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ORIGINAL RESEARCH

# An Evaluation of the Impact of Digital Technology Innovations on Students' Learning: Participatory Research Using a Student-Centred Approach

**Isaiah T. Awidi**[1,3] · **Mark Paynter**[2]

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**Abstract**

In this paper we report on a study of the impact of digital technology (DT) innovations on students' learning in a Western Australian University. The innovations were implemented by 42 course coordinators (CC) following two days of learning design workshops. In collaboration with nine CCs, we conducted an evaluation of their innovations. Data were collected through two structured interviews with each CC and an online questionnaire for 1500 students. Elements of students' course feedback were incorporated into the final analysis of the data. A model for improving students learning in a digital environment was used as a guide to the evaluation process. The findings indicated that DT interventions helped students prepare for laboratory activities and class participation, increased their levels of interaction and collaboration, and provided effective and timely management of feedback from lecturers. Students also reported greater access to learning resources, plus more motivation and engagement. CCs were generally pleased with their innovations; however, in their second interview, at the end of the semester, CCs identified several aspects of their course design that warranted improvement, including the need for more professional support in making those improvements

**Keywords** Digital technologies · Learning design, teaching innovation · Student learning experience · Enhanced learning · Support and motivation · Assessment and feedback · Critical reflection

## 1 Introduction

Digital Technologies has changed the way teaching and learning in higher education is delivered. Contemporarily, digital technology processes are being used by students to engage with their fellow students and with instructors during teaching and learning

✉ Isaiah T. Awidi
isaiah.awidi@usq.edu.au

1 University of Southern Queensland, Brisbane, Australia

2 University of Western Australia, Albany, Australia

3 NMSW, University of Queensland, Brisbane, Australia

activities. Although digital technologies have typically been approved by university administrators for the purpose of supporting and expanding the capacity of teaching staff, the adoption of the technology by course coordinators has varied in both commitment and effectiveness. And even when course coordinators have been enthusiastic and seemingly effective in their adoption of the technologies, the take-up by students has varied considerably (Bond et al., 2020; Zairul, 2020). Hence the need for more research on effects of digital technologies in teaching and learning innovation implementations. In this case, in collaboration with 9 of the 42 course coordinators who undertook training in digital technologies-related teaching design at a Western Australian University, we evaluated the effectiveness of their innovations. The innovations entailed the redesigning of existing courses toward digital, active and blended learning approaches. In this paper, we commence with an account of the aims and research questions for the study and follow with a review of literature on how digital technologies have influenced student learning. Next, we outline the theoretical framework underpinning the study, the methodology, findings, and discussion. Finally, we conclude with implications from this study for digital technology course design in higher education.

## 2 Aims and Research Questions

In 2016 a Western Australian university provided an intensive two-day program of learning design workshops for 42 course coordinators and approximately 120 teaching staff to facilitate their use of digital technologies in their teaching. The course coordinators who attended the workshops came from faculties in the university with oversight for courses in education, communication, research, architecture, engineering, accounting, epidemiology, and evolutionary processes. The two days of workshops were conducted by the university's Teaching and Learning Centre staff, supported by learning technologists and librarians. The workshop instructors delivered a six-phase design process, engaging the participants in the following learning activities: blueprinting, storyboarding, scaffolding, developing innovative activities, peer review, and action planning (Salmon, 2013; Salmon & Wright, 2014). The workshops were intended to have depth of content and concentrate on the participants' teaching design development and use of appropriate resources and technologies.

The evaluation of these digital innovations, conducted at the end of the semester, aimed to assess the impact of the innovations on the student learning experience, as underpinned by the following questions:

RQ1. How were the digital technology teaching and learning innovations effective in the students' learning experience?
RQ2. How could the innovations be improved, and what are the implications of such design innovations for future course design processes?

The principle underlying these questions was that the learning designs were outcome oriented; accordingly, the evaluation was focused on both the course coordinators' and students' perceptions of their acquisition of skills, knowledge, and values (Tyler, 2013). Hence, the study was intended to identify the benefits and shortcomings from this introduction of digital technologies into a particular higher education environment.

## 3 Literature Review

### 3.1 Student-Centred Learning (SCL)

The effects of digital technologies in Higher Education (HE) teaching and learning have attracted widespread attention (Castro, 2019; Crompton & Burke, 2018; Lacka et al., 2021). Student learning, no longer confined to the traditional lecture and follow-up tutorial, now encompasses new learning environments (Mercier & Higgins, 2013; Sevillano-Garcia & Vázquez-Cano, 2015). However, has the digital revolution increased students' control over their learning? In other words, has it enhanced SCL? Harden and Crosby (2000) described SCL as focusing on "the students' learning and what students do to achieve this, rather than on what the teacher does" (cfBond et al., 2020; Harden & Crosby, 2000; Lee & Hannafin, 2016); O'Neil & McMahon (2005). In student-centred learning the student is envisaged as an active participant of the learning process, in which the course coordinator acts as a coach or facilitator who encourages students to be self-motivated and self-regulated in their learning (Bailey & Colley, 2015). This approach also seeks students' deep learning and understanding, with increased responsibility for their interdependence in an environment of mutual respect. Thus, ideally, as the students take charge of their learning, their autonomy of what, when, where, and how to learn increases (O'Neill & McMahon, 2005; Zairul, 2020).

Some researchers have found that student-centred learning enhances course designs and students' power over their learning. According to Attard, Di Iorio, Geven, and Santa (2010), students in a student-centred learning environment become an integral part of the academic community, with increased independence and responsibility for their learning, motivation and engagement. According to Lee and Hannafin (2016), technology-driven student-centred learning generates learning opportunities and reconstruction of knowledge. It enables students to address their unique learning interests and needs and deepen their knowledge and understanding. Zairul (2018) has observed that student-centred learning also increases the clarity of learning objectives, guidance, and support for all concerned. Notwithstanding, Hoidn (2016) observed that lecturers were often reluctant to embrace calls for educational reforms, highlighting several barriers that undermined effective implementation of student-centred learning. Firstly, the barriers to incremental adjustments of the current practice which includes extrinsic factors such as insufficient time to plan instruction and inadequate support. Secondly, intrinsic factors that include beliefs about learning and teaching. Thirdly, established classroom practices and an unwillingness to change.

Sweetman (2017) study at Norwegian and English Universities described student-centred learning approaches as ambiguous and potentially contradictory, with no relationship established between student-centred learning and students' achievement of learning outcomes. Sweetman argued that student-centred learning ideals posed tensions for traditional teaching practice, in terms of transferring power and choice to students, and perceived pressures to specify and assess learning outcomes, which could be avoided when adequate digital resources were provided, with clear guidance, support, and motivation. Successful implementation would require course coordinators to structure the expected learning outcomes so that they are achievable, and the learning content and activities are relevant to the students' learning. Such restructure helps students construct their own learning, enhancing their motivation and incentive to learn, and emphasizing students' prior knowledge, experience, interest, abilities and learning style.

