualitative research and evaluation methods (3rd ed.). Thousand Oaks, CA: Sage Publications.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: The Free Press.

Sharples, M., McAndrew, P., Weller, M., Ferguson, R., FitzGerald, E., Hirst, T., Mor, Y., Gaved, M., & Whitelock, D. (2012). *Innovating Pedagogy 2012: Open University Innovation Report 1*. Milton Keynes: The Open University. Retrieved from http://www.open.ac.uk/iet/main/sites/www.open.ac.uk.iet.main/files/files/ecms/web-content/Innovating_Pedagogy_report_July_2012.pdf

Stover, S. & Veres, M. (2013). TPACK in higher education: Using the TPACK framework for professional development. *Global Education Journal*, 10(1), 93-110.

UQ Library (n.d.). *eTextbooks for courses*. Retrieved from https://web.library.uq.edu.au/library-services/teaching-staff/etextbooks-courses#diff

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A learning analytics view of students' use of self-regulation strategies for essay writing

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Essay writing is a fundamental part of higher education. Students' use of self-regulatory skills, such as time management and planning and writing strategies, while writing essays predicts better writing quality. Current characterisations of the relationship between self-regulation and essay writing are limited by the difficulty of assessing self-regulation in real-life essay writing contexts. This paper reports on a novel approach to examine students' use of self-regulation strategies in a real-life setting, using learning analytics. Four case studies are presented to illustrate similarities and differences in students' use of time management, planning and writing strategies. Participants managed their time in very different ways to complete the assignment. They were active over a different number of days, engaged in sessions of different durations, and at different times of the day. The participants used variety of approaches to their writing: one participant started early and allowed editing time, another typed gradually over a number of days, and two participants waited until the due date to complete the essay, with varying amounts of editing. Findings from this research contribute to a novel detailed empirical evidence of different essay preparation behaviour in real-life settings. After further studies with a variety of essay types and student samples, there may be significant value in using the approached outlined in this paper as the basis of tools they provide students with advice and support in their essay preparation.

Introduction and background

Essay writing is a widely used type of assessment in higher education. Essay writing requires students to use high levels of self-regulation; students' use of self-regulatory skills while essay writing predicts better writing quality (Santangelo, Harris, & Graham, 2015; Zimmerman & Risemberg, 1997). However, current characterisations of the relationship between self-regulation and essay writing are limited by the difficulty of assessing self-regulation in real-life essay writing contexts. Research on essay writing processes has heavily relied on self-report methods, either after essay writing in a real-life assessment context (e.g., questionnaires, Torrance, Thomas, & Robinson, 2000), or during essay writing in a lab study (e.g., think aloud protocols, Stratman & Hamp-Lyons, 1994). Learning analytics provides a way to more precisely characterise essay writing and the use of self-regulatory processes (e.g., Azevedo, 2014; van den Bergh & Rijlaarsdam, 2013). The use of learning analytics allows examining the writing process in a less intrusive manner, and, most importantly, moves investigations from the laboratory to real-life settings. In this paper we outline a study that used learning analytics tools to examine students' self-regulatory skills while essay writing in a real-life setting.

Models of self-regulation in writing argue students' personal processes are a key factor to their writing process (e.g., Flower & Hayes, 1981; Zimmerman & Risemberg, 1997). Zimmerman and Risemberg (1997) propose personal processes involve time planning and management, setting goals, setting self-evaluative standards to assist in monitoring performance, using cognitive strategies, and using mental imagery. This study focuses on two of the personal processes: *time planning and management*, and use of *cognitive strategies*. Time planning and management requires students to estimate and manage their time for essay writing. For example, estimating the total amount of time they will need to dedicate to essay writing, and how they will break that time into smaller blocks of time (Zimmerman & Risemberg, 1997). Cognitive strategies used in writing are related to planning the structure of the essay, producing the piece of writing itself, and revising it through iterative editing (Zimmerman & Risemberg, 1997). Both processes are considered important for improving writing (e.g., Hayes & Nash, 2013; Santangelo, Harris, & Graham, 2015). However, we are yet to develop a precise characterisation of the essay writing process itself and its relation to the use of self-regulatory skills.

Although well-described, personal processes involved in essay writing (e.g., time planning and management and cognitive strategies) are rarely examined in the context of real-life essay writing. Students' writing processes are largely unobservable. Educators have access to the final version of an essay, written using paper-and-pencil or commonly used word-processing software. While teaching staff can review essays by asking students to hand in outlines or preliminary drafts, this can be unfeasible when teaching courses with large student numbers. Together, the inability to measure writing processes, combined with the time burden of reviewing drafts effectively limits educators' ability to provide students with feedback during the writing process. Recent advances in word-processing technology may present a solution to this problem for both educators and researchers. An advantage of these technological developments is that large cohorts of students' essay planning and writing strategies (e.g., self-regulation) can be analysed through learning analytics.

Learning analytics is the "measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs" (Siemens & Gašević, 2012, p.1). Learning analytics can provide educators with the opportunity to better understand and act upon students' writing process (Gašević, Dawson, & Siemens, 2015). Over the last decade, the use of learning analytics to measure students' self-regulated learning skills has taken a central role in the field (Winne, 2010). Recent research has used learning analytics to examine time students took to write characters and words during an in-class essay assessment task. For example, Deane (2014) examined writing bursts in number of characters, duration of pauses between words, and between sentences, and time spend copying and pasting text. And Eklundh and Kollberg (2013) captured students' audit logs when revising their essays using a specific software. One limitation of these studies is that they have only examined students' essay writing over a brief writing period (e.g., one hour of class, Deane, 2014). In real-life contexts, students may be given several weeks to write the essay, and will need to use time planning and management skills to write the essay. Given students' use of writing processes varies with context (Biggs, 1988; Kellogg, 1988), it is likely that writing processes required for a one-hour essay-writing assignment will differ to those required for a multi-week assignment.

In the current study, students' use of self-regulation strategies for essay writing is examined in real-time and in a real-life context, using descriptive learning analytics. The focus of the investigation was on students' self-regulation strategies; specifically, their skills in managing time dedicated to their essay, planning essay structure, and writing their essay over a three-week period. As such, two questions underpinned the investigation. How do students manage their time to work on the essay across the assignment period? And how do students use different planning and writing strategies to complete their assignments? We use a combination of cohort data and case studies to describe and compare tertiary students' use of time management and cognitive strategies while writing an essay using an online writing platform.

Method

Participants and context

Participants were 107 students from a Business undergraduate course at the University of Melbourne. Ethics committee approval was obtained from the University and all participants provided informed consent. Participants were asked to complete a 1,000-word essay as part of their course, worth 10% of their final mark. Teaching staff marked participants' performance in this assignment using a score from 0 to 100. Participants could choose between two topics: (1) "The business of business is to make profits", and (2) "What is the business case for Corporate Social Responsibility?". Participants were instructed to include personal opinions about the material covered in the course. The aim of the essay was to assess participants' understanding of course material. Essay guidelines were released to participants on 8th of March and the due date for the essay was 27th of March. In total, participants had 19 days to work on the assignment.

Participants were instructed to complete their essay using Cadmus, an online word-processing software tool. Cadmus has most features of other word-processing software tools, such as main body section for writing with style editing, inserting tables and images, bolding, highlighting, among others. Some of the additional features of Cadmus include a section for dedicated note taking (referred to as "notes"), and a restriction of pasting at a limit of 90 words from external sources in a single paste. Cadmus is designed as a tool to support the development of participants understanding of issues associated with academic integrity. As such, a design feature is the display of automated warnings to participants related to academic integrity. For example, a warning appears if participants are close to reaching the paste limit. Participants were encouraged to use the Cadmus software for the whole essay construction:

through planning the structure of the essay, to producing the text, revising, and adding references.

Measures

Cadmus records the actions of participants via learning analytics while they work on their essay. Cadmus continuously records the user's actions via the keyboard and takes a snapshot of the document every two minutes, creating a temporal log of participants' writing activities. Learning analytics used in the current study include: number of sessions by student during the assignment period, duration of these sessions, number of words added and deleted, number of words copied and pasted, and which sections of the document they used (main body and notes). These measures were then organised and processed to represent participants' use of time management and cognitive strategies, such as planning and revising the essay.

Time management was represented by three variables. *Number of days* participants spent working on the essay, a count of days active in the Cadmus system. *Number of sessions* participants spent working on the essay. A session consists of a period of time greater than 30 minutes working in the Cadmus system, without interruption (Mao, Kamar, & Horvitz, 2013). *Active duration* was the amount of time a student presented any activity within a session (e.g., typing or deleting words).

Cognitive strategies for writing were divided in two categories: planning and working on the essay. Planning relates to how participants used the notes section, and was represented by four variables: *use of notes* section during the assignment, *number of added words to notes*, *deleted words from notes,* and *pasted words to notes*. The *use of notes* is a binary measure, and remaining measures are count data. Working on the essay relates to how participants used the main body section, represented by three variables: *number of typed words to main body*, *deleted words from main body,* and *pasted words to the main body*. For the class assessment, participants were marked on the contents of their main body section at time of submission.

Research design, data processing and data analysis

We used a multiple case studies design to examine similarities and differences between the cases (Baxter & Jack, 2008). Descriptive statistics were used to characterise the whole cohort, while descriptive temporal analysis was used for four case studies chosen to illustrate the different time management and writing strategies participants used.

Raw data was extracted from the Cadmus platform in CSV format for all 111 participants in the class. After initial inspection, four participants were found to have not completed their assignment, presenting a very low final word count to their essay (below 600 words); these participants were removed from further analyses. For the descriptive temporal analysis, closer inspection revealed that 5% of the learning analytics were recorded in intervals longer than two minutes (ranging from just over 2 minutes to 17 days). This was due to technical challenges, such as interrupted internet connection. These records were substituted for the median: two minutes. Statistical softwares R and IBM SPSS were used for data analysis.

Results

The results section is presented in two parts. First, we use descriptive statistics to examine how all participants managed their time and used planning and revising cognitive strategies when working on the essay. Second, four case studies are presented to illustrate the different writing strategies participants used to work on their essay.

Descriptive statistics

Length of time that participants spent completing their essay in the Cadmus system ranged from four hours to 14 days. Participants completed their essay in an average of four and a half days (*SD*=2.21). Figure 1 displays a histogram of the number of days and sessions participants spent writing their essay. One participant completed their essay in one single session, while five participants took 20 or more sessions to complete their essay. Of the 107 participants, 23 participants did not use the notes section. Participants added an average of 2425 words to the main body of their essay (*SD*=1334), and deleted an average of 1370 words (*SD*=1318).

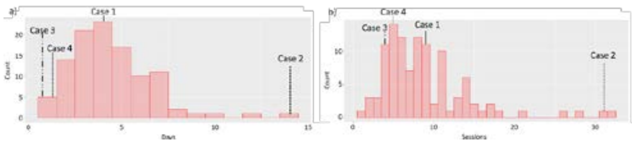

Figure 1: (A) number of days, and (B) number of sessions participants spent on the essay. Each case study is also identified

Case studies

The descriptive statistics analysis showed that participants used different strategies to complete their essay related to total of days, session duration and distribution, and writing strategies used. In this section, four case studies are presented to illustrate distinct applications of these strategies, using a descriptive temporal analysis (Figures 2 to 5). The four cases were chosen as they showed significant variation in the time management and writing strategies of interest in this investigation. The representativeness of each of these case studies is shown in Figure 1. Case 1 reflects the mode number of days. Case 2 represents the largest number of days and number of sessions. Case 3 and 4 both reflect the smallest number of days, with Case 4 also showing the mode number of sessions. Together, these case studies represent typical and atypical examples of time management strategies.

Case study 1 – AB (Figure 2)

AB completed the essay over four days, in 9 sessions. Sessions varied from 12 minutes to 3 hours and 9 minutes, and active duration varied between 12 minutes and 1 hour and 50 minutes, with a median of 32 minutes. AB worked on the essay from 12am to 12pm across the assignment period, on the days leading up to submission day. AB did not use the notes section, and started to work on the essay directly on the main body section. The first day working on the assignment (day 16) was AB's most productive day in terms of added words. Over four sessions, AB added the highest number of words in a day, including typed and pasted words, and deleted the highest number of words in a day. On the second day working on the assignment (day 17), AB started with a large deletion, followed in the next session with a paste of similar number of words. This suggests that AB cut and pasted a large amount of text, indicating the student was restructuring their writing. On the third day working on the assignment (day 18), AB spent little time in Cadmus, with few words typed, pasted, and deleted. Moreover, the student reached the word limit for the essay. On submission day, there was a similar number of words typed and deleted, indicating revision and editing. AB's final grade was 85%.

Case study 2 – CD (Figure 3)

CD completed the essay over 14 days, in 31 sessions. Sessions varied from 2 minutes to 2 hours and 47 minutes. Active duration ranged between 2 minutes to 1 hour and 22 minutes, with a median of 6.2 minutes. CD consistently worked on the essay from 12am to 12pm across the assignment period, and mainly on weekdays (days 10 and 11 were weekend). CD made use of the notes section, but did not use the paste function while writing the essay. On the first three days working on the assignment, CD focused on the notes section. On the third day working on the essay, CD worked on the main body section, while still making a small contribution to the notes section. For the following three days, CD made small contributions to the main body. Days 10 and 11 were the weekend, with CD working on this assignment Saturday but not on Sunday. At day 13, CD returns to adding words to the notes section. After this day, CD does not make any further contributions to the notes section. On days 14 and 15, CD showed a high level of activity in the main body, with high number of typed and deleted words, indicating some revision behaviour. After two days of rest (days 16 and 18), and a day with some contribution in a short session (day 17), the submission day arrives. CD engages in the longest session of this assignment with active duration of 1 hour and 20 minutes), and has the highest number of words typed and deleted in a day indicating both writing and revision behaviour. CD started work on the essay early, and worked on the essay over many days. For many days, CD spent little time in Cadmus (between 2 and 20 minutes). CD made use of notes, and had a high number of deleted words, indicating the student used notes to plan the essay before starting to write, and spent time revising the essay during the writing process. CD's final grade was 81%.

Case study 3 – EF (Figure 4)

EF completed the essay in one day (day 19), over four sessions. EF worked on the essay from 4am to 2pm on submission day. Sessions ranged from 2 minutes to 3 hours and 53 minutes. Active duration ranged between 2 minutes and 1 hour and 42 minutes, with a median of 8 minutes. EF started working on the notes section at 4am, typing and deleting a moderate number of words, suggesting some revision process during that writing process. Up until 10am EF made sparse contributions to the notes section. These short frequent sessions could indicate some sort of task switching between writing and reading materials, for example. From 10 am until 12pm, onwards, EF typed in the whole assignment in one long session, with active duration of 1h 42min. This session was mostly characterised by the constant addition of typed words, with some deletion of words throughout the session. At this point, EF was mainly writing down ideas, and probably revising small sections. EF did not paste any words when working on the assignment. EF's final grade was 70%.