Hoidn (2016), also observed some student level resistance to student-centred learning and argued that traditionally, students are more used to teacher-focused approaches and often lack familiarity with student-centred learning and, thus, may reject the student-centred learning approach. In addition, students' perceptions of student-centred learning can vary greatly across and within higher education Institutions because their perceptions depend on diverse factors such as personal preferences, the subject matter, capabilities and prior experiences (Attard et al., 2010; Geven & Attard, 2012). Hoidn, noted that, prior bad experiences with methods associated with student-centred learning such as group work or project work can result in student resistance to student-centred learning approaches. According to Lea et al. (2003), students may feel anxious in terms of what is expected from them, lack motivation or fear that they are being left to themselves without much guidance from the instructor. Hence, there is a greater need to prepare students to gradually take greater responsibility for their own learning, with the instructor discussing with them the theoretical ideas and practical implications of implementing student-centred learning to help them understand the benefits of the approach (Lea et al., 2003). In the current study, it was therefore necessary to provide adequate support to instructors through the workshops and encourage adoption through faculty incentives, grants for the innovations and acknowledgement of their effort in professional development assessments.

Lee and Hannafin (2016) argued that several assumptions must be considered for the successful implementation of a student-centred learning approach. Firstly, an underlying assumption of student-centred learning is that individual students need to assume greater responsibility for their learning; however, this poses challenges to students who have difficulty learning independently. Secondly, understanding is supported when cognitive processes are augmented by technology. When digital technologies are used to enhance the quality of teaching and learning, students become more autonomous in how they navigate and manage their own learning. Thirdly, understanding is most relevant when rooted in personal experience and evolving continuously. Learning, they argue, occurs best when varied/multiple representations are supported, while knowledge is personally constructed through interpretation and negotiations. These assumptions are deeply rooted in the constructivist principle that learning occurs best when it involves interaction and is linked to existing knowledge (Vygotsky & Cole, 2018). Fourthly, understanding requires time, noting that direct instruction alone does not support varied learning requirements. Thus, different approaches relevant to the learning outcome are necessary for effective learning. Finally, learning environments support underlying cognitive processes, and are not solely products of understanding; learners make, or can be guided to make, effective choices.

### 3.2 Digital Technologies in Teaching and Learning

Digital Technologies (DTs) are electronic devices, tool, resources and systems like mobile devices, social media, multimedia and online resources generates/receives, process, stores and communicate information (Camilleri & Camilleri, 2017, 2021). Students who are competent with digital technologies can access learning resources through a variety of online media, such as YouTube, social media sites, tablets, mobile devices, and video games (Camilleri & Camilleri, 2021; Hatzipanagos & John, 2017; Johannesen et al., 2019). Motivated and techno-confident students can draw from these online resources to clarify and reinforce what they have learned in lectures (Bueno-Ravel & Gueudet, 2009; Jacobsen, 2019; Pillutla et al., 2020). Thus, arguably, teaching and learning have become more engaging for students and more flexibly delivered by lecturers. However, some researchers are less optimistic about the potential of digital technologies to enhance education.

According to Selwyn (2016a), the claim that digital technologies make learning more social, situated, authentic, engaging and motivating is questionable. However, several evaluators of DT innovations have shown improvements in students' learning and instructors' teaching (Awidi & Paynter, 2019; 2019; Chanpet et al., 2020; Tawfik et al., 2014). According to Davies et al. (2017), technology-enhanced approaches in the UK have significantly impacted higher educational delivery. These approaches include simulated experiments and field trips, the use of Massive Open Online Courses (MOOCs) within face-to-face provision, the redesign of assessment tasks, and the development of flipped classrooms. These authors concluded that systematic curriculum redesign using technology-enhanced learning enables institutions to improve academic outcomes as well as the student experience overall. This observation has been supported by other researchers (Camilleri & Camilleri, 2017; Stec et al., 2020; Voogt & Knezek, 2018).

These findings imply that a necessary component of innovative change is the redesign process, which in most instances entails professional support for course coordinators within their institutional setting. Through such collaboration, course coordinators can be supported in the redesigning of their courses, the evaluation of subsequent student outcomes, and in follow-up redesigning for ongoing improvement. Collins and Halverson (2010) argued that, in contrast to traditional pedagogies, the integration of digital technologies allows for and encourages an environment in which students develop skills in problem solving, teamwork, and technological applications. Furthermore, these students benefit from learning that is customised to suit their individual needs and allows them increased control over their learning. This learning comprises interaction with learning resources, scaffolding of learning games and simulations; multimedia; publication opportunities, and self-reflection activities.

### 3.3 Integrating Technology into Pedagogical Design

As mentioned above, digital technologies have been found, in many instances, to have contributed significantly to improving educational outcomes, with a capacity to enhance teaching and learning in higher education (Chanpet et al., 2020; Phillips, 2015). It must, however, be noted that support for the pedagogical design is crucial in achieving the desired impact of digital technologies on student learning. In an Australian study, Maor (2017), used digital technologies to support learning design and delivery, and concluded that the students' confidence and understanding increased for both individual and group learning. However, this is not always uniformly the case. In examining the use of digital platforms, involving a comparison of collaboration between different students cohorts and employees, Wilms et al. (2017) found that undergraduate and masters level students preferred to use social network sites for collaboration and communication, whereas PhD students and employees preferred to use email. This finding suggests that in any learning environment course objectives, learner needs, and knowledge of the cohort of students need to be considered. For example, in the current study the researchers and course coordinators had to take into consideration which of the available digital technologies were viable for achieving the intended learning outcomes of the course.

The core aim of digital pedagogies is for lecturers to make their teaching and learning more effective, which may translate into 'students becoming more engaged and active in their learning'. The basic premise is that digital technologies will induce a more interactive learning environment and one that encourages students to become reflective, collaborative learners (Maor, 2017). Selwyn (2016a), in a critical review of the potential of technologies to support teachers, claimed, rather expansively, that digital technologies would:

- expand the capacity of instructors
- enhance the efficiency of educational institutions
- increase the relevance of the educational system for society

Evidence from the review of institutional studies (Awidi & Paynter, 2019; Hambright-Belue & Powers, 2018; Munro, 2018; Walker et al., 2018) supported the proposition that digital technologies have a positive impact on the way lecturers deliver courses to students. However, while the introduction of digital technologies may be significant in improving students' learning, this is not a given. Our position in the current study was that since digital technologies were readily available, in this environment it was expected that lecturers would embrace and incorporate them into their teaching practice. However, in a similar situation, the longitudinal study by Englund et al. (2017) of their incorporation of digital technologies at a Swedish University found that the experienced teachers exhibited little or no change in adopting digital technologies when left to their own devices. These researchers concluded that to ensure effective implementation of digital technologies in teaching and learning, lecturers needed to be monitored and supported to adopt the necessary conceptual changes and pedagogy. Arguably, this finding supports the notion that course coordinators are primarily discipline experts; they need support to incorporate digital technologies into their pedagogies.

Drijvers (2015) sought the significant factors involved in incorporating digital technologies successfully into a mathematics classroom, concluding that specific learning designs to exploit the pedagogical potential of each digital tool were crucial to a successful implementation. For example, use of mobile technologies for online course delivery and collaboration, learning simulations and delivery of instructional resources. In the Drijvers study, the role enacted by teachers and the educational context also influenced the success of digital technology to improve learning. In our study, we assumed that the extent to which a DT could improve teaching and learning could be a predictor of how the student learning experience would be improved. Hence, the suggestion that learning would be improved when technologies are effectively used to facilitate access to information, support and motivate learning activities, enhance engagement, improve assessment and feedback, and provide learning activities for students to construct knowledge (Awidi & Paynter, 2019). We therefore argued, from the evidence outlined above, that the incorporation of digital technologies in higher education has the potential to create a ubiquitous learning environment, that is, one that enables students to interact with learning resources at any time and in any location. By integrating digital technologies into their pedagogy, lecturers are more likely to focus on the needs of students and to encourage their engagement, independent interaction, and collaboration (Camilleri & Camilleri, 2017; Sevillano-Garcia & Vázquez-Cano, 2015).

## 4 Theoretical Framework

A primary objective of the forementioned learning design workshops was for each Course Coordinator (course coordinator) to envisage the key elements of the student learning experience for their proposed redesign. A Model for Improving Student Learning in a

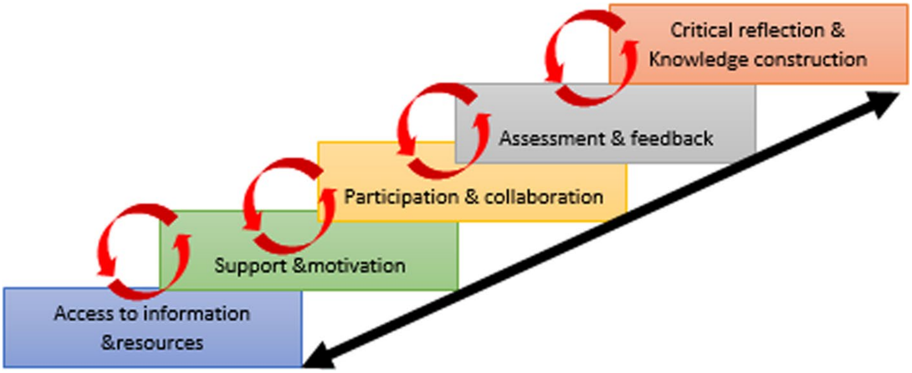


**Fig. 1** Model for improving student learning in a digital environment (MISL) (Awidi 2006)

digital environment (Awidi, 2006), was the framework used for this purpose. The model used in Awidi and Paynter (2019) and Awidir et al. (2019) postulated the following key elements of the learning experience: "access to information and resources (AIR); support and motivation (SAM); participation and collaboration (i.e. engagement) (PAC); assessment and feedback (ASF); critical reflection (CRF); and knowledge construction (KCO)" (Fig. 1). The elements of the model are described in more detail later in this paper. The model draws from the social constructivist paradigm which argues in part that effective learning occurs through active participation in learning, where learners construct knowledge by doing rather than passively taking in information. Through their participation and experience of learning reality is determined (Vygotsky & Cole, 1978).

With the course coordinators as facilitators of DT-related learning, we anticipated that for a successful student learning experience in a digital environment to occur, firstly, students would need adequate access information and learning resources (Oliver, 2000), that are relevant and clearly linked to the learning outcomes, and are accessible anytime, anywhere. Such resources must help the student's independent study to gain mastery of the subject. Secondly, students would need support and motivation (Chen & Jang, 2010) from the course coordinator and peers (Mishra, 2020) in such a way that the learning activities could influence, encourage, and inspire them to learn on their own, anytime, anywhere. Thirdly, the students would participate in learning activities that would reinforce their learning and collaboration with peers. These may include individual and group practice activities that may build authentic skills and competencies. Fourthly, the course coordinators would provide students with relevant assessment and feedback, aimed at reinforcing what they had learnt, and linked to the learning outcomes, in a way that would promote achievement of independent learning (Cauley & McMillan, 2010). Timely, concise and informative feedback with clear guidance would also be needed to support the students' learning experience. Fifthly, the students would benefit from critically reflecting on their learning, drawing on their experiences to clearly articulate their perceptions of 'what happened'. However, this should be achieved by the course coordinator offering students the opportunity to clarify their understanding of the concepts through reflection exercises (Boud & Knights, 1996a). Finally, from the reflection, the students should be able to construct new knowledge and independently develop solutions to problems. These are linked to Lee and Hannafin (2016) assumptions for student-centred learning as outlined in the literature section and shown in Table 1 below.

**Table 1** Model for improving students learning (MISL) and assumptions of student-centred learning (SCL)

| MISL instructor facilitates[a] | Assumptions of SCL |
|---|---|
| Access to Information and Learning Resources (AIR) | Learning environment support underlying cognitive processes; Understanding supported when cognitive processes are augmented by technology (SAM) |
| Support and Motivation (SAM) | Learners make, or are guided to make effective choices; learning best when varied representations are supported (AIR) |
| Participation and Collaboration (PAC) | Individuals assume greater responsibility for their learning; Personal experience; varied learning activities; Individual will assume greater responsibility for their learning; |
| Assessment and Feedback (ASF) | Traditional instruction is too narrow to support varied ways of promoting learning; [a]optimal learning occurs when varied representations are supported |
| Critical Reflection (CRF) | Understanding requires time; understanding most relevant when rooted in personal experience; |
| Knowledge Construction (KCO) | Knowledge personally constructed via interpretation and negotiation; understanding evolves continuously |

[a]Deep learning may occur at any stage of the experience process

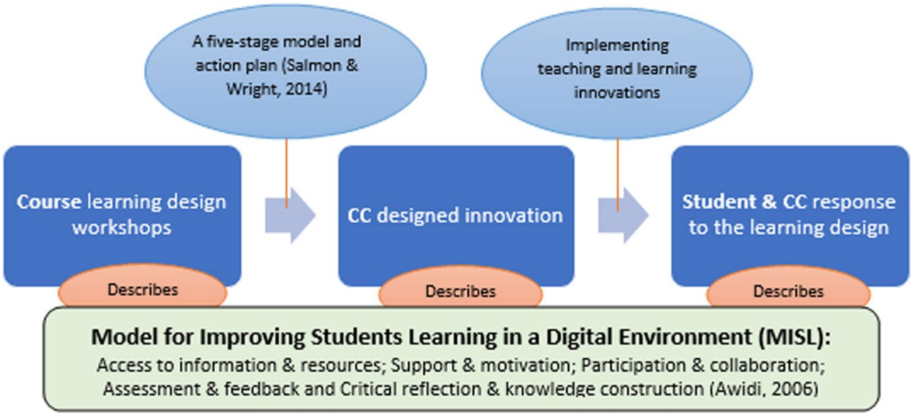


**Fig. 2** From learning design through to CC and student response—applying MISL *(Awidi 2006)* in the study

These criteria were intended to guide expectations for DT-related teaching and learning in Higher Education (HE) and to serve as criteria for the evaluation of the students' learning experience. Insofar as the model (Fig. 1) followed these guidelines, it was adopted for this study in a systematic manner to interpret the learning design intentions of each course coordinator, to interpret the response of the students to these designs, and as a checklist for subsequent improvement in future course redesigns. Thus, the model provided a valuable framework for all aspects of the study—from course design to implementation and the subsequent student and course coordinator response (Fig. 2). The six-phase design process used in designing the courses (Salmon, 2013) and the model for improving students learning (Awidi, 2006) were considered relevant to our evaluation study.