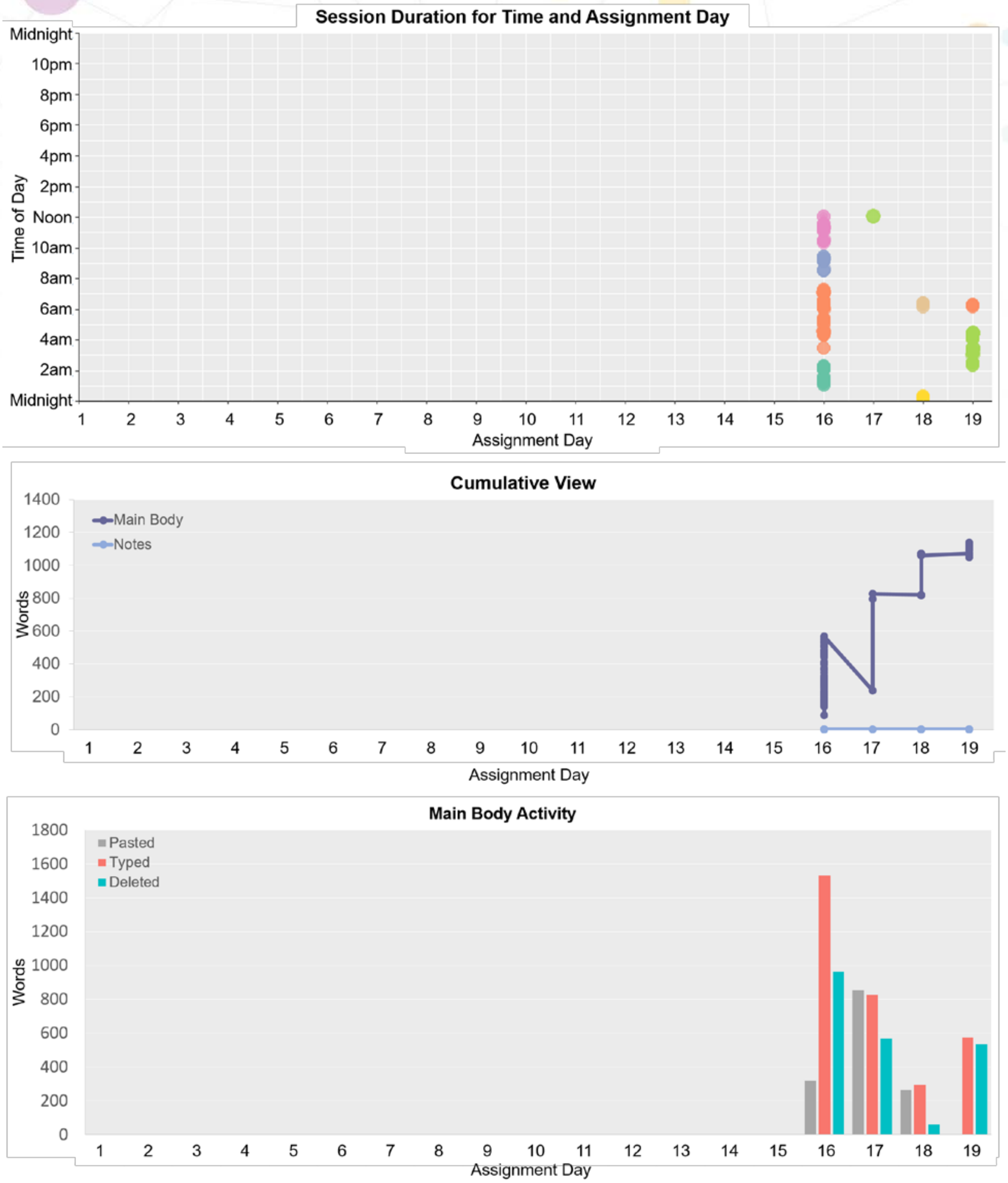

Figure 2: Case study 1: AB. Figure shows Session Duration (top) as a function of assignment day, and time of day throughout the assignment period (different colours indicates different sessions); Cumulative View (2nd from top) as a function of assignment day and number of words in the notes and main body; Main Body Activity (bottom) as a function of words typed and deleted each day.

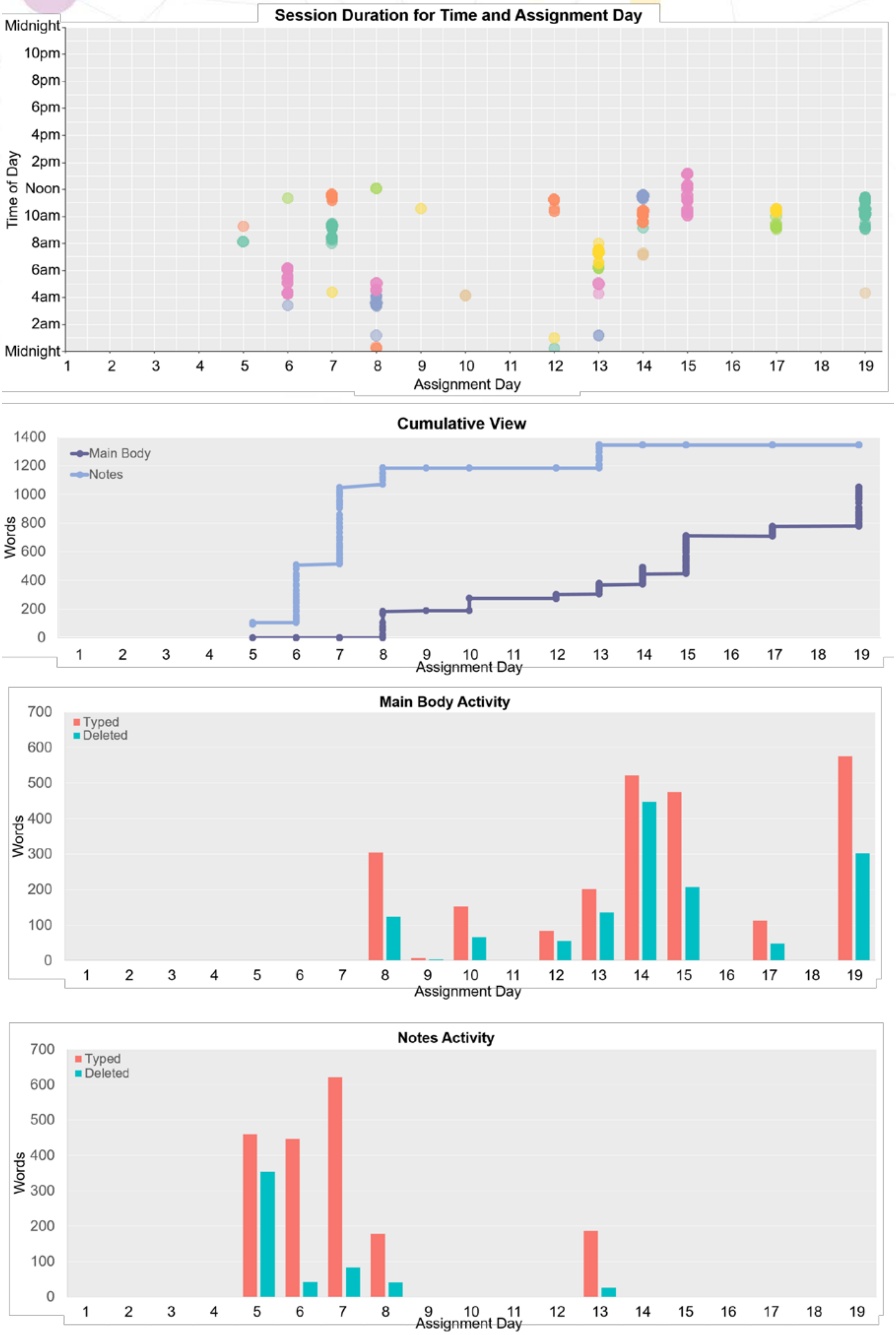

Figure 3: Case study 2: CD. Figure shows Session Duration (top) as a function of assignment day, and time of day throughout the assignment period (different colours indicates different sessions); Cumulative View (2nd from top) as a function of assignment day and number of words in the notes and main body; Main Body Activity (3rd from top) as a function of words typed and deleted each day; Notes Activity (bottom) as a function of words typed and deleted each day.

Figure 4: Case study 3: EF. Figure shows Session Duration (top) as a function of assignment day, and time of day throughout the assignment period (different colours indicates different sessions); Cumulative View (2nd from top) as a function of assignment day and number of words in the notes and main body; Main Body Activity (3rd from top) as a function of words typed and deleted over a single day; Notes Activity (bottom) as a function of words typed and deleted over a single day.

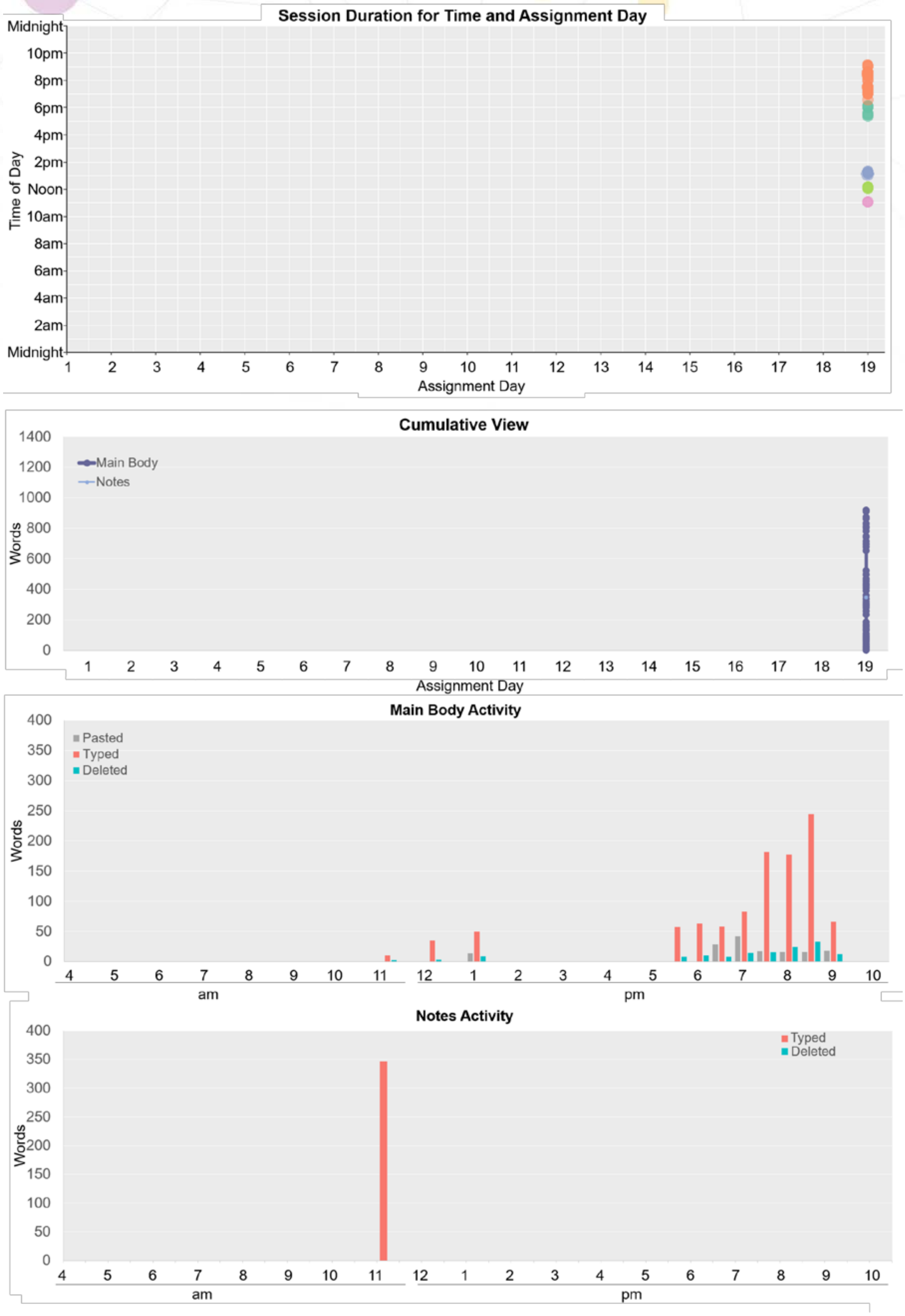

Figure 5: Case study 4: GH. Figure shows Session Duration (top) as a function of assignment day, and time of day throughout the assignment period (different colours indicates different sessions); Cumulative View (2nd from top) as a function of assignment day and number of words in the notes and main body; Main Body Activity (3rd from top) as a function of words typed and deleted over a single day; Notes Activity (bottom) as a function of words typed and deleted over a single day.

Case study 4 – GH (Figure 5)

GH completed the essay in one day (day 19), over five sessions. GH worked on the essay from 11am to 9pm on submission day, taking a break from 2 to 5pm. Sessions ranged from 4 minutes to 2 hours and 21 minutes. Active duration ranged between 4 minutes and 1 hour and 20 minutes, with a median of 11 minutes. GH first used the notes section, typing about 350 words. No deletion of words was recorded in the notes. This suggests GH was either writing down ideas or copying text from another source, and not revising. From 11am until 1pm, GH made small contributions to the main body section: typing 95, pasting 13, and deleting 14 words over three sessions, indicating GH was possibly switching between writing the essay and other activities. When returning to work on the essay at 5pm, GH had two consecutive sessions: between 5:40pm and 6:15pm (16 minutes active duration), and a second between 7pm and 9:15pm (1 hour and 10 minutes active duration). During those sessions, GH added 929 words, with few deleted and pasted words. The low deletion behaviour possibly suggests GH completed the essay in another platform and then typed it in Cadmus. GH's final grade was 78%.

Discussion

The case studies each managed their time across the assignment in different ways. AB and CD were more successful in managing their time to work on the assignment, dedicating more time overall to the assignment. On the other hand, EF and GH worked on the assignment only on the last day, suggesting poor planning and time management. Participants who started on the essay earlier deleted a far greater number of words, compared to the participants who began working on the assignment the day it was due, indicating these participants spent a greater amount of time revising their essay. The data from the cases also suggests that participants who were better at managing their time - indicated by them dedicating a greater number of days to work on their assignment – have more flexibility in their allocation of time to the assignment. Participants with fewer days to work on the assignment appear pressured by time to complete the essay in fewer, but longer sessions. Regardless of prior time spent on the essay, all case studies spent a long time working on the assignment on submission day. These findings suggest students who dedicate more time to their written assignments are able to spend more time revising their essays, which has been associated with improved writing quality (e.g., Hayes & Nash, 2013, Santangelo, Harris, & Graham, 2015). However, it is not clear the reasons that led students to use such different strategies to manage their time. It could be due to differences in time management skills, strategic approach, or perceived value of the assignment. Further research is needed to examine influences of these different time management patterns.

For the three cases who made use of the notes section, only two (CD and EF) made use of the notes section including adding and deleting words, indicating planning behaviour. It is possible that the other participants were also planning, but did so in the main text area of the Cadmus system, or indeed offline. Previous research has found that planning before writing an essay can reduce revising time (Kellogg, 1988), and guided planning activities may improve writing quality (Santangelo, Harris, & Graham, 2015). The current findings suggest that providing a notes section and instructing students to use them may be a good idea to promote the use of planning. It is important to note that researchers have been cautious to suggest for students to simply plan more: "If people who write well plan a lot, that does not imply that teaching people to plan a lot will help them to write well" (Hayes & Nash, 2013, p. 49). Therefore, it is advised for educators (and/or word-processing software) to provide guidance to students when promoting planning activities, such as generation and organisation of ideas, to see an impact on their writing quality (Santangelo, Harris, & Graham, 2015).

While the current study did not focus on investigating the relationship between students' writing strategies and performance, the selected case studies suggest a possible association between patterns in time management and writing strategies (e.g., revision) and grades. The first two case studies achieved a grade of 85 and 81, respectively, and the last two cases studies achieved a grade of 70 and 78, respectively. For these case studies, dedicating more days to work on the essay suggested to be related to the quality of their essay. Future studies may further examine the relationship between students' use of writing strategies and their performance.

Conclusion

This paper provides a novel approach into examining students' use of essay writing strategies in real-time and in a real-life setting. The four case studies illustrate students' similarities and differences on the use of self-regulation strategies when writing an essay in a real-life setting through the use of learning analytics. More specifically, we examined how participants manage their time and use planning and writing strategies while working on an essay over a 19-day period as part of their undergraduate course. Participants completed the essay over a different number of days, engaged in sessions of different durations, and at different times of the day. The participants used a variety of approaches to their writing. One participant typed many words within a single day and allowed significant time for editing. Another typed gradually, with many sessions over a number of days, and made a major contribution at the last minute. Two participants waited until the due date to complete the essay over a very long session. Overall, this study demonstrates the potential value of examining students' writing process over long periods of time in real-life settings. While very preliminary, the findings suggest that these patterns may be related to students' performance. Most importantly, this study demonstrated that the word-processing software used was a useful tool for research purposes in essay writing. Further studies as part of this project will focus on examining students' use of specific features of Cadmus using a more in-depth temporal analysis to better understand students' writing processes and their relationship to the use of self-regulate learning strategies.

References

Azevedo, R. (2014). Issues in dealing with sequential and temporal characteristics of self-and socially-regulated learning. *Metacognition and Learning, 9*(2), 217-228. doi: 10.1007/s11409-014-9123-1

Baxter, P., & Jack, S. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report, 13*(4), 544-556. Retrieved from http://nsuworks.nova.edu/tqr/vol13/iss4/2

Biggs, J. (1988). Approaches to learning and to essay writing. In R. Schmeck (Ed.), *Learning strategies and learning styles* (pp. 185-228). New York: Plenum.

Deane, P. (2014). Using writing process and product features to assess writing quality and explore how those features relate to other literacy tasks. ETS Research Report No. 14-03. Princeton, NJ: ETS.

Eklundh, K. S., & Kollberg, P. (2013). A computer tool and framework for analysing online revisions. In C. M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences and applications* (pp. 163 – 188). Hoboken: Taylor and Francis.

Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College composition and communication*, *32*(4), 365-387.

Gašević, D., Dawson, S., & Siemens, G. (2015). Let's not forget: Learning analytics are about learning. *TechTrends*, *59*(1), 64-71.