Principles we considered appropriate in examining each course design included: the reasons which led each course coordinator to develop a new design; the learning strategies incorporated that were aimed at students taking ownership of their learning; and the consistency of each design with the students' learning outcomes, activities and assessment. These principles were drawn from the five elements of the model (Fig. 1) and the principles of constructive alignment described by Biggs and Tang (2010), that assessments and learning activities must be focussed on the learning objectives. Table 2 below shows the extent to which each of the nine course designs were considered to address the five elements of the model, and it displays the patterns emerging across them. For example, the learning design in the Architecture course (A1) addressed all five elements of the model, whereas the design for the Business course (B2) addressed only two. The table shows that almost all designs focused on student access to information and resources; however, fewer designs focused on support and motivation and the remaining three elements. Only two designs addressed all five elements of the model.

## 5 Methodology

### 5.1 Research Design Process and Instrument

In this study a mixed-method approach was used to gather the data necessary for the evaluation. Instruments were developed for surveying both students and course coordinators (course coordinators). Two sets of interview questions were developed for the course coordinators in the form of pre- and post-intervention questions, and for the students a survey questionnaire comprising statements on a 5-point scale (strongly disagree (1) to strongly agree (5) and open-ended questions. The students' questionnaire was collaboratively developed with the course coordinators, involving questions guided by the five elements of the model and questions of interest to the course coordinators. Variations in questions of interest to the course coordinators were necessary to address objectives of the innovations for the individual course redesign.

The methodology entailed a shared research approach for evaluating the innovative teaching design and timeframes for the study, the joint development of student questionnaires, and the interpretation of the survey data. To ensure that the instruments measured what was intended, we established a logical link, between the questions and objectives of the study. All items and questions covered the full range of issues being measured. Coverage of the issues or attributes in the model was balanced, with each aspect having similar and adequate representation in the questions or items. Once the questions were developed, they were trialled with students from other disciplines to ensure that the statements or questions were clear and represented the issues they were supposed to measure. The pilot responses were used to tweak some aspects of the questions.

### 5.2 Sampling Process and Data Collection

To ensure that the study covered a broad range of student learning experiences, we selected a sample of course coordinators from those who had attended the two-day university redesign workshops. All course coordinators in this larger group were invited to participate in the semester-long study. Eleven course coordinators initially signed on to participate, but to withdrew. Consequently, nine course coordinators completed both interviews for the study. These course coordinators were associated with four out of nine faculties: Science, Humanities, Business, Architecture and Visual Arts, (that is 5) and included both

**Table 2** Elements of MISL associated with learning designs across the nine courses in the study

| Faculty | Course | Innovation incorporated into learning design | Element of MISL | | | | |
|---|---|---|---|---|---|---|---|
| | | | Access to information & resources | Support & motivation | Participation & collaboration | Assessment & feedback | Knowledge construction |
| Architecture, landscape and the visual arts | A1 | Peer and UC feedback | ✓ | ✓ | ✓ | ✓ | ✓ |
| | A2 | Building an online community | ✓ | ✓ | ✓ | ✓ | x |
| Business | B1 | Visualising course | ✓ | x | x | X | ✓ |
| | B2 | Embedded online annotated lectures | ✓ | ✓ | x | ✓ | x |
| Engineering, computing and mathematics | E1 | Online quizzes | ✓ | x | ✓ | X | x |
| | E2 | Interactive Video | ✓ | ✓ | x | ✓ | ✓ |
| Science | S1 | Online-quizzes | ✓ | x | x | ✓ | ✓ |
| | | Flipped class | X | ✓ | ✓ | ✓ | ✓ |
| | S2 | Pre-lab video | ✓ | ✓ | ✓ | X | ✓ |
| Education | E1 | Pre-seminar quizzes | ✓ | ✓ | x | ✓ | ✓ |
| | E2 | Online Lectures | ✓ | x | ✓ | ✓ | x |
| Arts | A1 | Group project | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Critical self-reflection | X | x | x | X | ✓ |

✓—learning design is associated with specified MISL element, x—learning design is not associated with specified MISL element

**Table 3** Courses, enrolments and proportion of students in each course responding in the study

| Faculty | Course | Number of students enrolled | Undergraduate (U) or post-graduate (P) | Students responding to questionnaire no. (%) | SURF respondents no. (%) |
|---|---|---|---|---|---|
| Architecture, landscape and the visual arts | A1 | 12 | P | 4 (33) | 6(50) |
| | A2 | 108 | U | 62 (57) | 41(38) |
| Business | B1 | 317 | U | 99 (31) | 117(37) |
| | B2 | 262 | U | 39 (15) | 84(32) |
| Engineering, computing and mathematics | E1 | 136 | U | 57 (42) | 54(40) |
| Science | S1 | 107 | U | 50 (47) | 41(38) |
| | S2 | 302 | U | 119 (39) | 82(27) |
| Education | E1 | 28 | P | 21(75) | 15 (52) |
| Arts | A1 | 137 | U | 101 (74) | 59(43) |
| Total | | 1409 | | 552 (39) | 499 (35) |

(1) Percentages rounded to nearest one percent. (2) SURF: University-wide Student Unit Reflective Feedback survey

undergraduate and post graduate programs, with enrolments ranging from 12 to 317 students (see Table 3).

All students from each of the nine courses were invited to complete a customised online questionnaire, which was deployed through the LMS, with students having up to two weeks in which to respond (after ethics approval). In addition to the invitation by email and in the LMS, course coordinators also advised students about the study during lectures, emphasising that it was being conducted to assess and improve the course designs. A sample of the questionnaire from one of the courses is included in Appendix 2. Items in the student survey questionnaire required a response to statements on a five-point Likert scale: 1 (strongly disagree), 2 (disagree), 3 (neither agree nor disagree), 4 (agree), and 5 (strongly agree). The open-ended questions elicited qualitative responses, which enabled us to evaluate the level of agreement or disagreement with the statements. The questionnaires were deployed through Qualtrics, an online survey management tool. The semester-long study comprised data from several sources, as determined by the research questions (see Table 4).