Hayes & Nash (2013). On the nature of planning in writing. In C. M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences and applications* (pp. 29 – 56). Routledge.

Kellogg, R. T. (1988). Attentional overload and writing performance: Effects of rough draft and outline strategies. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *14*(2), 355. doi:10.1037/0278-7393.14.2.355

Mao, A., Kamar, E., & Horvitz, E. (2013). *Why stop now? predicting worker engagement in online crowdsourcing.* Paper presented at the First AAAI Conference on Human Computation and Crowdsourcing.

Santangelo, T., Harris, K. R., & Graham, S. (2015). Self-Regulation and Writing. In C. MacArthur, S. Graham & J. Fitzgerald (Eds). *Handbook of Writing Research, Second Edition* (pp. 174 – 193). New York: Guilford Publications.

Siemens, G., & Gašević, D. (2012). Special Issue on Learning and Knowledge Analytics. *Educational Technology & Society, 15*(3), 1–163.

Stratman, J., & Hamp-Lyons, L. (1994). Reactivity in concurrent think-aloud protocols. Issues for research. In P. Smagorinsky (Ed.), *Speaking about writing: Reflections on research methodology* (pp. 89-112). [Written Communication Series 8]. Thousand Oaks, CA: Sage.

Torrance, M., Thomas, G. V., & Robinson, E. J. (2000). Individual differences in undergraduate essay-writing strategies: A longitudinal study. *Higher Education*, *39*(2), 181-200. doi:10.1023/A:1003990432398

Van den Bergh, H., & Rijlaarsdam, G. (2013). The dynamics of composing: modelling writing process data. In C. M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences and applications* (pp. 207 – 232). Hoboken: Taylor and Francis.

Winne, P. H. (2010). Improving Measurements of Self-Regulated Learning. *Educational Psychologist, 45*(4), 267-276. doi:10.1080/00461520.2010.517150

Zimmerman, B. J., & Risemberg, R. (1997). Becoming a self-regulated writer: A social cognitive perspective. *Contemporary educational psychology*, *22*(1), 73-101. doi: 10.1006/ceps.1997.0919

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Recipes for institutional adoption of a teacher-driven learning analytics tool: Case studies from three Australian universities

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The changing landscape of higher education is putting increasing strain on educators, leading to a diminishing ability to provide pedagogical and pastoral support to ballooning and diversifying cohorts. Learning analytics promises solutions to these challenges for educators, including by personalising learning support and experiences, streamlining data capture and analyses, and providing teachers with new, efficient teaching approaches. However, reports of these impacts, or widespread adoption of learning analytics, or even examples of cross-institutional collaboration are sparse. We argue that this may be because of a lack of educator-driven learning analytics tools that meet their felt needs, and present case studies from three Australian universities that have collaborated to implement such a tool. This tool, the Student Relationship Engagement System (SRES), empowers educators to collect, collate, analyse, and use student engagement and success data that they consider meaningful for their particular contexts. Developed by unfunded educators and widely adopted through collegiate recommendations, the SRES enables personalisation and targeting of student learning and support using relevant data, fostering positive student-teacher relationships and enhancing student engagement. Using the three case studies as a backdrop, we present a revised learning analytics adoption framework focussing on strategy, structure, support, and impact, and use this framework to systematically evaluate the implementation of the SRES at the three institutions to derive 'recipes' for adopting an educator-focussed learning analytics platform. We also discuss three core themes emerging from the case studies, around the needs of academics, the role of academic and educational developers, and flexible and agile information technology practices.

Introduction

The changing demands of higher education on teachers

Two prominent features of today's changing higher education landscape are the increasing number and diversity of students and the ubiquitous learning technologies that handle a growing amount of data about students and their learning. Beyond the obvious and financially-impactful problem of attrition, ballooning cohort sizes and increasing use of online teaching modalities threaten to diminish the quality and personalisation of higher education. This challenging landscape has negatively impacted on student learning and student experience, particularly in large first year cohorts (Nelson & Kift, 2005). This can be redressed by better engaging students and helping teachers meaningfully interact with students and provide learning support at scale (Tinto, 1999). However, managing the competing demands of teaching and research is a reality of modern academic life. For many staff, particularly those involved in first-year teaching, this can mean managing very large student cohorts with minimal administrative support. It is in this context that the research field of learning analytics (LA) has grown, promising new approaches and applications for understanding and improving student learning (Siemens, 2013). Practically, LA promises to impact the classroom by improving feedback to students and providing more personalised learning experiences, streamlining administrative processes and data capture to ease logistic burdens of large cohorts, and providing teachers with deeper insight into their curriculum and teaching approaches (Shacklock, 2016). However, reports from around the world suggest laggard adoption and implementation of LA by institutions and educators (e.g. Bichsel, 2012; Colvin et al., 2016; Shacklock, 2016; West et al., 2015).

Issues with adoption and impact of learning analytics

Recent reports on Australasian LA adoption and implementation have highlighted that, as the primary implementers of any LA tool, educators need to be involved in designing LA approaches that "are sensitive to their environments, meeting and extending their pedagogical requirements, and ensuring flexibility" (Colvin et al., 2016, p. 19). In this context, educators' needs seem to revolve around actions that involve personal contact with their students, balancing the automation of computers with the personal approach of teaching (West et al., 2015). Notably, this report highlighted that educators "still have to make sure that it [communication and feedback] is personalised and meaningful for students" (p. 20), and that educators need LA tools with "some ability to modify it to their own requirements because each course and each cohort of students may differ" (p. 20).

Despite the field of LA being almost a decade old, there is a striking gap in practitioner and research literature on reports of educator-centric LA systems for personalising feedback and communication that have seen wide acceptance and adoption. Additionally, despite calls for more cross-institutional and researcher-practitioner collaboration to impact students and educators (e.g. Siemens et al., 2011), positive reports of successful collaborative implementations are lacking. Reasons for this include a cultural resistance to change, a lack of understanding from management, concerns about academic workload, and simply that the right tools may not yet be available (Colvin et al., 2016; Macfadyen & Dawson, 2012). A fixation on predictive analytics and its reliance on big datasets may also dilute the importance of context, meaning, and personalisation (Gašević, Dawson, Rogers, & Gasevic, 2016; Liu, Rogers, & Pardo, 2015), further contributing to the lack of impact for educators.

A useful comparison for LA adoption may lie in blended learning, which also raises concerns around technology, culture, context, and pedagogy. Graham et al. (2013) proposed a framework to organise their findings about blended learning adoption which spans three developmental stages (awareness/exploration, adoption/early implementation, and mature implementation/growth) and three categories (strategy, structure, and support). One missing component in their framework is impact, which includes effects on stakeholders and benefits to the organisation. In this respect, it is helpful to consider the observations by Ali, Asadi, Gašević, Jovanović, and Hatala (2013) in regards to the LA acceptance model (LAAM). Their model provides important dimensions for considering impact: (1) engagement; (2) responsibility; (3) course design; (4) performance; (5) satisfaction; (6) relevance; and (7) overall usefulness. These may be combined (Figure 1) to evaluate a number of questions regarding the effectiveness of LA implementation, particularly from the perspective of educators, but also question the processes, interactions, and relations between the tools and stakeholders.

Strategy – describes issues relating to the overall approach, including definition, forms of advocacy, degree of implementation, purposes, and policies surrounding use and adoption
Structure - included issues relating to the technological, pedagogical, and administrative framework facilitating adoption, including governance, models, scheduling structures, and evaluation
Support – is related to the way in which an institution facilitates the implementation and maintenance of the tool, incorporating technical support, pedagogical support, and faculty incentives.
Impact – considers the effect (over time, from short to long; on practice, from the team to the broader higher education context) on different stakeholders; also includes questions from the LAAM**.**

Figure 1: Dimensions of the recipes, partly adapted from Graham, Woodfield, and Harrison (2013).

A way forward? Empowering teachers with a context-driven tool, the SRES

In this paper, we apply this revised framework to systematically analyse and evaluate three case studies where Australian institutions have collaborated to adopt and implement the same LA platform. This platform, the Student Relationship Engagement System (SRES; www.sres.io), is a bespoke development initiated by a team of educators from the University of Sydney. In stark contrast to other LA approaches and tools, the SRES shuns predictive algorithms and big data in preference for teacher intelligence and small but meaningful data (Liu, Bartimote-Aufflick, Pardo, & Bridgeman, 2017). Notwithstanding the algorithmic insights that big datasets can offer such as determining predictive factors for student performance and uncovering some structural forces shaping student outcomes (e.g. de Freitas et al., 2015), an important caveat of learning analytics based on big data is that local pedagogical context, and therefore meaning, may be lost (Gašević et al., 2016). Therefore, the SRES' approach enables educators to choose data that are important for their unique local learning and teaching context (e.g. interim marks, attendance, tutor feedback, in-class participation grades, etc), and helps them to collect, collate, analyse, and make direct use of these data. Critically, educators can use the SRES to efficiently personalise learning support and feedback to students at scale by building simple rules to customise information that different students will receive via email, SMS, or a web page embedded into an LMS. For example, course coordinators can use it to design a mobile-friendly SRES web app interface for tutors to save grades and feedback in class, and then build customised messages to be sent out to different students with suggestions for improvement based on these data. Teachers can also build interactive dashboards to visualise class trends and select sub-cohorts for follow-up. This puts teachers in control of the whole data lifecycle, enabling them to obtain and use contextually-meaningful academic engagement and success data to foster relationships with, and belonging in, their students. McDonald et al. (2016) reported on a closely-related development to this, similarly emphasising the importance of meeting "grassroots classroom needs" (p. 404) when building out a collaborative LA venture.

In the following sections, we reflect on the initial driving factors for development of the SRES at the University of Sydney, and discuss its wide adoption and outcomes. We follow this with reflections on why the SRES was needed at two other Australian universities, how it was implemented, and preliminary outcomes for students and teachers. Finally, we evaluate these implementations using the modified framework presented above, and discuss three critical and common threads around academics' needs, the role of support, and information technology workflows.

Case study 1: University of Sydney

Driving factors

The SRES was initially designed and developed in 2012 within the Faculty of Science at the University of Sydney. The spark behind creating a new educational technology stemmed from pedagogical and pastoral needs not being met by any existing platform at the University or in the marketplace. At a low level, these needs were around an integrated system that could track attendance, efficiently collate data from various sources (spreadsheets, databases), replace manual data collection processes, and then empower teachers to use these data to build targeted communications to students, supporting an improved sense of place, purpose, and connection.

At the time (and even now) there were no effective tools for mass personalised communications, customisable according to context-sensitive data available about students, readily usable by academics running individual units of study. Other systems that did exist at the University operated in terms of fostering a relationship with the University, as opposed to individual teachers, such as those used by and for the careers and alumni offices, university-wide academic integrity initiatives, degree program announcements from faculties and schools, end-of-semester student experience surveys, student union groups, and enrolment and timetabling. However, none of these appropriately met the widespread desire from academics for an approach that afforded scalable and personalised communication with students which did not add to workload (West et al., 2015). Extant tools for efficient communication at scale were built into the LMS (Blackboard Learn at the time), but this was insufficient for the pedagogical requirements for meaningful communication since it only allowed the broadcast of generic announcements. There was no way to offer differentiated information to all, or particular, groups at once. Moreover, there was no way to use data about students to drive or target these communications. There was simply no practical means for individual teachers to reach out to their students except through generic emails with various clauses that would simultaneously present relevant and irrelevant information, or to engage in an extremely labour-intensive effort to collate sets of email addresses for hundreds of students (and write personalised messages) for an equal number of emails to be sent manually.

Development and implementation

Two academics coordinating large first year units with 1000-2000 students per semester decided to develop a simple web-based tool to re-personalise students' learning experiences. Through collegial sharing, the SRES was quickly adopted by like-minded academics. As a side project with little active promotion and no budget, the SRES largely stayed within the Faculty of Science for the first two years. Here, a unit with particularly high attrition and many students co-enrolled in other Science units catalysed the cross-faculty implementation of the SRES before it was adopted more widely. Initial interfaculty spread of the SRES did not stem from any top-down institutional drive, but rather from word-of-mouth recommendations between colleagues with similar pressing needs in other first-year units. Beer, Tickner, and Jones (2014) report a similar trajectory of bottom-up growth in another LA tool at an Australian university, and suggest that this 'do it with' and 'do it for' teachers approach was most effective at gaining initial momentum, as opposed to traditional top-down 'do it to' approaches that are likely to fail.

This organic adoption of the SRES continued primarily in this way over the following two years, until its further spread within the University of Sydney was fortuitously catalysed by a change in staff whereby the two main academics behind the SRES moved from the Faculty of Science to become institutional players in a central learning and teaching unit. From 2016 when the SRES became part of the offerings coming from this central unit supporting all faculties, its adoption has spread more rapidly but uptake was still based on academic choice due to the usefulness of the software. This has been supported through small increases in availability of technical support from the central unit in the form of hands-on workshops and the central eLearning helpdesk managing simple queries related to access and training requests. Additionally, more focussed development time was available to improve the software in conversation with users' needs. As uptake increased across different schools and faculties, local educational designers from these areas were tasked by their departments to support academics in their use of the SRES. In essence, these designers provided the data and technology skills to connect academics with LA (Arnold et al., 2014).

As a tool largely developed and adopted by individual academics as opposed to an approach initiated or mandated from the top down, the SRES has struggled or received only late adoption in other nodes of influence and power within the University, outside of classrooms. For example, for a long time our instance of the SRES lacked fully automated integration with other key enterprise systems such as the LMS and the SIS due to a lack of coordination with the central Information Communications and Technology (ICT) team. This meant that some processes needed manual intervention from users, including updating student enrolments and importing data from the LMS grade centre via CSV files (although the University's recent move to Canvas has allowed the automation of these). This was the most common issue and improvement request reported by our users. Despite the lack of full automation, this did not deter the vast majority of SRES users who continued to use it because of the significant downstream benefits to staff and students.

Additionally, the unique affordances of the SRES have enabled and encouraged improvements in other workflows. For example, tutors can access the SRES mobile web app to view and enter grades and feedback, which are saved to the SRES database and can be used in the form of targeted and personalised emails or HTML pages; previously this workflow was entirely manual and paper-based (with associated data integrity and security risks), or even non-existent, making the provision of timely feedback to students difficult or impossible. The ability to capture, collate, and use different data for different purposes depending on learning and teaching contexts is a core ethos of the SRES, and one that resonates strongly with teachers; this approach empowers their agency as educators as opposed to top-down approaches which are typically prescriptive and deterministic.

Because the data brought into the SRES are those already available to teachers (e.g. assessment grades, feedback, LMS access) or collected live by teachers (e.g. attendance, comments, grades), issues around ethics and privacy presented by other LA systems are less of a concern. These large-scale centrally-managed LA systems typically leverage data warehouses that bring in big datasets (e.g. WiFi access, library usage, demographic background, academic history, socioeconomic status), which may risk labelling or discriminating against certain students based on their background and learning approaches (Prinsloo & Slade, 2013). In contrast, the SRES focusses on 'small data' (Berman, 2013) and the subsequent actions that are inherently meaningful to teachers and their students. This has meant that it generally fits within guidelines around how academics may already use the LMS and tools already available to them. This allows teachers and pedagogy to drive the need for analytics rather than trying to find a home for generic approaches to LA. Finally, and perhaps advantageously, its use has always been optional rather than mandated; a sense of choice and freedom in academic selection of educational technology systems avoids issues around programs mandated by senior management (Macfadyen & Dawson, 2012).

Outcomes and next steps

The SRES is currently used in 17 schools/departments at the University, effecting personalised learning and support for over 20,000 students in over 100 units of study. Academics have chosen to use it because the SRES fulfils a need not adequately met by other available options. They have also reported multiple benefits including better connectedness with students, increased performance, better student engagement with learning resources, increased attendance, and reduced attrition (Liu et al., 2017). An open and non-restrictive faculty leadership and policy environment has also supported the SRES through allowing academics to use educational technology in innovative ways, but without any formal support or endorsement coming from the senior management.

The main hurdles have come from the restrictive policies around information management concerning student records and from a lack of engagement or support from the central ICT teams who are often equipped to deal with external, commercial systems rather internally-developed innovations. The primary outcome from this hurdle has been a lack of systems integration which has resulted in (until recently) a residual and technologically unnecessary administrative burden on academics to manually connect the SRES to source systems through a download/upload method. One of the challenges in aligning the SRES with enterprise implementation approaches will be ensuring that the flexibility and agility of innovation, which has served the project well so far, is not stifled by the predominantly managerial and relatively static mindset of ICT departments (Jones & Clark, 2014). Previous reports of LA tools that have been scaled by involving central ICT have resulted in significant loss in functionality caused by forcing an initially user-driven design into an inflexible software framework that could not tolerate idiosyncrasies (Lonn, Aguilar, & Teasley, 2013). In that situation, the slight gain in extract-transform-load automation was accompanied by a less nimble solution that presented an "irreconcilable challenge to the ability of the system to scale beyond the [initial] community of users" (p. 238).

Therefore, despite some additional administrative workflows, the SRES has been successful in being adopted by so many academics at the University of Sydney as it is a flexible and bespoke system adapted to academics' felt needs. This is in sharp contrast to the typical technologist-designed educational technology tool where academics are expected to fit their teaching approaches into a fixed menu of options. Rather than operating as a fixed product or with extended development roadmaps, the SRES is a home-grown system actively developed by members of staff, allowing greater efficiency and an improved sense of ownership in our collegial user base. This 'bricolage' model of user-centred design, development, and implementation has been identified as a necessary approach that promotes wide stakeholder involvement and acceptance in LA (Colvin et al., 2016; Ferguson et al., 2014; Jones & Clark, 2014).

Case study 2: University of Melbourne

Driving factors

In the Faculty of Science at the University of Melbourne, the effective management of, and communication with, large first-year cohorts pose significant challenges for teaching staff. Although the University supports a commercial LMS, many Schools use their own student management systems that have generally been grown over time in an *ad hoc* manner to deal with individual Schools' needs and reporting requirements. However, there are security risks involved in storing student data on discrete databases and their management is resource-inefficient. At the same time, the exploitation of data to support student learning (encapsulated in LA) has seen significant growth. From a faculty perspective, the use of local databases means that data, such as that on student attendance and performance, across a program of study is not readily available.

Our interest in the SRES started when one of its lead academic developers from the University of Sydney gave a presentation at the University of Melbourne describing how the system was successfully being used to personalise learning support for large cohorts of students in many units of study. The Associate Dean (Undergraduate Programs) in the Faculty of Science had been interested in exploring systems that would provide data on students' attendance and performance, particularly to identify students-at-risk and allow early intervention to support such students.

Whilst there are many commercial LA products available, there was still a significant disconnect between the utility offered by these technologies and everyday instructors' need to integrate actionable items from these tools into their learning environments. The rapid evolution and adoption of the SRES at University of Sydney provided evidence that academics valued its effectiveness in improving learning outcomes for students. However, the decision to adopt the SRES was strongly influenced by previous relationships between the academics. As noted in King and Cattlin (2017), when academics seek solutions to challenges in their teaching, they most often turn to a trusted colleague for advice. The Associate Dean had seen the development of the SRES at national learning and teaching fora over a number of years, and previous collaborations and discussions with the developer had built the degree of confidence needed to embark on a pilot of the SRES.

Although the importance of engagement and enrichment of the learning and teaching experience is universal in the higher education sector, each institution's learning and teaching context is different. The fact that the SRES can be customised to work in many contexts was an important consideration in our decision to pilot it. A key attraction of the SRES has been the direct engagement with academic staff and its ability to meet specific in-class needs, which may be different from subject to subject. In addition, early results suggested increased student retention within subjects where the SRES has been deployed (Liu et al., 2017). The SRES platform provides instructors with ultimate control over data and the deployment of various actions. For us, this approach addressed three objectives: (1) to promote a data-driven pedagogical approach to aid learning and teaching; (2) to provide a platform for data management which was user friendly to encourage adoption; and (3) to improve the data literacies and competencies of instructors. Taken together, the successful track record, flexibility, and accessibility of the platform made the initiative for collaboration with Sydney even more appealing. This was cemented by another visit by the lead academics and developers of the SRES, which led to the tool and its philosophy being embraced by many academics within the Faculty.

Implementation

From the outset, both the Universities of Melbourne and Sydney were committed to maintaining the same development and philosophy as that already developed at Sydney, which was to work in partnership with teaching staff to implement a system that would help them to increase student engagement. Close support and collaboration with the SRES lead developer was crucial for its initial implementation since it was being installed for the first time. The implementation stage commenced in November 2016 and the lead developer worked closely with the ITS (Information Technology Services) group at Melbourne (specifically with Faculty of Science ITS staff) to have the system ready for use in Semester 1, 2017.

Contributing to this rapid rollout was the relative speed at which an ITS-provisioned virtual machine could be deployed, and connectivity provided to various services such as authentication and email servers. Additionally, the implementation of the SRES at Melbourne demonstrated that as an open source platform it could be deployed at other institutions with a minimal amount of customisation.

While the technical setup was occurring, an academic developer in the Faculty held preliminary discussions with the academics who, after being introduced to the SRES at a seminar given by the SRES lead academics, had expressed an interest in being involved in a pilot study. These academics identified two high-level system requirements: it needed to (1) directly support student engagement; and (2) support academics to teach. Our discussions with academics also identified class engagement and attendance data were important, in keeping with evidence-based practice (Credé, Roch, & Kieszczynka, 2010). Interim grade and other performance data were also relevant to academics. Using these as guiding principles, specific use cases were developed with these academics in six subjects across the Faculty.

To aid smooth implementation, training was provided by the lead developer from Sydney to the academic developer at Melbourne who was working directly with the pilot academics, following a train-the-trainers model. Fortuitously, a new software developer in the Faculty's ITS team also took on the role of technical support for our installation of the SRES, conducting various system tests and fine-tuning configurations. This software developer has also started to contribute to the open source development of the SRES. Alongside the technical development and training, the project team (initiated by the Associate Dean) ran information and training workshops with academics and sessional staff to introduce them to the system and to demonstrate practical applications. Close collaboration between the Sydney developers and Melbourne developers continued throughout the implementation phase to discuss issues that arose, technical queries, and pedagogical approaches to student support. Together, these contributed to a rapid implementation cycle from initiation to piloting in live subjects.

Outcomes and next steps

At the time of writing, the pilot at the University of Melbourne for Semester 1 has just concluded. The development team worked closely with academic staff in large (some over 1350 students) and small subjects to pilot the SRES. The system was used to mark attendance, enter live grades, and send personalised emails to students based on criteria set by, and important to, individual academics. Each context is unique and thus triggers for actions varied depending on the teaching and learning requirements in a subject; the SRES was able to accommodate this variation. Our experience of the pilot thus far is perhaps best summed up in the following testimonial from an email circulated from one of the subject coordinators to the project leader at the University of Melbourne after the first communication was sent to students: "*Over 445 personalised emails [were sent] to students. The students [were] assigned to three different teaching streams and received a unique message from the subject coordinator. The time spent working through data, wrangling technical issues with our barcode scanner to mark attendance, as well as quality control of the communication was well worth it. The sent out email certainly resulted in responses from students, including positive responses like "you have boosted my confidence" and "thanks for the information I will see a tutor on duty for help" and "I need to sort out my consideration" etc.*"

We experienced some minor issues around the new technology-driven approach which were resolved through training and workarounds. Interestingly, we also observed pushback from some sessional staff who objected to using mobile devices in class to access the SRES; preferring to use hard copy to mark attendance with later transfer into the SRES. Later they moved on to using iPads to avoid double handling data and extra work. After further explanation and assurances about student experience and workload, the staff continued with the pilot. Generally, the feedback from academics, tutors and ITS staff to date has been positive, encouraging, and enthusiastic. In Semester 2, we hope to see the project progress to a point where the impact of the SRES on student engagement and learning can be systematically evaluated.

Case study 3: University of New South Wales

Driving factors

There is a key strategic driver which makes the landscape at UNSW fertile for the implementation of tools like the SRES: improving the student experience which is at the core of the 2025 Strategy (http://www.2025.unsw.edu.au). Together with a re-prioritisation toward excellence in teaching, the strategy is characterised by a focus on digitization (shifting towards blending technology into learning and teaching) and personalisation. An important feature of UNSW is that it is a large, research-intensive university relying on a distributed organisational structure. This means that several initiatives often start at the local level (i.e. schools and programs) and are pushed from the periphery to the centre (a bottom-up approach) when there is a critical mass supporting them. In this sense, there are numerous examples of innovation and excellence in learning and teaching which started this way (such as SmartSparrow and REVIEW). Another important factor has been the timing of a separate project funded by the now-defunct

Australian Government Office for Learning and Teaching aiming to develop a tool ('OnTask') to personalise support actions. The early development process of OnTask made it possible to initiate conversations with interested academics and set up pilots intended to experiment with the new tool. Yet, because of some delays in the development of OnTask, using SRES was taken as a concrete, viable alternative for the personalisation of communications with students.

Implementation

Initially, four course conveners volunteered to pilot the OnTask tool, and so were redirected to the SRES. They convened introductory courses across faculties, characterised by two fundamental problems: (1) very large and diverse cohorts (between 800 and 1600 students) requiring a lot of time and effort to coordinate numerous tutorials/labs classes; and (2) an aspiration of the lead educators to make the interactions with students more personal and relevant.

Leveraging some internal capacity in the PVC Education portfolio, an Amazon instance (C4.Large, EC2 Linux) was created, including setting up of the database and security and defining the basic rules and protocols for access and use of the service. A close cooperation with the SRES lead developer was essential given that the service did not exist at UNSW and we accomplished an incredibly rapid rollout of a usable SRES environment within just two weeks, before the start of semester. The successful implementation demonstrates that it is possible to deploy the SRES for a pilot relatively quickly, benefiting from the experience accumulated in the SRES project with multiple institutions. As highlighted by Lonn et al. (2013), we felt this was necessary to capitalise and champion academic enthusiasm without compromising the nature and capabilities of the SRES system.

The support channels for this pilot were limited to one-to-one relations between one academic developer in a central learning and teaching unit and the academics in the faculties. The main strength of this approach was the ability to maintain a strong personal link with the academic leads partnering in the project and provide *ad hoc* support. This was essential to ensure trust, flexibility and responsiveness, all of which made the outcomes of the project more likely to succeed and provide value for those involved. The biggest weakness was one of capacity and scalability: the workload required to manage the data collation and preparation for all these courses in the first few weeks of the semester was challenging and the sustainability of the project was highly dependent on those involved. Although the latter may not be a critical risk for a pilot, it may affect longer term uptake and impact of the implementation. Solutions to this involve a move to the elusive automation of data flows from enterprise systems, or an approach similar to the earlier stages at the University of Sydney where committed academics and their local support staff took on this role.

A notable feature of the continued conversations with the academic leads of these courses was that they expected all data (such as updated enrolment, class registration, and LMS data) to come automatically into SRES. This has not been the case in the UNSW implementation thus far, because direct access to other university systems was not possible to implement in the short timescale and remains one of the major obstacles to any LA tool's implementation. However, the affordances of the SRES provided an opportunity to improve the data capture in the courses as it allowed tutors to take attendance on the fly and assign class participation grades from their mobile devices in class (a massive improvement compared to the asynchronous data entry from several spreadsheets). It also allowed academics to collate information from different systems (including the LMS, external tools, class exams) and give a single point of contact for the course conveners to take the pulse of what is happening at any point in time of the semester.

Outcomes and next steps

The SRES's major achievements at UNSW were in the streamlining of data collection for tutorials, and its ability to send customised feedback to students at regular intervals. With the inbuilt roster view, the SRES was a winner with both course convenors and tutors; for the first time in these courses, conveners had the ability to view at-a-glance the status of attendance and class performance without having to scramble together several spreadsheets and lists. This provided considerable efficiencies and enabled them to quickly confer with tutors to address potential issues. The SRES also allowed us to explicitly articulate the feedback that academics may give to students in a more personalised way.

Even though ours was a small pilot with four courses, we started to push the limits of the SRES because of the nature of the courses (very large) and the complexity of the data gathered (up to 180 different features/columns to be imported into the SRES data store at once). This was in contrast to how the SRES had been used at Sydney and Melbourne; at those institutions, academics were very selective about the data that were meaningful to include, which meant that each course (even very large ones) only had up to 30-50 features/columns. The large number of features in our pilot started to push the SRES beyond its primary purpose of enabling teachers to work more effectively with lots of 'small data'. In one of the largest courses on campus, the sheer volume of students (1600+) and columns (150+) made it very hard to load the entire set of data for all of students at once in the browser, and required tweaking of the various server settings as well as the way in which previews and message queues were built. A relatively smaller course (800+ students) also provided some challenges which were quickly resolved as problems occurred. These changes improved the stability of the system, but the challenges posed by technical difficulties made the academic partners somewhat restless. Through implementing the SRES with these pilot courses, significant improvements were made to the software itself, following the user-driven approach taken at Sydney.

The pilot demonstrated the need and value of tools such as SRES to support course logistics/admin and empower academics with the ability to support students with personalised communication and feedback. More work will be needed to establish process and protocols to automate data feeds into the system and resolve the issues of system scalability. Yet, putting academics at the centre was essential in creating stronger engagement with the students. This was clearly demonstrated by the rate of email opening and feedback left in the SRES about the value of the nudges provided by the course leads.

Discussion

In this paper, we set out to provide *recipes* for institutional adoption of the SRES. After describing the three cases, which help to contextualise both differences and similarities, it is worth taking a few steps back and evaluating the cases through existing adoption and implementation models. In particular, the synthesis between a blended learning implementation framework (Graham et al., 2013) and the LAAM (Ali et al., 2013) presented in the introduction provides a scaffold to systematically analyse the cases and to extract *recipes* out of them (Table 1). Using this synthesised framework, it is possible to compare the cases and provide an informative starting point for others who may be following a similar pathway. Building on these, the three case studies have also highlighted a number of lessons and their implications for others undertaking similar approaches. The review of the cases allows the identification of three core elements.

Firstly, the key driver for initial adoption was to meet academics' pressing needs. Academics are the key implementers of LA, and LA has a "greater focus on informing and empowering instructors" (Siemens & Baker, 2012, p. 253). As Colvin et al. (2016) pointed out, "implementers require an analytic tool or combination of tools that manage data inputs and generate outputs in the form of actionable feedback" (p. 30). The ability of the SRES to help academics collect and collate data, and provide personalised learning support to students, resonates strongly with this. In this context, it is important to note that the utility of this particular tool is not just about personalised emails generated from rules acting on imported, already-collected data. Instead, it is crucial that the tool is able to support the whole data lifecycle as experienced and needed by educators, which includes streamlining (or indeed enabling) the electronic collection of data itself.

Secondly, the implementation process is catalysed by staff who can connect academics with LA tools. These staff may be, as in our case studies, in educational or academic developer roles within faculty or central learning and teaching units, and not necessarily dedicated data scientists. However, this is likely due to the SRES being unique in the LA field in that the data/variables chosen and what actions are derived are determined primarily by the academic or course designer. This is in stark contrast to the usual LA approach where predictive modelling or statistical expertise is required to understand standardised pre-existing data harvested from existing and readily-available electronic sources (Arnold et al., 2014). Instead, in our context the educational or academic developers helped to bridge the gap between software (as opposed to just ‘data’) and pedagogy.