### 5.3 Analysis

The first structured interview with each course coordinator was conducted early in the semester, the second at the end of the semester. All interviews were tape recorded, transcribed, and thematically analysed using Braun and Clarke (2019) six-stage process of familiarisation, coding, generating themes, reviewing themes, defining and naming themes and write-up. All open-ended responses from the students' survey were thematically analysed. The two interview frameworks and transcription procedures are summarised in Appendix 1. The transcripts were closely examined to identify common emerging themes, ideas, and patterns from the responses. This was done through a process of data reduction,

**Table 4** Data sources associated with each research question in the study

| Research questions for study | Data sources | | | | |
|---|---|---|---|---|---|
| | Course coordinators | | | Students | SURF (n = 499) |
| | Interview 1 (n = 11) | Interview 2 (n = 9) | Closed items (n = 552) | Open items (n = 552) | |
| 1. Which revised designs were implemented? | ✓ | x | ✓ | X | x |
| 2. How did the revised designs affect the student learning experience? | x | ✓ | ✓ | ✓ | ✓ |
| 3. How might the revised designs be improved? | x | ✓ | x | ✓ | x |
| 4. What are the implications for the course design process? | ✓ | ✓ | x | ✓ | x |

✓—Specified data source informs this question, x—specified data source does not inform this question

**Table 5** Representation of level of impact for redesign on elements of MISL—CC data and student data

| MISL | Data source | | | | Overall |
|---|---|---|---|---|---|
| | Course Coordinator (CC) | | Student Questionnaire | | |
| | Interview 1 *(Expected)* | Interview 2 *(Observed)* | Closed items | Open items | |
| Access to information and learning resources | ✓ | ✓✓ | ✓✓ | ✓ | ✓✓ |
| Support and motivation | ✓✓ | ✓✓ | ✓✓ | ✓✓✓ | ✓✓ |
| Participation and collaboration | ✓✓✓ | ✓✓ | ✓✓ | ✓ | ✓✓ |
| Assessment and feedback | ✓ | ✓✓✓✓ | ✓✓ | ✓✓✓ | ✓✓✓ |
| Knowledge construction | ✓ | ✓ | ✓✓ | ✓ | ✓ |

Level of impact: ✓—very weak or none, ✓✓—some, ✓✓✓—strong, ✓✓✓✓—very strong

organization, and interpretation. We adopted an inductive approach, allowing the responses to dictate the themes. The transcripts were carefully reviewed initially to gain an overview of the responses, then coded by highlighting sections of the responses, ideas, phrases, and sentences that were common, and grouped in tables. Broad themes were then generated and subsequently divided into sub-themes of patterns and ideas. We then reviewed the emergent themes and sub-themes by revisiting the transcripts to compare and ensure that they were accurate representation of the responses.

All data captured in the Qualtrics were exported to the Statistical Package for Social Sciences (SPSS v.23). Initial exploratory statistics were generated to gain understanding of the data outcome, and to identify which outliers would affect its interpretation. Once the outliers were generated and cleaned-up, all items explaining the constructs were combined, and the Means and Standard Deviations for the 5 categorised constructs were generated, as shown in Table 5 below. For construct validity of the survey questions (quantitative data), Cronbach's Alpha was computed for each item to ascertain the similarity and contribution of each construct to the total variance observed (DeVellis & Thorpe, 2021). After deletion of inconsistent items, the scales demonstrated good internal reliability, with a Cronbach Alpha coefficient range of between 0.76 and 0.93, and a mean scale between 3.18(SD = 1.27) and 4.86(SD = 0.31). Overall, the totals and subscale scores correlated significantly. For the open-ended questions (qualitative responses), the pilot responses were compared with survey responses to verify reliability. Responses to items on the five-point scale were re-categorised into two groups by combining and recoding student responses 1 to 3 as 1 (not satisfied) and responses 4 and 5 as 2 (satisfied). The relative proportion of student responses in each of these two categories was used to inform the study of the degree of student satisfaction with the innovations implemented by course coordinators in the course redesigns.

The course coordinators were provided with the mean score for their course on each student's Unit Reflective Feedback item, together with the mean score for the same items for their faculty and the whole university. For the nine courses in this study, 35% (499) of the total students enrolled (1409) participated in the students' feedback questionnaire (Table 2). All student data collected by the course coordinators were summarised, presented graphically, and subsequently used as a focus for discussion between the research team and the course coordinators during the second interview of the study. The purposes of this discussion were to interpret the data, and to use the interpretation as a guide for the design review and any further actions.

## 6 Results

### 6.1 Pre-implementation Interview with Course Coordinators—RQ1

In this interview, the course coordinators were asked about their learning at the university-provided learning design workshops, the innovations they planned to implement, the outcomes expected for the innovations, and any anticipated barriers to their implementation (see Appendix 1b). The course coordinators gave several reasons for participating in the design workshops. Four course coordinators cited active encouragement from a supervisor, and several others acknowledged the value of particular workshop promotional strategies. The innovations planned by course coordinators included: uploading recorded lectures to the LMS with an associated quiz (3); creating pre-laboratory activities and a briefing video for students (3); using online discussion forums [including Facebook] (1); redesigning assessment structures and tasks (1); and redesigning aspects of the LMS to be interactive, including digital submission and digital assessment of tasks (1). Some course coordinators (4) were of the view that the innovations they planned to introduce would give the students the opportunity to access interactive learning resources to support their learning anytime, anywhere, and become more engaged in learning activities.

Course Coordinators hoped to achieve through their teaching innovations the following improvements: better student communication with peers (7), better student attendance in face-to-face classes (5), more collaborative student projects and learning activities (4), stronger student engagement with course materials (2), better student achievement (grades) (2), a clearer understanding [for course coordinators] of what it means to be innovative (2), course coordinator assessment efficiencies (1), more student enjoyment of the course (1), stronger student critical thinking skills through reflection (1). Based on these expectations, a representative summary, using the five elements of the model, is presented (Table 5). The summary shows that improved participation and collaboration, followed by increased support and motivation, were the two most common intentions of course coordinators for their course redesigns. The general observation was that course coordinator were optimistic about how digital technologies could be used to support their teaching and students learning, considering the complexities of cohorts of students. These observations indicate the willingness of faculty to adopt reforms, in contrast to the observations made by Hoidn (2016). The course coordinators attributed willingness for adoption and use of the digital resources to the availability of support from learning designers, educational technologist, liaison librarians and educational researchers. Anticipated barriers to the implementation of course coordinators designs were limitations of the LMS (6), students' reluctance to engage and inability to adjust to digital learning technologies (3), course coordinators' lack of proficiency with digital technologies, including the LMS (3); and course coordinators' workload and time management, which precluded them having sufficient time to redesign courses (5).