Table 1: Recipes and reflections of adoption of the SRES at three Australian universities

	University of Sydney	University of Melbourne	University of New South Wales
Strategy			
Purpose	Better engaging students in growing cohorts; aiding student transition; increasing strategic use of LA	Improve student engagement in large cohort classes, increase learning and teaching satisfaction for students and staff; provide access to faculty-wide data on student engagement	Alignment with 2025 Strategy and the four pillars for education: 1) inspired learning through inspired teaching, 2) digitization; 3) feedback through dialogue; 4) building communities
Advocacy	Support from DVC(E) and staff in the portfolio; academics and professional staff championing innovation and sharing practice	Faculty of Science academic initiative in innovation around student engagement/experience improvement	Support from PVCE to fulfil the strategy; academics championing innovation; support in managing large courses
Implement-ation	Teams of academics, sessional teachers, and professional staff using the SRES	Lead developer from Sydney, academics, tutors, local ITS staff from Melbourne	Individual faculty members piloting SRES
Definition	LA to improve students' learning experience and outcomes	No universal definition of terms/uses	No universal definition of terms/uses
Policy	Part of strategic plan for educational innovation; open experimentation	No specific policy, open experimentation	No specific policy, open experimentation
Structure			
Governance	Course coordinators use the SRES to enable and augment workflows; limited oversight in some faculties	Subject coordinators decide to use the SRES	Internal support from PVCE and custom support
Model	Free adaptation and use by academics; some local sharing of best practice models	No institutional models established	No institutional models established
Scheduling	Academics self-select	Academics self-select, no planning or selection of subjects	Quick response to academic needs; no specific planning or selection of courses
Evaluation	Student engagement, satisfaction, retention, and academic performance; staff feedback	Student engagement, satisfaction, staff feedback	Student engagement, satisfaction and performance; staff feedback on process and tools; consideration of the sustainability of process
Support			
Technical	Staff from DVC(E) portfolio train the trainers and academics; educational designers embedded in faculties; academic champions providing ad hoc support	Support of lead developer from Sydney in training academic developer who provided ad hoc support; local ITS support	Internal provision from PVCE to support pilot; no central IT support, partial support from local teams
Pedagogical	Enhancing feedback and learning support	Enhancing feedback and learning support	No fundamental changes in course design, BUT consideration of 'learning conversations' and how to support logistics/management of courses
Incentive	Workload reduction; increased student engagement and feedback scores; intrinsic reward as dedicated teachers	Engagement and feedback scores; increase student learning satisfaction	Education-focussed careers; funding support for 'Inspired learning initiatives'; 'Lazy user model' (Collan & Tétard, 2007)
Impact			
Students	Improved connection with staff; improved engagement, satisfaction, performance; enhanced feedback provision; reduced attrition	Enhance connection with staff; improved engagement based on student feedback	Improved engagement and satisfaction; improved learning?
Academics	Improved connection with students; streamlined workflows and workload reduction; increased data literacy; new data-driven workflows enabled	To some extent improved connection with students; increased data literacy for student support	Positive reaction to admin streamlining; increased consideration of learning and student support
Support staff	Streamlined workflows and workload reduction; open conversations on learning support; increased data literacy	Further training and support required for broader involvement. Open conversations on learning support; increased data literacy.	Will need broader involvement and training
Management	Reduced attrition; moving institution to increased data literacy and data-driven actions	Contribution to increased data literacy; increased consideration of learning and student support	Contributing to fulfilment of KPIs

Finally, flexible and agile ICT practices (or at least dispensations) are critical for providing the necessary infrastructure. This is important to maintain momentum once a decision to pilot or implement has been sparked, as well as to preserve as much of the original functionality (and therefore expectations that implementers have) of the tool as possible. If LA adoption is a 'pipeline' problem, rapid deployment (and development) helps to ensure that implementers do not fall back from interested to not-interested (Colvin et al., 2016; Liu et al., 2015). Another key infrastructural element observed in our case studies was the (not unreasonably) pervasive expectation of systems integration - that the SIS, LMS, and SRES would all interchange data freely and automatically. While most LA initiatives depend on data warehousing solutions (Shacklock, 2016), in our experiences most of the data that academics considered meaningful and wanted to use for providing personalised learning support were either not captured in any existing database (such as attendance, in-class notes, and interim grades and feedback), or could be simply imported through a basic CSV from source systems (such as LMS gradebook data). In fact, academic freedom to teach how they wish often means that desired data are not 'available' to traditional LA approaches (West et al., 2015); the SRES affords the opportunity to modify existing workflows so that these data can be captured electronically.

At time of writing, preparations are in place for pilots of the SRES at two other Australian universities, sparked similarly by academic needs. We aim to follow a similar approach to the existing three implementations, and warmly invite other interested parties to collaborate.

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References

Ali, L., Asadi, M., Gašević, D., Jovanović, J., & Hatala, M. (2013). Factors influencing beliefs for adoption of a learning analytics tool: An empirical study. *Computers & Education, 62*, 130-148.

Arnold, K. E., Lynch, G., Huston, D., Wong, L., Jorn, L., & Olsen, C. W. (2014). *Building institutional capacities and competencies for systemic learning analytics initiatives.* Paper presented at the Fourth International Conference on Learning Analytics And Knowledge, Indianapolis.

Beer, C., Tickner, R., & Jones, D. (2014). *Three paths for learning analytics and beyond: moving from rhetoric to reality.* Paper presented at the 31st ASCILITE conference, Dunedin.

Berman, J. J. (2013). *Principles of Big Data: preparing, sharing, and analyzing complex information*: Morgan Kaufmann.

Bichsel, J. (2012). Analytics in higher education: Benefits, barriers, progress, and recommendations. Retrieved from https://net.educause.edu/ir/library/pdf/ERS1207/ers1207.pdf

Collan, M., & Tétard, F. (2007). *Lazy user theory of solution selection.* Paper presented at the CELDA 2007 Conference.

Colvin, C., Rogers, T., Wade, A., Dawson, S., Gašević, D., Buckingham Shum, S., Fisher, J. (2016). Student retention and learning analytics: a snapshot of Australian practices and a framework for advancement. Canberra, ACT: Australian Government Office for Learning and Teaching.

Credé, M., Roch, S. G., & Kieszczynka, U. M. (2010). Class attendance in college: A meta-analytic review of the relationship of class attendance with grades and student characteristics. *Review of Educational Research, 80*(2), 272-295.

de Freitas, S., Gibson, D., Du Plessis, C., Halloran, P., Williams, E., Ambrose, M., . . . Arnab, S. (2015). Foundations of dynamic learning analytics: Using university student data to increase retention. *British Journal of Educational Technology, 46*(6), 1175-1188.

Ferguson, R., Clow, D., Macfadyen, L., Essa, A., Dawson, S., & Alexander, S. (2014). *Setting learning analytics in context: overcoming the barriers to large-scale adoption.* Paper presented at the Fourth International Conference on Learning Analytics And Knowledge, Indianapolis.

Gašević, D., Dawson, S., Rogers, T., & Gasevic, D. (2016). Learning analytics should not promote one size fits all: The effects of instructional conditions in predicting academic success. *The Internet and Higher Education, 28*, 68-84.

Graham, C. R., Woodfield, W., & Harrison, J. B. (2013). A framework for institutional adoption and implementation of blended learning in higher education. *The Internet and Higher Education, 18*, 4-14.

Jones, D., & Clark, D. (2014). *Breaking BAD to bridge the reality/rhetoric chasm.* Paper presented at the 31st ASCILITE conference, Dunedin.

King, D., & Cattlin, J. (2017). Building a Network and Finding a Community of Practice for Undergraduate Mathematics Lecturers *Implementing Communities of Practice in Higher Education* (pp. 29-51): Springer.

Liu, D. Y. T., Bartimote-Aufflick, K., Pardo, A., & Bridgeman, A. J. (2017). Data-Driven Personalization of Student Learning Support in Higher Education *Learning Analytics: Fundaments, Applications, and Trends* (pp. 143-169): Springer.

Liu, D. Y. T., Rogers, T., & Pardo, A. (2015). *Learning analytics - are we at risk of missing the point?* Paper presented at the 32nd ASCILITE Conference, Perth.

Lonn, S., Aguilar, S., & Teasley, S. D. (2013). *Issues, challenges, and lessons learned when scaling up a learning analytics intervention.* Paper presented at the Third International Conference on Learning Analytics and Knowledge, Leuven.

Macfadyen, L. P., & Dawson, S. (2012). Numbers are not enough. Why e-learning analytics failed to inform an institutional strategic plan. *Journal of Educational Technology & Society, 15*(3), 149-163.

McDonald, J., Liu, D. Y. T., Moskal, A. C. M., Zeng, R., Blumenstein, M., Gunn, C., Pardo, A. (2016). *Cross-institutional collaboration to support student engagement: SRES version 2*. Paper presented at the 33rd ASCILITE conference, Adelaide.

Nelson, K. J., & Kift, S. M. (2005). *Beyond curriculum reform: Embedding the transition experience*. Paper presented at the HERDSA 2005 Conference, Sydney, Australia.

Prinsloo, P., & Slade, S. (2013). *An evaluation of policy frameworks for addressing ethical considerations in learning analytics.* Paper presented at the Third International Conference on Learning Analytics and Knowledge, Leuven.

Shacklock, X. (2016). From Bricks to Clicks - The Potential of Data and Analytics in Higher Education: Higher Education Commision.

Siemens, G. (2013). Learning analytics: The emergence of a discipline. *American Behavioral Scientist, 57*(10), 1380-1400.

Siemens, G., & Baker, R. S. (2012). *Learning analytics and educational data mining: towards communication and collaboration.* Paper presented at the 2nd International Conference on Learning Analytics and Knowledge, Vancouver.

Siemens, G., Gašević, D., Haythornthwaite, C., Dawson, S., Shum, S. B., Ferguson, R., Baker, R. (2011). Open Learning Analytics: an integrated & modularized platform: Society for Learning Analytics Research.

Tinto, V. (1999). Taking retention seriously: Rethinking the first year of college. *NACADA journal, 19*(2), 5-9.

West, D., Huijser, H., Lizzio, A., Toohey, D., Miles, C., Searle, B., & Bronnimann, J. (2015). Learning Analytics: Assisting Universities with Student Retention, Final Report (Part 1): Australian Government Office for Learning and Teaching.

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The changing nature of student engagement during a digital learning task

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The construct of student engagement has been useful in understanding students' motivation in digital learning environments where they are required to show increased autonomy and independence in learning. Increasing clarity around this construct has allowed researchers to more accurately describe the nature of student engagement and the context in which it is being investigated. At a task-level, psychological states of engagement have been shown to be beneficial for students' positive learning experience, and performance. Despite this, we still lack knowledge of how these engaged states unfold or sustain during a learning task. In this paper we report on a qualitative study that investigated undergraduate students' experiences of psychological states of engagement in a digital learning task. Findings revealed that the three dimensions of engagement - cognition, affect, and behaviour - changed in intensity, with students experiencing both times of engagement and of not being engaged through the course of a digital learning task.

Introduction

With increased use of digital and online learning in higher education, researchers have sought ways to improve students' experience and outcomes in digital and online learning. Student motivation has become increasingly important as students' work becomes more independent and self-directed in nature. Student engagement is a well-researched construct relating to student motivation in higher education, yet much of its nature and the psychological processes involved remain clouded. Research that further teases out the processes and factors that underpin the engagement process remain important for understanding students' experience of learning, students' learning outcomes, and how these can be enhanced through evidence-based learning design.

Student engagement in digital learning

Despite the broad body of literature surrounding student engagement in higher education, the waters remain muddy in terms of how the construct is operationalised at different levels and in different contexts (Kahu, 2011; Balwant, 2017). Kahu (2011) began to separate out the construct of engagement from its antecedents and outcomes. Drawing from the organisational psychology literature (Kahn, 1990; Shuck, 2011), Wiseman, Kennedy, and Lodge (2016) proposed that education research could benefit from more specific delineations between the 'levels' at which the student engagement construct is operationalised. For example, a macro investigation of student engagement may involve students' behaviours and attitudes in relation to their university or their degree course. At a meso-level, students' attitudes and behaviours toward their studies may be related to persistence and commitment. At a micro level, students' involvement in learning may be considered at a within-task level. As a first step, higher education researchers might begin to specify the level at which they are investigating student engagement as this provides the necessary context for understanding how various important constructs (belonging, persistence, meaningfulness) are related to students' engagement with their institutions, degree courses, and learning activities.

Another step in clarifying the meaning of student engagement is then providing clarity of the type of engagement being discussed. At a macro-level, investigation may focus primarily on students' behavioural engagement when investigating attendance and retention of large cohorts in an institution-wide context. Students' attitudinal stances towards their university, and learning in general, may be the focal point of a meso-level investigation into students' learning behaviours and habits. These behaviours may be underpinned by psychological and emotional factors, yet would be unlikely to involve a student being in an absorbed psychological state. At a micro-level, a psychological state of engagement may be considered as consisting of cognitive, emotional, and behavioural dimensions of engagement (Fredricks, Blumenfeld, & Paris, 2004), that when combined allow a student to enter into a state of absorption for a discrete period of time within a particular learning task or activity.

Research around the student engagement construct is more broadly located within education literature relating to student motivation, and broader still, human motivation in general. Student engagement and other closely related constructs such as intrinsic motivation (Lepper & Cordova, 1992), situational interest (de Barba, Ainley, & Kennedy, 2015), flow (Chan & Ahern, 1999), and interactivity (Simms, 2000), have been well researched within the context of technology-mediated learning. We follow the Fredricks, Blumenfeld, and Paris (2004) conceptualisation of engagement as consisting of three dimensions (cognition, affect, behaviour). We (Wiseman, Kennedy, & Lodge, 2016) proposed a unifying model of task-level engagement in digital learning environments, that draws upon intrinsic motivation (Ryan, 2012), situational interest (Hidi & Renninger, 2006), flow (Csikszentmihalyi, 1990), and episodic engagement (Kahn, 1990). *Digital task engagement* (Wiseman, Kennedy, & Lodge, 2016) refers to an active psychological state when a student is fully invested - cognitively, emotionally, and behaviourally - in a digital learning task. We theorised that this state may result in enhanced learning outcomes and improved learning experience.

Engagement, as a psychological state, has been investigated by organisational psychologists for over 25 years. Kahn (1990) observed the tendency of subjects to move into and out of engaged psychological states during the performing of their work activities. He clearly differentiated between this notion of cognitive, affective, and behavioural engagement in a task or role, and the ‘higher’ levels of employee engagement that consider employee commitment and other enduring attitudes towards work and organisations. He observed that employees moved in and out of discrete periods of engagement in their work and described this ebb and flow as episodic engagement. Kennedy and Lodge (2016) demonstrated how students transition through affective states such as confusion, frustration, and boredom at a task-level. Yet, there is little research that has investigated this same ebb and flow of cognitive, affective, and behavioural engagement at a learning task level in digital and online learning. Research that provides evidence of how and why digital task engagement changes during a learning task would be informative for digital and online learning design, and help to dispel some of the myths around good teaching practice (e.g. 'videos must be shorted than X minutes').

In this study we aimed to explore the nature of students’ cognitive, affective, and behavioural engagement, as they undertook a digital learning task chosen on the basis of being likely to promote a state of engagement. As a complex psychological process, digital task engagement is heavily influenced by individual and socio-cultural factors that may promote or inhibit a student’s ability to become engaged. Such individual differences are difficult to capture using quantitative methods. In this study, we used a qualitative approach in relation to students’ individual experiences of being engaged – or not – during the learning task. This paper presents results from a qualitative analysis of undergraduate students' experiences of digital task engagement in a digital learning module.

Methods

Participants

Participant recruitment occurred via an online advertisement through the university careers website and via posters placed on campus noticeboards. In accordance with the university ethics approval, participants were compensated with a sum of $15 for one hour of their time to participate in the study. A total of 23 participants were recruited. All participants were undergraduate students from a range of disciplines.

Nine participants reported having completed an online course previously, and one participant reported having previously studied biomedical science. Thus 22 participants did not have any significant prior knowledge of the topic in the learning task. Four of the participants were male and 19 were female. The mean age of all participants was 21.3 years. Ethics approval for this study was granted by the appropriate university Human Research Ethics Committee.

Materials

This study used a mixed methods approach to explore undergraduate students' experience of digital task engagement in a digital learning task. The instruments used to capture self-reported digital task engagement are consistent with prior research of school engagement (Fredricks Blumenfeld, Friedel, & Paris, 2005), work engagement (May, Gilson, & Harter, 2004), flow (Martin & Jackson and 2008), and self-regulated learning (Pintrich, Smith, Garcia, & McKeachie, 1991). Quantitative data were collected through surveys completed prior to, during, and after the learning task. Qualitative data were collected using semi-structured interviews with a sub-set (eight) of the participants. A framework of analysis based on prior research of engagement was used to uncover a variety of ways in which participants may report the cognitive, affective, and behavioural facets of digital task engagement during the learning task. Qualitative data were further analysed for emergent themes based on students' descriptions of their experiences during the learning task. Due to the small sample size, quantitative data did not reveal any significant findings. However, analysis of the qualitative data revealed some important insights into the changing nature of digital task engagement during the learning process. These qualitative data are the focus of this paper.

The study was conducted in a computer laboratory at a major Australian university. The digital learning task was presented on a 13-inch computer monitor. Participants used a mouse to control all on-screen activities. All survey instruments were delivered in printed format.

Blood alcohol concentration learning task

The Blood Alcohol Concentration (BAC) digital learning task presented material about blood alcohol concentration (Dalgarno, Kennedy, & Bennett, 2014). The concepts within the task are considered to be challenging for users without a background in biomedical science. This task was chosen as it would present a challenge to participants requiring them to invest cognitive effort to understand and complete the task. In line with known flow antecedents (Csikszentmihalyi, 1990), an undergraduate student should have sufficient ability to have a balance of challenge and skills.

The BAC task was developed by Dalgarno, Kennedy, and Bennett (2014), and written in Adobe Director. The digital module presents users with task instructions (5 screens) and some basic information about some of the variables that affect blood alcohol concentration over time (4 screens). Following these informational screens, the user is presented with a 'simulator' screen shown in figure 1. Users can adjust the values of each variable ('Your Values') up or down relative to a baseline in the form of 'Bill's Values'. Participants are asked to mentally predict what effect a theorised change will have, before making that change in value and running the simulation. Once a simulation has been run the output is displayed in a graph where users can compare the effect change against the baseline.