### 6.2 Post-implementation Interview with Course Coordinators—(RQ2)

Generally, the course coordinators considered their teaching innovations were successful and felt confident and encouraged to further develop their courses. Seven of the nine course coordinators claimed they had met their innovation objectives, whereas the other two expressed some disappointment with how students had responded to their redesign, although they felt the students enjoyed it. Broad themes of satisfaction that emerged from their responses were: improvements in quality of student group project work; alignment of course learning activities, assessments, and outcomes; and the course mean score in the student feedback questionnaire. Areas of disappointment described by course coordinators comprised: a decline in student attendance in flipped classes (face-to-face sessions) as the semester progressed; decreasing student participation in online quizzes over the semester; poor student response to a specific teaching approach; increased lecturer workload; and for courses that had lectures recorded and uploaded, a decrease in student attendance at face-to-face sessions. Here are two sample responses.

> Judging from the students' comments in the survey, I think the redesign largely worked, but some tweaking needs to be done around the use of SPARK, including the weighting of the final SPARK (an online peer assessment tool) in week 13, and how the three SPARK scores are used to generate a grade that more clearly separates process from product in the design project. The other noticeable benefit of the changes was that the general quality of the design projects has improved, with most students better able to recognise the importance of the unit's focus on hard-copy interactive designs. (course coordinator-CM-1)
>
> The responses to all aspects of the student experience were highly positive, in keeping with the normal level of student satisfaction in this unit. Next time I will link lectures, activities, and quizzes more explicitly for students. (course coordinator-M/SE-4)

These further observations were made by the course coordinators about specific activities: quizzes proved to be an effective replacement for a mid-semester exam; insights were gained into why some students failed to complete online quizzes; quizzes helped students keep up with their reading commitments; and online activities effectively supplemented in-class learning activities. A symbolic summary of the impact of the redesigns implemented, on the five elements of the model, is presented in Table 5. Overall, course coordinators considered that the learning experience element most positively impacted by the redesigns was assessment and feedback. Hence, we attribute the overall effectiveness of student-centred learning to course coordinators' ability to provide students concise and accurate feedback to queries they may have to clarify their understanding of constructs or topics.

In response to the study data (outcome), all course coordinators stated that they intended to adjust course designs for subsequent semesters, such as providing more targeted feedback to students; better preparing students for challenging content and workload demands; and accessing LMS data analytics that would show frequency and duration of student engagement with media they had uploaded. Some course coordinators hoped to get more feedback from students on learning activities which they (the students) considered of value. Further intentions from course coordinators comprised:

- provide clearer directions to students on the use of social media
- improve team building and group work
- identify and assist specific students with digital technologies
- integrate online activities
- adapt in-class activities and assessments
- reduce opportunities for collusion on quizzes
- make quizzes more enjoyable
- establish themes to provide more coherence in the course topics
- investigate why students did not attend the flipped classes

course coordinators identified the following types of support needed to improve future course design:

1. training in creating online assessment rubrics
2. provision of more automated assessments tasks
3. assistance with using learning technologies more effectively to support students learning outcomes
4. help with improving online activity design, integrating sample exam questions into course activities, rebalancing the mix of delivery modes within a blended approach, and reducing the content required in the course
5. instruction on blogging options, recording more lectures
6. advice on provision of additional readings prior to lectures and on developing a digital database of images for an architecture course.

After reviewing the questionnaire data with the course coordinators, one course coordinator put a number of immediate actions in place and subsequently reported a positive shift in student engagement using revised online learning activities. According to the course coordinators, students were observed to enjoy the interactive online lectures and reflection together with the use of simple exemplar questions aimed at helping them to refresh their understanding of the lectures.

Pre and post implementation observations suggest that course coordinators' ability to support effective learning is not limited to the adoption of appropriate pedagogies but also the appropriate use of those technologies and the effective management of students' motivation to engage consistently with the tools and their learning. Aside from workload issues and time constraints, significant to the challenges experienced may be the selection of the appropriate DT tool to support learning activities effectively, keep up with student queries and monitor online activities. These course coordinator experiences agree with Mwalongo and Mkonongwa's (2021) suggestion that staff need support for the effective integration of digital technologies in teaching and learning. The issues evident require a holistic and institution wide approach for the effective integration of DT tools in teaching and learning.

Course coordinators found the workshop activities helpful, explaining that, it helped their understanding of how learning activities they select effectively support students learning experience, in line with their teaching philosophy. Drawing on the thematic analysis and workshop benefits, we made 5 key observations, Firstly, although significant mention was made of student-centred learning and active and blended learning, their effective implementation was a challenge to most, if not all, of the course coordinators. The question of how DT tools can be used to support these learning approaches was of significance to course coordinators. Secondly, most of the course coordinators (35/42) had challenges with clearly explaining the teaching and learning philosophies that supported the approaches they were adopting for their practice. Thirdly, some learning activities and assessment types were adopted without clear alignment with the course learning objectives. Fourthly, some course coordinators had difficulty clearly defining the learning activities that supported effective learning. Finally, the LMS was used by most course coordinators as a repository for learning objects such as reading materials and videos without the use of interactive activities. These issues were all resolved during the design session in the workshop.

### 6.3 The Student Responses

Overall, students reported a positive response to their learning experience. Data from the students' feedback questionnaire were collected in eight of the nine courses, showing that the architecture and education postgraduate courses had feedback mean scores of 3.8 and 3.9 respectively—close to the maximum of 4.0; and, of the remaining six courses, four had mean scores for both items at or above the university mean of 3.2, and the remaining two had means of 3.0 and 3.1. These scores suggest the range of students' satisfaction with the innovations. Two samples of students' perception of innovation are:

> The flipped lectures were a great way to learn and understand the content of the unit. It meant I was more inclined to watch the lectures and it gave me the opportunity to fully understand it in the class discussions. (SB-12)
>
> The pre-lab activities were very helpful in preparing for the laboratory and review workshops and it was great to have two attempts and be able to see where I went wrong between attempts. Labs have also been more enjoyable/less stressful where I can just focus on completing the experiment and then can take the lab sheet home to complete. (SChe-6)

The overall survey response to Research Questions showed significant students' satisfaction in all categories of the model, with mean scores greater than 3.0 (Table 6).

The highest mean score for the statement "The teaching and learning activities introduced in the course helped me study independently" was 4.8 (Education) while the

**Table 6** Students response to module for improving the students learning experience (MISL)

| | Maths education | | Science education | | Media studies | | First year chemistry[b] | | Electronic material[b] | | Landscape and visual arts | | Marketing research[b] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| | N = 21 | | N = 21 | | N = 100 | | N = 116 | | N = 44 | | N = 49 | | N = 99 | |
| AIR[a] | 4.9 | 0.30 | 4.88 | 0.33 | 3.34 | 0.95 | 3.73 | 1.23 | 3.43 | 1.01 | 3.96 | 0.71 | 4.35 | 0.82 |
| SAM[a] | 4.9 | 0.31 | 4.76 | 0.54 | 3.70 | 1.02 | 3.49 | 1.07 | 3.46 | 1.16 | 3.94 | 0.83 | 4.26 | 0.79 |
| PAC[a] | 5.0 | 0.19 | 4.76 | 0.56 | 3.85 | 0.90 | 3.69 | 1.32 | 3.57 | 1.00 | 3.71 | 1.15 | 4.11 | 0.85 |
| ASF[a] | 4.8 | 0.46 | 4.65 | 0.87 | 3.59 | 0.93 | 3.67 | 1.05 | 3.18 | 1.27 | 3.58 | 1.05 | 4.07 | 1.01 |
| REF[a] | 4.7 | 0.45 | 4.58 | 0.59 | 3.32 | 0.94 | 3.34 | 1.14 | – | – | 3.61 | 1.08 | 3.83 | 0.78 |
| KNC[a] | – | – | – | – | 3.84 | 0.97 | 3.40 | 1.22 | 2.82 | 1.09 | 3.18 | 0.79 | 3.09 | 1.07 |
| INDP | 4.85 | 0.31 | 4.73 | 0.46 | 3.59 | 0.92 | 4.14 | 1.05 | 3.20 | 1.05 | 3.77 | 0.88 | 4.09 | 0.80 |
| DTEC | 3.65 | 0.30 | 3.86 | 0.96 | 4.07 | 0.70 | 3.36 | 1.38 | 3.91 | 0.84 | 4.24 | 0.78 | 3.77 | 0.96 |

[a]Common but varied items describing the MISL from the different survey instruments for 7/9 implemented courses, [b]combined unit mean scores

REF and KNC are separated where CCs wanted to see difference in satisfaction

lowest was 3.20 (Engineering). For the statement "I feel confident to use the digital technologies to support my independent learning" the highest mean score was 4.24 (Architecture) and the minimum score was 3.36 (Chemistry). The model was employed to categorise all responses from the student questionnaire according to how the learning designs affected students' learning experience (Table 5). Over the entire study group, the student response rate was 39% (552 students) of the total enrolment in all nine courses (1409 students) (Table 3). Students' responses to specific innovations tended to show a lower level of satisfaction than for the course overall. Here are two examples:

> Multiple choice questions are good for understanding the content, but to test their understanding of the content it's important that students get exposed to exam level questions. (SE-5)
> I feel as if this may not be necessarily relevant to students' future careers. While games are fun and there are game mechanics and functions of play within all forms of life, this doesn't necessarily constitute a reason to base a whole university unit on them. (SC-15)

The two aspects of the learning experience that students were most dissatisfied with were access to information and resource, and support, motivation and knowledge construction. Other areas of concern were technical difficulties with some digital resources or websites, digital learning resources being of an inferior standard, and lack of alignment of the course learning outcomes with its learning activities and assessment. Some negative feedback from individual students' experiences on their courses (normally 1 or 2) appeared to be demoralising to some of the course coordinators who appeared to have given their best. It was our view that course coordinators took a wholistic view of the responses in light of the entire class, effectiveness of their teaching philosophies and how the learning outcomes aligned with the assessments and learning activities. In two of the courses (Biology and Education), it was established that, by clearly separating and describing learning resources that helped the students to directly or indirectly achieve the learning outcomes, partially achieve the learning outcomes, and resources that provided additional information, the students expressed high satisfaction of their experience.

The students' open-ended responses in the study questionnaire identified ways and means for improving the learning design for particular courses, such as: the need for course coordinators to acquire adequate skills to select, develop, and effectively incorporate appropriate digital tools in the LMS; construct well-scaffolded learning activities—particularly in enabling knowledge construction; sequence the learning activities and organise resources in the LMS; create video recordings to a sufficient standard; manage group learning activities in face-to-face sessions to maximise participation; construct and coordinate the learning activities for a blended learning mode; and construct assessment strategies to ensure fairness. The responses outlined above are summarised using the five elements of the model in Table 5. There were varying emphases on each of the five elements. For example, most course coordinators in their second interview identified assessment and feedback as having the most positive impact on students. In their open responses, students regarded assessment and feedback as the elements most helpful in the redesigned courses they took. Whereas support and motivation were noted by only four of the course coordinators in their designs (Table 3), most students and course coordinators reported significant level of impact on this element of the learning experience (Table 5).

# 7 Discussion

## 7.1 Effect of New Designs on Student Learning Experience

This study was conducted to explore the effect of teaching and learning innovations involving DT tools. In this section we discuss the ways in which the new learning designs affected the student learning experience. the model was used to frame the aspects of the innovation in which students considered an improvement to their conceptual understanding and knowledge during the period of the study.

Access to information and resources is deemed a fundamental element of the student learning experience (Barneva et al., 2019). Connecting course coordinators with faculty librarians who exposed them to effective ways of guiding student access to learning materials and authentic open educational resources was appreciated to be helpful by the course coordinators. Satisfaction expressed by both course coordinators and students in the provision and access to authentic learning resources that support learning outcomes can be linked to Lee and Hannafin (2016) student-centred learning assumption that, students' understanding would be supported when cognitive processes are augmented by adequate resources through technology. This is further supported by student responses that indicate that video resources, journal articles, reference books and other materials were of value to their learning. We observed that when adequate learning resources are provided with clear directions and tailored to meet student needs and learning outcomes, increased student satisfaction may occur (as shown in Table 5) a position that is supported by Oliver (2000). Student responses in this study indicate that while some resources were considered valuable, others were lacking for example one student commented that "*Resources provided prior to in-class sessions were not linked clearly to the course topic, making it difficult for us to prepare well for class" (SB-9)*. Courses with feedback concerns related to the clarity of instructions, constructive alignment and other issues were fixed by the course coordinators and used to improve the design and packaging of learning resources to the students. Perhaps, a significant lesson learnt was that student misconceptions could easily occur when the clarity of instructions for resources was not carefully checked before being posted online. We suggest the careful checking of these instructions, bearing in mind the different categories of students (domestic and international) taking the courses.

Some responses from course coordinators revealed that, providing and sustaining support and motivation to students in an online learning environment requires on-going monitoring and engagement with them to see how they are progressing which they found very time consuming. On the other hand, most students expressed satisfaction with the support and motivation they received from the course coordinator. Significant to this was the feedback they received on assessments, through forums, and prompt email responses that encouraged their learning. These experiences are consistent with the student-centred learning assumption that teaching that stimulates, motivates, encourages and supports students to learn, as individuals (Lee & Hannafin, 2016),(Mishra, 2020), can improve their learning experience.