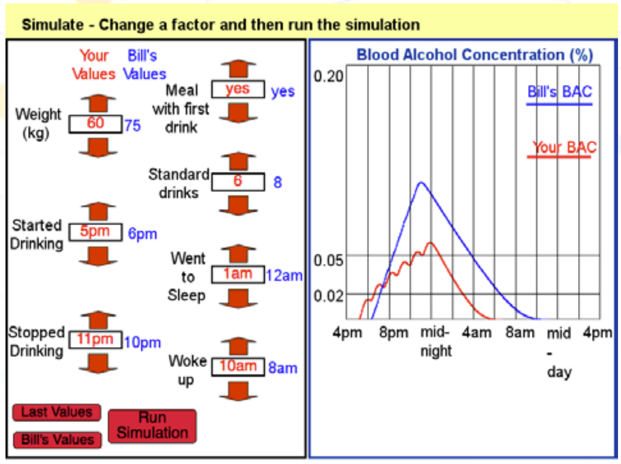

Figure 1: Sample screen from blood alcohol concentration learning task

Procedure

Participants began the BAC learning task and proceeded to work through the informational screens at their own pace. Once they finished this section of the module they were free to run one or two simulations to familiarise themselves with the tool. At this point a timer was started and participants were free to run as many simulations as they desired for a period of five minutes. At the end of the five-minute period, participants were presented with a short five-item in-task probe (questionnaire). Once completed, participants resumed the BAC learning task. This process was repeated three times resulting in four blocks of five minutes on task, each followed by an in-task probe.

Semi-structured interviews

Interviews were conducted with eight of the participants immediately following the completion of the study. Interviews ranged in time from 10 – 30 minutes depending on the willingness of the participant to engage in meaningful discussion about their experiences during the learning task. The researcher used a set of prepared questions to guide the conversation while allowing the participant to describe their experiences in their own words and to identify the most important or meaningful aspects of their experiences.

Interview recordings were transcribed and read multiple times. A framework for analysis was developed using known elements of the psychological constructs of engagement and flow, and their antecedents (Flanagan, 1954). Other key themes were recorded as they emerged from the data. Quotes were extracted from the interview transcripts and coded according to the analytic framework or emergent themes (Merriam, 2009). The unit of analysis was a thought by a participant that reflected on or articulated an element of the learning task or study process. An initial list of 21 themes was developed containing 185 quotes. Themes with only a few quotes were re-examined to see if they had shared meaning with other themes. The list of themes was reduced to 15 distinct categories containing 183 quotes. A second rater examined a selection of quotes and matched them against the 15 themes. The second rater was in agreeance and confirmed the fit of quotes with the developed categories, ensuring reliability of the coding process.

Results and discussion

Digital task engagement

Participants in the study reported phenomena that would lead us to believe they experienced episodes of digital task engagement. They described thoughts and feelings that are consistent with cognitive and affective states of engagement. Log file data from the BAC learning task showed behavioural patterns of a strategic approach to the learning task. Participants' descriptions of being engaged during the BAC task reveal differences in both the frequency and duration of engaged episodes throughout the duration of the learning task.

Cognitive engagement

As expected the BAC task provided sufficient stimuli to promote some degree of cognitive engagement. Seven of the eight participants reported being attentive and focused on the problem of trying to understand the task content. One participant described their thought process in the task as follows;

> *"Yeah, I wonder whether like the body weight is getting higher or getting lower to see very a better graph or the values and so I just keep trying then to see the relationship."*

Some participants further demonstrated cognitive processes that connected the information they were learning in the task with their own prior knowledge and experience.

> *"Like I watch the TV shows, the ones about the mobile speed thing and then drink-driving so some of that made sense when say I changed only the weight or I changed how many drinks I had and sleep doesn't affect it at all which is interesting."*

Cognitive engagement seems to have been fairly consistent for all participants as they each undertook and completed the task in some fashion. Several participants seem to have experienced more pronounced cognitive engagement with the task as they related the content to contexts outside the simple objectives of the task as evidenced by the quote above. However, some participants clearly articulated a sense of being cognitively engaged despite not being emotionally involved or particularly invested in the exercise. One participant described their experience thus;

> *"I wouldn't say I was 'in the zone' – I was just maybe focused. Like, I really wanted to know certain things. Maybe it's just me having like a little short attention span or, you know, like I'll find it hard to focus… especially in the same thing for like a long time."*

The data clearly show differences between participants' cognitive engagement in the task. While not unexpected, these differences are a reminder that other motivational factors may play a critical role in supporting cognitive engagement in a digital learning task. Further, we are reminded that while digital task engagement might be an ideal 'flow-like' state, cognitive engagement and subsequent on-task behaviour may be entirely sufficient for learning to occur.

Metacognitive awareness

Several participants were further able to articulate moments during the task where they demonstrated some metacognitive awareness of their cognitive processes during the learning task.

> *"It was kind of sometimes good to see what I was feeling at the time as well, so I'd be like 'Oh, okay, so the things I was doing it wasn't working or it wasn't what I predicted,' and then I felt a bit like 'Oh, okay, maybe I wasn't completely in control' for example. So that kind of gave me some sort of alertness as to what I was feeling and thinking at the time."*

Most of these comments seem to indicate times when the participant stepped back from the task to evaluate what they were learning and how they were approaching the task. However, one participant described how she felt that this metacognitive process of 'self-checking' required such a level of cognitive focus or concentration that it pulled her out of the engaged 'flow-like' state.

Affective engagement

Six of the eight participants described some form of emotional response during the task. A mix of both positive and negative emotions were reported, including confusion (both procedural and conceptual), interest (*"it was very gripping…"*), happiness, perceived control, absorption (*"I got really engrossed"*), annoyance, and boredom. Of these, the most commonly reported were absorption, and boredom.

Absorption

Not all participants reported a sense of absorption, but the descriptions provided by five participants demonstrated periods within the task when they entered into an absorbed state. One participant spoke of being so absorbed in the task that she was initially unaware of some noise and commotion that was happening outside the computer laboratory. As the task progressed, her level of absorption decreased and she became more acutely aware of that noise. Several participants indicated that these periods of absorption did not last for the full duration of the exercise, but that they changed during the task:

> *"When I came to the second part of it, when it was all the simulations, in the beginning I just got really absorbed."*

In line with flow theory (Csikszentmihalyi, 1990) this sense of absorption in a task or activity is an indicator of an engaged psychological state, and is considered a positive affective state promoting intrinsic motivation in the task. Of particular note in this study is the apparent fluctuation in participants' sense of absorption throughout the duration of the task.

Boredom

The largest affective category overall in the data set was experiencing a sense of boredom. Six participants spoke frequently about being bored at some point during the task. This is particularly interesting as all but one of these participants also spoke explicitly about the BAC task as being interesting with much of this interest in the topic being related to the relevance of alcohol consumption in the participant's life. As with absorption, these feelings of boredom changed throughout the task, although the general pattern was that it was more interesting at the beginning and more boring toward the end.

> *"I don't know, it gets a bit dull towards the end, like maybe the third or fourth attempt* [block of 5 minutes] *because I was kind of losing focus."*

Most frequently, the descriptions of being bored were related to the task processes rather than to the topic of interest. Participants spoke of the task as being repetitive and becoming increasingly more boring as time progressed.

> *"It got a little bit boring after a while because you were doing the same thing again, again, and again."*

This may be attributable to the time given to participants to complete the task. It seems that once they had exhausted all their ideas of how to change the variables, they began to lose interest. The time taken to reach this point differed between participants. One participant became bored by the end of the first block of five minutes on task. Others reported reaching this point of boredom in the second or third time block, or only when they reached the fourth block.

What is consistent about the reporting of affective states during the task is the changing nature of those states. The task may start as interesting and then become boring. Yet, concentration on the task, or metacognitive awareness of the learning process may enable a participant's interest to be rekindled and allow the participant to re-enter a state of absorption. While the links between constructs such as metacognition (Pintrich et al., 1991), motivation and interest (Hidi & Renninger, 2006) are well documented, their interactions within a learning task are less well understood, particularly in terms of the ebb and flow of affective states throughout the duration of that task.

Changing engagement

One emergent theme was participants' descriptions of how their task engagement changed during the BAC learning module. Participants' change in engagement differed in time and duration. Some were engaged during the first five-minute block of time on the task and became less engaged in the later half or toward the end of the whole study session. One participant described their overall experience in the following way;

> *"Well I was pretty engaged. It was just that I think I exhausted all my options and then like I basically finished it and then I had nothing to do. It was just that I felt like I'd learned everything I needed to."*

Others described a change in their engagement within a five-minute block of on-task activity.

> *"As I started the fourth* [five-minute block], *it was still all right and then it got – again, got boring like towards the end. It was just kind of like an up and down kind of thing."*

Several participants spoke about reaching a point where they had discovered everything that they could and felt they had successfully completed the task even though there was still some time left. They then chose to find ways to interest or entertain themselves within the task by 'playing' with the simulator. Some simply entered random numbers to fill in time while others entered extreme values to experiment and see what effect these would have on the graph output in the simulator. One participant described becoming increasingly annoyed that she had to use the mouse to click on the up and down arrows to change values rather than being able to type the values directly into the text box. While she began the task with a significant level of enjoyment, her affective state changed considerably as time passed, due in part to this annoying procedural function of the task.

The differences between interest in the topic and frustration or boredom with the mechanics of the task was also demonstrated in participants' reflections on their changing engagement. The following quote is from a participant who had articulated being absorbed in the task;

"I think as I was doing all of these new ones, the sort of novelty of it just gripped me quite a bit but when, as I said before, going back to... like re-running the old simulations again – again, it's the whole novelty of it, it kind of just doesn't make your brain as engaged so it doesn't flow as well because it's not something that's interesting anymore in the same sense as if you go to a new movie."

Novelty was clearly linked to interest and engagement for this participant, and when that novelty wore off, engagement appears to have waned.

Other affective states also seem to have had some impact on participants' engagement. In one case confusion seems to have disrupted or diminished engagement. A participant was describing the process of predicting an outcome prior to running the simulation;

"I think at times when my predictions might not have been what I thought it would be – that took me off the... slightly with the engagement."

These descriptions of change in the intensity, frequency, and duration of engagement support the idea that engagement within a task is not static and can fluctuate dynamically as a result of conceptual or procedural processes within the task, or may be influenced by within-person factors such as interest, or other affective states such as confusion.

Discussion

Cognition seems to have been the most stable of the three dimensions of engagement during the task. Even when participants became bored with the task they were still thinking about it and what else they could do. They may not have been strategic about this or even trying to learn, but they mostly remained focused on completing the task. Participants described change in their cognitive engagement as the novelty of the task wore off. Both the conceptual nature of the content and the visual graph output of the simulator seem to have promoted interest in the initial stages of the task, but then became less interesting as the novelty wore off. Metacognitive awareness was sometimes an extension of cognitive engagement, helping to support interest in the task and resulting in greater cognitive and affective engagement. At other times, metacognition seems to have required such an increase in cognitive effort that feelings of absorption were disrupted.

Similarly, behavioural engagement was relatively consistent throughout the task. Participants' on-task behaviour seems to have remained consistent. There was one exception to this where one participant described 'filling in time' by entering random values into the variables and running simulations without being interested in the output. In this case, there seems to have been no cognitive effort, and the behaviour was not related to the task.

The affective dimension of engagement appears to be where the most change occurred. Feelings of absorption were disrupted by a number of other affective states. Decreasing interest, annoyance with procedural aspects of the task, and loss of perceived control all contributed to negative affect during the task. In most cases confusion was also described as disrupting affective engagement. This included both procedural confusion with the task and conceptual confusion with the task content. However, in one case conceptual confusion seems to have been a prelude to increased engagement as a participant grappled with trying to understand why her prediction was wrong. This is consistent with patterns of confusion and resolution leading to engagement in an online task demonstrated by Kennedy and Lodge (2016). In this case, the conceptual confusion led to a re-evaluation of how the participant approached the task (metacognition) which seems to have promoted increasing interest in the task.

These data show that digital task engagement is not a static state and that all three engagement dimensions go through changes during a learning task, although affective engagement seems to be the most pronounced. The interplay between numerous affective states and their influence on cognitive and affective engagement seems to be of particular interest for learning design. As we would expect, interest is critical to promoting and sustaining digital task engagement. In the BAC learning task where the same process is repeated multiple times, interest seems to have diminished for several reasons. The repetitive nature of the task itself seems to have resulted in decreasing interest and increasing boredom. Conceptual understanding - or even perceived understanding - also seems to have resulted in this decline in interest. Learning tasks with multiple stages based on students' conceptual understanding may resolve both these issues as a student could demonstrate their conceptual understanding within the task and immediately progress to another stage or component of the task (Kennedy & Lodge, 2016). This may alleviate the sense that the student is just doing the same thing over and over with increasing levels of annoyance or frustration. Dividing a learning task into multiple stages with progressive learning goals could be a way to sustain and support interest over the task duration.

Following on from this, conceptual confusion may also have a role to play in stimulating digital task engagement. Recent research on misconception in learning (Arguel, Lodge, Pachman, & de Barba, 2016) suggests that confusion may have utility in promoting learning. Learning tasks that present users with a misconception and the resources to resolve their confusion may provide sufficient challenge and interest to facilitate cognitive and affective engagement.

Kahn (1990) clearly articulated the idea that episodes of engagement were temporary and transient psychological states in which people had the capacity to be fully invested - cognitively, emotionally, and behaviourally - in their work roles and tasks. We recognise that there may be differences in the nature of engagement in a work role versus that of a work task, and further note that even in this study the outworking of formal and informal roles (e.g. researcher and participant), may also have had an effect on participants' task-level engagement during this study. Despite this, participants clearly articulated their experiences of being engaged and not-engaged within the learning task. Clearly, other individual and socio-cultural factors would have also influenced each individual's ability to engage in the learning task used in this study. We do not claim that these are not highly significant factors that contribute to an individual's engagement. Our purpose here was to further explore experiential phenomena related to the learning task, conceptual material, and task processes. Thus, our focus has been on how participants' experience of digital task engagement went through changes throughout the duration of the learning task.

This study has shown that digital task engagement and its three dimensions - cognition, affect, and behaviour - vary in intensity throughout a learning task. This is consistent with observations of employee engagement (Kahn, 1990). This change in digital task engagement is important for researchers to consider in terms of observing or measuring cognitive, affective, and behavioural engagement at multiple points during a learning task rather than relying solely on self-report data captured after the conclusion of a learning task. Using multiple observations or measures may allow researchers to track an individual's engagement, or the mean engagement for a group, over the duration of a particular learning task. Such an analysis may provide insight about what aspects of the task best facilitate digital task engagement, or other task-based factors that promote, inhibit, or disrupt that engagement. In turn, such knowledge might assist learning task designers in constructing tasks that account for some of the procedural disrupters of digital task engagement that we have discussed.

Further research

We recognise that this study used a single digital learning task and that comparisons of fluctuating digital task engagement between multiple digital tasks may be informative for digital learning researchers and learning designers. Future research could focus on identifying common attributes of digital learning tasks that either promote or disrupt students' digital task engagement. We call for further research to explore well-defined conceptualisations of student engagement within specific contexts, to develop our understanding of how engagement fluctuates within digital learning tasks and the implications this has for learners, educators and learning designers.

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References

Ainley, M., Enger, L., and Kennedy, G. (2008). The elusive experience of 'flow': Qualitative and quantitative indicators. *International Journal of Educational Research, 47,* 109-121.

Arguel, A., Lodge, J. M., Pachman, M. & de Barba, P. (2016). Confidence drives exploration strategies in interactive simulations. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), *Show Me the Learning. Proceedings ASCILITE 2016 Adelaide* (pp. 33-42).

Balwant, P. T. (2017). The meaning of student engagement and disengagement in the classroom context: Lessons from organisational behaviour. *Journal of Further and Higher Education*.

Chan, T.S., & Ahern, T.C. (1999). Targeting motivation – Adapting flow theory to instructional design. *Journal of Educational Computing Research, 21*(2), 151-163.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper Collins Publishers.

Dalgarno, B., Kennedy, G., & Bennett, S. (2014). The impact of students' exploration strategies on discovery learning using computer-based simulations. *Educational Media International*, 120. doi:10.1080/09523987.2014.977009

de Barba P., Ainley, M.D. & Kennedy, G. E. (2015). *The trajectory of situational interest in an online learning session.* Paper presented at the American Educational Research Association Annual Meeting, Chicago, United States of America.

Flanagan, J. C. (1954). The critical incident technique. Psychological Bulletin, 51(4), 327-358.

Fredricks, J. A., Blumenfeld, P., & Paris, A. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research 74*, 59-109.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111-127.

Kahn. W. A. (1990). Psychological conditions of personal engagement and disengagement at work. *Academy of Management Journal, 33*(4), 692-724.

Fredricks, J. A., Blumenfeld, P., Friedel, J., and Paris, A. (2005). Student Engagement, in K. Anderson Moore and L. H. Lippman, What do children need to flourish, in my research studies. USA: Springer.

Kahu, E. R. (2011). Framing student engagement in higher education. *Studies in Higher Education, 38*(5), 758-773.

Kennedy, G. & Lodge, J. M. (2016). All roads lead to Rome: Tracking students' affect as they overcome misconceptions. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), *Show Me the Learning. Proceedings ASCILITE 2016 Adelaide* (pp. 318-328).

Lepper, M.R., & Cordova, D.I. (1992). A desire to be taught: Instructional consequences of intrinsic motivation. *Motivation and Emotion, 16*, 187-208.

Martin, A. J., & Jackson, S. J. (2008). Brief approaches to assessing task absorption and enhanced subjective experience. *Examining 'short' and 'core' flow in diverse performance domains. Motivation and Emotion, 32*(3), 141-157.

May, D. R., Gilson, R. L., and Harter, L. M. (2004). The psychological conditions of meaningfulness, safety and availability and the engagement of the human spirit at work. *Journal of Occupational and Organizational Psychology, 77*, 11-37.

Merriam, S.B. (2009). Qualitative research: A guide to design and implementation (3rd ed.). San Francisco: Jossey-Bass.

Pintrich, P. R., Smith, D. A. F., Garcia, T., and McKeachie, W. J. (1991). *A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ)*.

Ryan, R. M. (2012). *The Oxford handbook of human motivation*. Oxford: Oxford University Press.

Sims, R. (2000). An interactive conundrum: Constructs of interactivity and learning theory. *Australian Journal of Educational Technology, 16*(1), 45-57.

Wiseman, P.J., Kennedy, G.E. & Lodge, J. M. (2016). Models for understanding student engagement in digital learning environments. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), *Show Me the Learning. Proceedings ASCILITE 2016 Adelaide* (pp. 666-671).

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Constructive alignment of materials in tertiary programs

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With the increasing adoption of blended learning, tertiary programs are becoming ever more varied and complicated. Laying at the heart of a range of complex learning activities, the role of blended materials once again comes into discussions concerning learning outcomes. But how do contemporary educators design and use blended materials to support pedagogical goals? In this study, we examine the constructive alignment of blended materials with the learning outcomes of modern language programs. Using pedagogical claims analyses with data gathered in two case studies, we found that educators tend to align materials to the curriculum, student interests, a research agenda and contemporary culture. We conclude our work with a discussion of constructive alignment of materials design and use in tertiary blended learning.

Introduction

Constructive alignment, or the setting of logical pathways throughout learning to achievement, is a key concept throughout education (McCann, 2017; Onsman, 2015). As programs move to fully integrate technologies in face-to-face settings, the clarity of such pathways may demand much greater attention as blended approaches continue to introduce new complexities (Czaplinksi, 2015). Lying at the heart of many programs, blended material designs and use illustrate the number of factors that come into play when questions of alignment are raised; indeed, as Richards and Rogers (2014) point out, materials design is a core element of programs and one that links theory to practice.

To date, however, here has been little investigation of how materials are aligned to outcomes in blended programs. What constitutes 'pedagogical material' has long been debated (for example, see Tomlinson, 2011; McGrath, 2016), and views of blended learning now attempt to take into account the close relation between materials and technology (Gruba & Hinkelman, 2012; Healey, 2016). In this study, we investigate the ways tertiary educators in modern language programs take into account materials when designing their courses and making use of technologies in blended approaches. Following a review of the literature, we illustrate our work in two case studies through an argument-based approach of pedagogical claims. Our paper concludes with implications and agenda for further study.

Constructive alignment in tertiary blended programs

According to Biggs and Tang (2011), constructive alignment can help to foster deep learning through a transparent progression of task and activities that can lead to the clear achievement of intended learning outcomes. As a number of studies have shown (Larkin & Richardson, 2013; McCann, 2017; Treleaven & Voola, 2008; Trigwell & Prosser, 2014; Wang, Su, Cheung, Wong & Kwong, 2012; Walsh, 2007), a focus on constructive alignment can enhance pedagogical goals that include fostering deeper learning, developing graduate attributes and improving overall curriculum design.

As shown by Mavor and Tayner (2001), for example, a focus on constructive alignment throughout discussions of curriculum design and teaching can be foundational for interdisciplinary course design. Similarly, in Wang et al. (2012), students who took part in aligned curriculum were found to be more likely to adapt their own styles to meet those in the program and thus engage in deeper learning. For McCann (2017), engaging students with feedback and aligned assessment help to minimize issues of plagiarism.

As we reflected on the works on constructive alignment, we realized that aspects of the concept have been neglected; although the concept of constructive alignment has been used to guide curriculum design, for example, it has not been used extensively to help explain how materials can be used effectively in the blended classroom.

Although work on constructive alignment has largely focused on traditional face-to-face environments, Jones (2007) demonstrates how a program integrates technology to achieve pedagogical purposes, rather than using technology for its own sake. Jones sought to ensure that technology, intended learning outcomes, graduate attributes, pedagogical foundations and activities were each aligned and concluded that a focus on constructive alignment help technology to be in a “serving, rather than driving” role (Jones, 2007, p. 466). Other work, such as that by Barry, Murphy and Drew (2015) shows how student uses of technology may be misaligned to intended learning outcomes. In their study, Barry and colleagues concluded that socio-technological behavior and needs of students must be taken into account to result in a truly aligned curriculum.

Based on earlier work by Gruba and Hinkelman (2012), we see that materials can be seen as a proxy for content that can be situated within a wide view of technology. In this view, the role of technology in blended language learning is manifested in five dimensions: actions, groupings, timings, texts and tools. Here, in line with Laurillard (2012), actions in materials refer to how students act upon the materials, which can be narrative, interactive, adaptive, communicative and productive actions. Groupings refer to students using the materials individually, in pairs or collaboratively. Timings refer to how materials can be used synchronously or asynchronously. Texts refer to the variations of texts which can be multimodal, still or interactive. Finally, tools refer to how materials can be constructed through the uses of software and hardware (Gruba & Hinkelman, 2012).

A third concept in our review concerned materials design and use. The needs to focus on materials arise as blended materials change materials design and use in two ways: the forms of materials and the skills and knowledge needed to design and use materials. The forms of materials are not as clearly defined as they used to be. Gray (2016) categorized materials into published materials, authentic materials and teacher made materials. With blended materials, however, the lines blur between these categories. Published materials can be in print, online, offline, or only available under specific conditions, such as mobile applications. The connectivity and mobility of technology (for examples, massively multiplayer online roleplaying game and social networking sites) make materials authentic as learners are now connected to real audience and they perform real-life communications (Healey, 2016). This also, however, means new challenges for educators to use technology for educational purposes. Second, the skills and knowledge expected of educators in materials design and use are getting more demanding. Technology competency checklists such as TESOL Technology Standards (Healey, Hegelheimer, Hubbard, Ioannou-Georgiou, Kessler & Ware, 2008) include a long list of skills expected of teachers. Rapid advanced in technology is likely to cause these checklists to keep expanding (Kessler, 2016). With these changes in mind, materials become more complex, and educators are challenged to keep materials design and use pedagogically-driven.

Methods

In this study, we undertook participatory action research through a qualitative case study design. Participatory action research (Kemmis & McTaggart, 2005) allowed us to work closely with the lecturers as we sought not only to investigate their motivations and work but also seek to improve it. After gaining ethics clearance, we began our work in discussion with the lecturers about constructive alignment. How did they come to terms with the complexity of blended materials design? We chose two case studies to pursue our research.

Each case study provided specific insights (Stake, 2010) on how contextual factors can influence alignment practices. The two cases differ contextually in terms of physical settings, groupings and program outcomes. Lecturers of two language programs volunteered to participate in this study. The lecturers used online and offline materials and/or activities during face to face or non-face-to-face learning time. Both programs were offered as breadth subjects that permit students from various disciplines to join the programs.

The first case, BLP1, is a language program aims at developing undergraduates’ academic reading, writing and oral skills. The curriculum of BLP1 is designed based on The Melbourne Curriculum (The University of Melbourne, 2016) which offers “blending learning opportunities”. This program emphasizes the development of language skills and introducing academic skills including referencing, plagiarism, locating sources and evaluating information. These skills are taught across a wide range of topics focusing on the history of Australia, migration and Australia as a multicultural society. During the data collection, BLP1 was taught through one one-hour lecture, one one-hour tutorial and one two-hour tutorial. In the lectures, the lecturer presented and discussed the weekly readings. In the one hour-tutorials, the lecturer and students engaged in activities to understand the concepts associated with the weekly reading in-depth. In the two-hour tutorials, students participated in hands-on activities to develop language and academic skills based on the weekly readings. The lecturer used a variety of online and offline materials including websites, collaborative writing tools, videos, interactive essay maps, quizzes and polls. The lectures were taught by the lecturer of the program, while tutorials are taught by different tutors. Approximately 120 students attended the lectures, and tutorial groups were limited to no more than 25 students.

Our second case, BLP2, is also a language program aims at developing language proficiency in grammar, vocabulary, speaking, listening, reading and writing. In addition, the program also introduces students to the contemporary culture of the target-language country. BLP 2 is offered as an eight-level program. BLP2 is the level 2 of the program. Some of the materials used in this program included videos produced by lecturers and former students, interactive website, quizzes, audio manga, news clips and websites. The subject was taught through a one-hour lecture and two 90-minutes tutorials. Lectures were conducted by lecturer of this program, while tutorials were conducted by different tutors. Approximately 200 students attended the lectures and 25 students each were enrolled in the eight different tutorials.

After gaining ethics approval, Yoon first worked with the lecturers to help design a set of materials for use in blended configurations. Following that, she observed their teaching and implementation to gain an insider's experience that deepened her understanding of the issues (Patton, 2015). Observations were carried out for 12 teaching weeks covering lectures, seminars, tutorials and field trips. One program was observed for four hours a week while another program was observed for two hours a week. The observation produced description on how materials were used in different configurations.

Yoon also conducted a number of interviews. Unstructured interviews with lecturers were conducted from time to time during the observation. The unstructured interviews were brief and "go with the flow" (Patton, 2015, p. 437). The interviews were conversational (Merriam, 2014), thus we were able to conduct the interviews as soon as significant incidents were observed during the lectures, seminars, tutorials or field trips. Questions asked during the interviews included teaching beliefs and experiences in using the materials. Questions were created based suggestions by Strauss, Schatzman, Bucher, and Sabshin (1981) to include hypothetical, devil's advocate, ideal position and interpretive questions.

After working with the lecturers, Yoon then talked with students in a series of focus group sessions. Eleven students participated, and the sessions were structured in ways that allowed them to recall ideas and think about certain issues in blended learning (Fontana & Frey, 2000). Each session involved two to five students. Finally, in anticipation of examining ways that documents may show the way lecturers think about teaching, we systematically gathered weekly plans, lecture slides, preparation slides and university teaching policies (Bowen, 2009).

In summary, with an aim to cover one entire cycle of design and implementation of materials, we gathered data through 84 hours of class observation, two unstructured interviews, two semi-structured interviews, two focus group interviews and 46 documents from two programs. We then turned out attention to data analysis with a focus on materials and constructive alignment.

Pedagogical claim analysis

The data analysis method used in this study is an adaptation from pedagogical claim analysis used by Cooper and Brna (2000). Pedagogical claim analysis is a design rationale which allows design issues revolving around identifying and exploring scenarios (Cooper & Brna, 2000). Claim analysis have been used in several studies (Brna, 2008; Carroll & Rosson, 1992) to include stakeholders' perspectives in software development. The use of pedagogical claim analysis is the key to understand materials design and use as both the analysis and constructive alignment explore issues based on pedagogical activities. In pedagogical claim analysis, scenarios here refer to the teaching and learning activities which utilise the materials.

Pedagogical claim analysis used in this study consists of nine elements. Pedagogical claim analysis ensures "pedagogical intentions" (Cooper & Brna, 2000, p. 89) by including pedagogical aim. Other elements included in the pedagogical claim analysis are scenario, claim, support, because, check rule and issue. As both cases involved in this study were language programs, the researchers expand the pedagogical claim analysis to include language focus and skills. Table 1 shows a sample of pedagogical claim analysis. The inclusion of language focus and skills ensure that the scenarios are language-focused. Pedagogical claim analysis allows us to illustrate the intertwining relationships among the materials, pedagogical aim, teaching and learning activities and constructive alignment based on specific scenarios.

Table 1. A sample of pedagogical-language claim analysis

Element	Detail
Scenario	Talking about opinion and reporting information in the past.
Material	Flash card (PDF)
Language focus	Past tense short form for verbs and adjectives (affirmative and negative)
Language skills	Listening and speaking
Claim	Lecturer introduces vocabulary and verb forms to enable students to do speaking activity.
Support	Lecturer provides input for speaking activity.
Because	Students need to conjugate language structures and use new vocabulary.
Check rule	Students participate in a dialogue activity with two or three friends.
Issue	Students only use prescribed sentences in the speaking activity.

The method begins with identifying key scenarios (Cooper & Brna, 2000). Key scenarios in this study refer to teaching and learning activities and the materials associated with the activities. Scenarios were identified at the pre-teaching and teaching stages. Identification of key scenarios lead to generation of claims. Claims are generated and validated throughout cycle 1 of data collection. Generating and validating claims helped to understand how and to what lecturers align materials in each scenario. The claim analysis informed the source of evidence needed to validate the claims. Claims also evolve based on the evidence gathered, resulting in some claims to have newer versions. The claims were revised and validated (Cooper & Brna, 2000) based on the different sources of data collected.

Similar to Cooper and Brna, (2000), generating a number of claims in this study has two main benefits. First, the claims help in illuminating the lecturers' decision-making process explicitly. Second, it allows researchers to identify priorities in materials design and use. This method is not without challenges. Due to the changes made on claims while revising and validating, tracking changes in claims can be challenging. In fact, storing a high number of claims tends to be 'messy' (Cooper & Brna, 2000). Therefore, Cooper and Brna, (2000), recommend setting up a systematic claim management system at the early stage of the research.

Findings and discussion

A total of 23 claims have been generated from the data. The claims are categorised into six categories (see Table 2). Findings reported in this paper discuss briefly each of these categories.

Table 2: Categories of claim

Categories	Number of claims
Learning outcome	11
Curriculum	3
Students' interests	3
Assessments	2
Lecturer's research interests	2
Contemporary culture	2

Aligning materials to learning outcomes

Lecturers aligned online and offline materials to learning outcomes. Learning outcomes refer to language skills, language use, and transferable skills which are stated in the program handbook. A total of 11 claims showed that materials were aligned to learning outcomes. Table 3 shows an example of claim in which materials are aligned to learning outcomes. Lecturers from both programs also explicitly stated the weekly learning outcomes in their materials.

Table 3: Aligning materials to outcomes

Element	Detail
Scenario	Question and answer about weather
Material	Forecast report on a website
Language focus	How to report temperature
Language skills	Speaking
Claim	Aligning materials to real life usage
Support	Language is used in authentic setting.
Because	Language form is used in a website.
Check rule	Lecturers asks questions to the whole class. Students answer lecturer's questions using the new structure based on the information in the website.
Issue	Not all students answer lecturer's questions.

Aligning materials to curriculum

Materials, of course, were explicitly aligned to the Melbourne Curriculum (The University of Melbourne, 2016). Due to Melbourne Curriculum, lecturer of BLP1 integrated Australian culture, values and history into the program. According to lecturer of BLP1, the program "try to provide something that reflects the nature of Australia and particularly Melbourne". A total of three curriculum-related claims have been generated. Table 4 shows a sample claim of aligning materials to the Melbourne Curriculum. Data gathered from focus group interviews showed dividing views about the inclusion of historical events in BLP1. While two students applauded the inclusion of topics related to indigenous and culture of different migrant groups, three out of five students also thought that there were too many historical events covered in BLP1. Commenting on the topics, one student comment that "it turned out to be like a history paper" more than what had been expected.

Table 4: Aligning materials to the Melbourne Curriculum

Element	Detail
Scenario	Introducing Vietnamese migration
Material	A video of an Australian-Vietnamese working as an Australian police officer.
Language focus	Vocabulary
Language skills:	Listening and speaking
Claim 10.1	Aligning materials to historical event
Support	Provide students background information to understand multiculturalism in Australia.
Because	Students learn about Australian values and cultures.
Check rule	Students talk to each other based on the three questions prepared by the lecturer.
Issue	Students need some historical knowledge on Vietnam in order to understand Vietnamese migration.