Students generally considered support valuable in building a productive learning environment for reflection and knowledge construction, and that it provided them with the confidence necessary to contact the course coordinator and their peers, either electronically or directly. In one course, for instance, students felt well supported and motivated by the course coordinator's enthusiasm and prompt response to student queries. This was also the case in another course that used social media (Facebook) in the course design to engage students. Students also reported that good peer support encouraged their participation in the course. These findings support the evidence in the literature that peer learning in a supportive environment can scaffold and enhance students learning outcomes (Boud & Knights, 1996b; Herrington & Reeves, 2011). As the students collaborate with peers and course coordinators online, their intrinsic motivation increases through the satisfaction they gain from this engagement, which, according to Shonfeld et al. (2020), would affect their attitude towards the use of the technologies that support their learning.

Student participation in activities and collaboration with peers to solve problems were key aims identified by most course coordinators for their course design. In describing their course designs, course coordinators commonly identified increased student engagement in blended learning as a primary driver behind their design. In three of the courses, the face-to-face sessions had been redesigned to include what is often referred to as a 'flipped' approach which was anticipated to encourage higher levels of attendance at the on-campus classes. The course coordinators response revealed that while the initial response in attendance was high, it declined by about 20% throughout the duration of the course. Open responses from the students attributed such declines to competing timetable clashes. The participation and collaboration element of the model reflects the social constructivist theory that learners construct meaning from experience, including discourse and collaborative activities with others (Henson, 2003; Von, 1996). It recognizes too, that in a blended-learning environment, social inclusion is important in maximising participation in shared learning experiences (Vygotsky & Cole, 2018). Given the students responses that the course coordinators and learning activities of units they were enrolled in motivated their participation in class learning activities, it is evident that the course coordinators design of the student learning is key to engagement. The high levels of student satisfaction within elements of the model, as shown in Table 5, could also be explained by the group work incorporated into the course redesigns, which was enjoyed by most of the students. Working in groups afforded students the opportunity to learn from peers, particularly in the flipped classroom designs. In addition, after the first few weeks, the initial response from students about their impressions of the course enabled course coordinators to identify strategies to increase interaction between students, such as through online discussion using a popular social media platform. We therefore argue that while independent learning is important in a student-centred learning approach, collaboration and peer support enhance effective student-centred learning.

As outlined in the literature review, learning occurs best when varied representations (including assessment and feedback) are supported to foster independent learning (Lee & Hannafin, 2016). Students expressed satisfaction in relation to assessment in which they got formative feedback which was helpful in improving their learning compared to summative assessment where they got grades as feedback. This is supported by Dutton et al. (2017) who found formative feedback to be more valuable for student learning.

The model recognizes the value of formative assessment for timely and well targeted feedback. Both students and course coordinators reported a positive impact from this element with students emphasising the importance of receiving feedback for completed tasks and for identifying ways for improvement. The overall minimum Mean score of 3.18 across all units suggests how significantly students value formative assessment in student-centred learning. Knowledge construction, as an element of the model, further reflects constructivist learning theory. We therefore agreed with Boud and Knights (1996a) findings that course designs should provide students the opportunity to clarify their understanding of ideas by introducing a framework or model to aid thinking about reflection. One significant observation in our study was that course coordinators expressed satisfaction with improvements in the standard of projects from student group work. Overall, however, knowledge construction was the least reported (of the five elements) as revealed in Table 5, of student satisfaction. Many suggestions were made by course coordinators and students about specific improvements in course designs, however findings from the study data indicate that there is a need for further professional development (PD) for course coordinators. Our data suggests that PD should focus on increasing course coordinator capacity to: developing learning designs that target student knowledge construction, the selection and development of suitable digital tools within the LMS, the development of video resources to suitable standards, and the clear communication and alignment of course outcomes to activities and assessments to students.

## 8 Implications

### 8.1 Course Design Process

Course Coordinators found data from the study helped them to reflect on their course design and the student learning experience. Our framing of the study data, using the six elements of the model, enabled course coordinators to readily translate data into design changes for their courses. For students, it provided an opportunity to reflect on their approaches to learning and to generate specific feedback for the course coordinator. This approach helped create an awareness of course design improvement that focusses on key aspects of the student learning experience. In summary, the study findings describe.

- an association between course redesign by course coordinators and their earlier participation in learning design workshops

- a broad range of initiatives, including online activities (quiz, video) that enable a flipped approach and the use of social media for collaboration and online peer feedback
- a high level of satisfaction by course coordinators with changes made to their learning designs
- reservations by course coordinators about the capacity for some students to engage in a digital learning environment, and for the level of attendance of students at face-to-face classes
- design elements targeted by course coordinators for improvement in the next iteration of their course were improved communication with students, constructive alignment, and better use of digital media
- a positive response by students to their learning experience, particularly for improved access to information and resources, support and motivation, and assessment and feedback
- lower levels of satisfaction expressed by students in relation to knowledge construction and participation and collaboration
- workload issues that may arise from effective online teaching would require effective management of such workload

### 8.2 University Policy

This study presents some of the teaching and learning innovations that occurred within the university during the period of the workshops conducted by its teaching and learning centre in 2016, and still relevant in contemporary COVID context and proliferation of online teaching and learning. We consider that benefits to the student learning experience from these course design innovations will be optimised when there is coherency in curriculum design within each faculty. Without this coherency, designs introduced by a specific course coordinator may be considered by students as solely idiosyncratic, as their experience in other courses does not reflect a similar level of innovation or pedagogical approach. Thus, if there is wide variation in design approaches used by course coordinators in a faculty, a diminished learning experience for students overall is likely to result. Consequently, we consider that coherence in curriculum policy is important for the whole university. If this policy is explicit in describing standards for student-centred learning, e-pedagogies and active learning designs particularly in the ongoing COVID conditions it will provide students with a more coherent learning experience for the duration of their study program.

### 8.3 Future Evaluations

During the redesign and evaluation process, course coordinators were encouraged to reflect on the objectives for their learning design innovations. These reflections were observed to be helpful for course coordinators in describing the intended change, identifying obstacles, and formulating plans to respond to the obstacles. It was clear that a participatory research approach has the potential to benefit course coordinators in their acquisition of implementation skills for teaching innovations, and students in their capacity to become active and independent learners. These findings in using the model as a tool for evaluating learning innovations in turn will inform judgements by course coordinators and students about future innovations.

## 9 Conclusion

In this paper we set out to evaluate the impact of incorporating digital technologies into learning designs for the enhancement of students' learning experience in a Western Australian university. We found that a participatory research approach enabled course coordinators, along with supporting staff, a small research team, and the participating students, to benefit from being involved in this evaluation. The students generally responded favourably to the innovations and the course coordinators overall felt that the objectives of these innovations were achieved. The learning model was useful in the analysis of the data, providing a framework for categorising course coordinators' intentions, interpreting student responses, and identifying focus areas for course coordinators to review and improve their course designs. However, two of the five model elements—participation and collaboration and knowledge construction—were regarded by students as barely affected by the course redesigns in the study. These two elements were adopted by some course coordinators as goals for improvement in their subsequent designs, but clearly further curriculum development and research on these elements is warranted.

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