Aligning materials to students' interests

Students' interests, their background and perceived needs was another point of alignment. A total of three claims support that lecturers aligned materials to students. In aligning materials to students' interests, lecturer of BLP2 firstly introduced new structures which were the different forms of expressions. Then, she used audio manga to present how the forms are used in real-life situations. In the focus group interview, a student stated that he was interested with popular culture such as manga. This statement corroborates with the lecturer's experience that students are more interested with popular culture compared to historical events. In BLP1, a student also commented that he liked how the topics were related to popular culture that he said, "I like to make the link between academic knowledge, academic references to broader, shared culture like songs".

In another scenario, in BLP1, lecturer chose materials which reflected the students' needs in language learning. In a tutorial in which the lecturer used a collaborative writing tool, the students felt that the materials helped them to learn writing better. Students wrote and presented their answers. Then, the lecturer pointed out the mistakes and the students corrected them. Student 02 said that the collaborative writing tool allowed them to see each other's answer and think from other students' perspectives.

Aligning materials to assessments

Assessments, both written and oral, were another key point of alignment for the lecturers. There are two claims which show that lecturers used materials to show how students can perform better in assessments. In BLP1, lecturer organized a field visit to a gallery. Students were asked to record a video of themselves presenting a painting. The videos were shown in the following tutorial. Student 04 mentioned that he was able "correct all the things which are not good" after watching the video of himself presenting during the field trip. From the observation, it seemed that students were able to point out on useful expressions for the oral assessment. However, they sometimes commented on other elements which were not related to the oral assessment such as video-editing and background noise.

Aligning materials to lecturers' research interests

The research interests of each of the lecturers inspired some points for alignment. A total of two claims have been generated. Both lecturers teaching BLP1 and BLP2 stated that some of the materials used reflected their research areas. For example, Lecturer of BLP1 used an excerpt of an article she wrote on intertextuality to highlight the issues to plagiarism. She felt that selecting what to include in the program allowed her in "approaching some of the work I did in case studies, more from an identity perspective". In a similar vein, lecturer of BLP2 also stated that she connected her sociolinguistic background to the materials such as gender and discourse.

Aligning materials to contemporary culture

Finally, contemporary political, social or economic issues provided a basis for the alignment of materials. In our analysis, two claims focused on housing and food culture emerged. When teaching about traditional houses, lecturer first showed an interactive website to introduce the vocabulary related to the topic. Then, she showed the different houses around the country. Finally, she showed a video on micro apartment, which is gaining grounds among the young house buyers. She explained to the students that this issue is happening due to the expensive cost of houses in the country. It is noteworthy that a possible problematic issue for aligning materials to contemporary culture is that students may not have the experience to talk about the issues in the target-language country.

Challenges of aligning materials

The present findings suggest two challenges faced by lecturers in aligning materials. First, avoiding misalignment between materials and learning outcomes. This scenario was depicted in learning and using referencing styles. In this activity, lecturer directed students to read a website which contains information about referencing styles and formats. One student expressed that she was not sure if this activity was beneficial. In the focus group interview, she suggested that an independent and online exercise could had been added in the LMS to facilitate the mastery of referencing styles. BLP1 not meeting the learning outcomes is summed up by another student:

> I think this subject didn't get my expectation. The knowledge they taught is not perfectly linked to the handbook, what the handbook written…they should give us students more practice and more exercises to ensure that we know all the knowledge we intended to know.

Another type of misalignment happened when lecturers did not ask students to respond the materials. Table 5 shows a sample of misaligning materials with learning outcomes. Students only watched videos of songs, news excerpt or documentary excerpt without responding to the videos in oral or written forms. Failure to ask students to respond to an activity could result in a lack of alignment as students were expected to complete several assessment tasks based on the factual knowledge presented through the materials (Biggs & Tang, 2011).

Table 5: A sample of misaligning materials with learning outcomes

Element	Detail
Scenario	Introducing events related to the 'Stolen Generations'
Material	A video of song produced by an indigenous singer.
Language focus	Vocabulary
Language skills	Listening
Claim 6.1	Aligning materials to learning outcomes
Support	The song is written from the point of view of the indigenous people, describing the significance of 'Stolen Generation' to the indigenous community.
Because	Students are not familiar with the historical event.
Check rule	None
Issue	There is no follow-up activity after watching the video.

Second, the findings seem to indicate that lecturers struggle to strike a balance in aligning materials to meet curriculum and students' needs. There were dividing opinions on aligning materials with curriculum among the lecturers and students. While lecturers defended the need to align materials to institutional curriculum, students thought that the curriculum aligned-materials failed to cater to students' needs. In selecting topics for BLP1, the lecturer felt the need to "provide something that reflects the nature of Australia and particularly Melbourne". In the university website specifying graduate attributes, one of the attributes is "Active Citizenship" which states that "graduates are aware of the social and cultural diversity in communities and can work collaboratively with people from diverse linguistic and cultural backgrounds" (The University of Melbourne, 2017). However, some students felt that the historical topics covered in BLP1 did not cater to their interests. When asked on what they liked least about the program, students mentioned that the topics were "boring" and "doesn't match my interests".

In summary, materials in the blended tertiary programs studied aligned to learning outcomes, students' interests, assessments, lecturers' research interests and contemporary culture. Nevertheless, there are also evidences suggesting possible misalignment between materials and learning outcomes. Analysis also points to contradicting evidences in aligning what curriculum requires and what students want.

Implications and conclusion

As blended learning becomes increasingly immersed in tertiary programs, there is a need for a guided, pedagogically-led framework for programs planning and implementation, especially in using materials in a blended environment. Gruba and Hinkelman (2012) proposed four considerations in planning and implementing blended learning: purpose, appropriacy, multimodality and sustainability. Purpose ensures that actions in a program are enacted based on pedagogical principles. Appropriacy of blended learning ensures that a program fits the diverse linguistic and cultural backgrounds of the students. Multimodality in blended learning offers different modes for knowledge to be communicated to students (Kress, 2000). Sustainability allows materials to be transferable, adaptable and reusable.

The key problem with this proposition is the exclusion of alignment as a consideration as crucial as purpose, appropriacy, multimodality and sustainability. This study contributes to the consideration of blended learning proposed by Gruba and Hinkelman (2012) by suggesting the inclusion of alignment as the fifth consideration. Although Biggs and Tang (2011) proposed three elements for alignment, in blended environment, alignment can also include a number of other elements. The findings suggest that apart from learning outcomes and assessment tasks, alignment in blended environment can also include curriculum, students' interests, lecturers' research interests and contemporary culture.

The findings also reported misalignment between materials and learning outcomes. Misalignment found in this study seems to affirm with Wang et al. (2012). They noted that lecturers' awareness on designing constructive aligned programs is still low, and this needs to be addressed through professional development. In designing and using materials, teachers engage in local configurations, that is, trying out new materials and revise them according to the contextual needs (Blin, Jalkanen & Taalas, 2016). Sustainability use of technology not only need professional development in training teachers to revise materials, but also the ability to revise teaching activities and align technological changes to the activities and learning environment (Blin et al., 2016).

Based on the number of claims, it seems that lecturers mostly aligned materials to learning outcomes, followed by curriculum. In aligning materials to learning outcomes, at times, lecturers seem to treat students as receiver of information when using audio-visual materials to provide information (Laurillard, 2012). This situation is probably because lecturers are not well-informed in didactics design for blended learning (Mozelius & Rydell, 2017). By themselves, as Laurillard (2012) reminds us, materials do not magically support active learning as it is lecturers who must foster active engagement.

Although the findings affirm Biggs and Tang (2011) who discuss learning outcomes, teaching and learning activities and assessment as the core elements in constructive alignment, curriculum has been placed in much higher emphasis in this study. This is probably due to the fact that curriculum is seen as mandated, as curriculum has been stated explicitly in a university's strategic plan. In the strategic plan, curriculum is stated as one of the strategic priorities for high quality teaching and learning (The University of Melbourne, 2015). Thus, there is potentially a conflicting area in striking a balance between aligning materials to meet curriculum and students' needs. This situation mirrors Laurillard (2012) that curriculum often reflects the requirements of the authorities, rather than meeting what the disciplines need. Lecturers often have to decide to empower students with some control of learning and risk not having enough time to cover the curriculum, or cover the curriculum but not empowering students to control the direction of the learning process in class (Hussey & Smith, 2003). Lecturers and students in this study seemed to fall into this conflicting situation.

Finally, in data analysis, the study shows that pedagogical analysis can help to verify claims through the use of language and pedagogic reasoning. Furthermore, it also helps to identify problematic issues in using materials. The use of specific scenarios helps in illustrating details on how materials are designed and used in blended environment. Further analysis needs to be done to explore what other elements are involved and the relationship between these elements in aligning materials. Reflecting from a claims perspective, generating claims with language skills and focus added posed some challenges. Some of the claims did not involve every element in the pedagogical claim analysis. For example, claims related to culture do not involve check-rule. Likewise, claims related to policy do not involve language skills and focus. This resulted in different ways in making sense of the claims.

References

Barry, S., Murphy, K., & Drew, S. (2015). From deconstructive misalignment to constructive alignment: Exploring student uses of mobile technologies in university classrooms. *Computers & Education*, *81*, 202–210. https://doi.org/10.1016/j.compedu.2014.10.014

Biggs, J. B. (1999). *Teaching for quality learning at university: What the student does*. Berkshire: Society for Research into Higher Education and Open University Press.

Biggs, J.B, & Tang, C. (2011). *Teaching for quality learning at university: What the student does*. (4th ed.). Maidenhead: McGraw-Hill Education and Open University Press.

Blin, F., Jalkanen, J., & Taalas, P. (2016). Sustainable CALL development. In F. Farr & L. Murray (Eds.), *The Routledge handbook of language learning and technology*. New York: Routledge.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40. doi: 10.3316/QRJ0902027

Brna, P. (2008). Narrative interactive multimedia learning environments: Achievements and challenges. In G. A. Tsihrintzis, M. Virvou, R. J. Howlett, & L. C. Jain (Eds.), *New directions in intelligent interactive multimedia* (pp. 33–44). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-68127-4_4

Carroll, J. M., & Rosson, M. B. (1992). Getting around the task-artifact cycle: How to make claims and design by scenario. *ACM Trans. Inf. Syst.*, *10*(2), 181–212. https://doi.org/10.1145/146802.146834

Cooper, B., & Brna, P. (2000). Classroom conundrums: The use of a participant design methodology. *Educational Technology and Society*, *3*(4), 85–100.

Czaplinski, I. (2015). Investigating the effectiveness of an ecological approach to learning design in a first year mathematics for engineering unit. In T. Reiners, B.R. von Konsky, D. Gibson, V. Chang, L. Irving, & K. Clarke (Eds.), *Globally connected, digitally enabled. Proceedings ASCILITE 2015 in Perth* (pp. 52-64).

Fontana, A. & Frey, J.H. (2000). The interview: From structured questions to negotiated text. In N.K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research*. (2nd ed., pp. 645-672). Thousand Oaks, C.A: Sage Publications Inc.

Geertz, C. (1973). *The interpretation of cultures.* New York: Basic Books.

Gray, J. (2016). ELT materials: Claims, critiques and controversies. In G. Hall (Ed.), *The Routledge handbook of English language teaching*. (pp. 94-108). London: Routledge Taylor & Francis Group.

Gruba, P., & Hinkelman, D. (2012). *Blending technologies in second language classrooms*. Hampshire: Palgrave Macmillan.

Healey, D. (2016). Language learning and technology: Past, present, and future. In F. Farr & L. Murray (Eds.), *The Routledge handbook of language learning and technology* (pp. 9–23). New York: Routledge Taylor & Francis Group.

Healey, D., Hegelheimer, V., Hubbard, P., Ioannou-Georgiou, S., Kessler, G., & Ware, P. (2008). *TESOL Technology Standards Framework*. Alexandria, Virginia: TESOL Publisher. Retrieved from https://www.tesol.org/docs/default-source/books/bk_technologystandards_framework_721.pdf

Hussey, T., & Smith, P. (2003). The uses of learning outcomes. *Teaching in Higher Education*, *8*(3), 357–368. https://doi.org/10.1080/13562510309399

Jones, P. (2007). When a wiki is the way: Exploring the use of a wiki in a constructively aligned learning design. In Atkinson, R.J., McBeath, C., Soong, S. K. A. & Cheers, C. (Eds.), *ICT: Providing choices for learners and learning. Proceedings ASCILITE Singapore 2007.* (pp. 460–467).

Kemmis, S., & McTaggart, R. (2005). Participatory action research: Communicative action and the public sphere. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (pp. 559–603). Thousand Oaks, C.A: Sage Publications Inc.

Kessler, G. (2016). Technology standards for language teacher preparation. In F. Farr & L. Murray (Eds.), *The Routledge Handbook of Language Learning and Technology*. (pp. 57-70). London: Routledge Taylor & Francis Group.

Kress, G. (2000). Multimodality: Challenges to thinking about language. *TESOL Quarterly*, (2), 337.

Larkin, H., & Richardson, B. (2013). Creating high challenge/high support academic environments through constructive alignment: student outcomes. *Teaching in Higher Education*, *18*(2), 192–204. https://doi.org/10.1080/13562517.2012.696541

Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. (3rd ed.). New York: Routledge

Mavor, S., & Trayner, B. (2001). Aligning genre and practice with learning in Higher Education: An interdisciplinary perspective for course design and teaching. *English for Specific Purposes*, *20*(4), 345–366. https://doi.org/10.1016/S0889-4906(01)00025-4

McCann, M. (2017). Constructive alignment in economics teaching: A reflection on effective implementation. *Teaching in Higher Education*, *22*(3), 336–348. https://doi.org/10.1080/13562517.2016.1248387

McGrath, I. (2016). *Materials evaluation and design for language teaching*. Edinburgh University Press.

Merriam, S. B. (2014). *Qualitative research: A guide to design and implementation*. California: John Wiley & Sons, Inc.

Mozelius, P., & Rydell, C. (2017) Problems affecting successful implementation of blended learning in higher education: The teacher perspective. *International Journal of Information and Communication Technologies in Education*, *6*(1): 4-13, https://doi.org/DOI: 10.1515/ijicte-2017-0001

Onsman, A. (2015). Constructively aligning the curriculum of a 'New Generation' Bachelor of Environments degree from a social realism perspective. *Cogent Education*, *2*(1), 1061264. https://doi.org/10.1080/2331186X.2015.1061264

Patton, M. Q. (2015). *Qualitative research and evaluation methods: Integrating theory and practice*. (4th ed.). Thousand Oaks, C.A: Sage Publications Ltd.

Richards, J. C., & Rodgers, T. S. (2014). *Approaches and methods in language teaching*. Cambridge University Press.

Stake, R. E. (1995). *The art of case study research*. California, London & New Delhi: SAGE Publications Inc.

Stake, R. E. (2010). *Qualitative research: Studying how things work*. Guilford Press.

Strauss, A. L., Schatzman, L., Bucher, R., Ehrlich, D., & Sabshin, M. (1981). *Psychiatric ideologies and institutions* (Revised edition). New Brunswick, N.J: Transaction Publishers.

The University of Melbourne (2015). *The University of Melbourne strategic plan 2015-2020: Growing* *esteem*. Retrieved from http://about.unimelb.edu.au/__data/assets/pdf_file/0006/1462065/11364-GROWING-ESTEEM-2015-FA-WEB.pdf

The University of Melbourne (2016). *The Melbourne curriculum*. Retrieved from http://provost.unimelb.edu.au/teaching-learning/melbourne-curriculum

The University of Melbourne (2017). *The Melbourne graduate: Graduate attributes*. Retrieved from http://provost.unimelb.edu.au/teaching-learning/the-melbourne-graduate

Tomlinson, B. (2011). *Materials development in language teaching*. Cambridge University Press.

Treleaven, L., & Voola, R. (2008). Integrating the development of graduate attributes through constructive alignment. *Journal of Marketing Education*, *30*(2), 160–173. https://doi.org/10.1177/0273475308319352

Trigwell, K., & Prosser, M. (2014). Qualitative variation in constructive alignment in curriculum design. *Higher Education*, *67*(2), 141–154. https://doi.org/10.1007/s10734-013-9701-1

Walsh, A. (2007). An exploration of Biggs' constructive alignment in the context of work-based learning. *Assessment & Evaluation in Higher Education*, *32*(1), 79–87. https://doi.org/10.1080/02602930600848309

Wang, X., Su, Y., Cheung, S., Wong, E., & Kwong, T. (2013). An exploration of Biggs' constructive alignment in course design and its impact on students' learning approaches. *Assessment & Evaluation in Higher Education*, *38*(4), 477–491. https://doi.org/10.1080/02602938.2012.658018

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