Using technology to enable flipped classrooms whilst sustaining sound pedagogy

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This paper initially provides an understanding of what constitutes a flipped classroom model. It then provides a series of four case studies that describe the application of some different flipped classroom approaches to university courses, largely mediated by the use of online learning technologies. It demonstrates that these flipped classrooms are informed by constructivist pedagogy and highlights the role university teachers can play in facilitating their students' engagement with learning. It also highlights that to be successful in this transition to a new mode of learning requires both a holistic institutional planning approach, one based within a coherent student learning journey model, and sustained development by a team of centralised support staff, including technology experts, librarians and learning designers. The paper concludes with a discussion of the implications associated with adopting a flipped classroom approach.

Keywords: Flipped classrooms, technology, changing practice, Student learning journey

Introduction

This paper provides an analysis of four case studies that clearly demonstrate the affordance of technology in enabling a coherent model for the sustained use of flipped classrooms in a largely blended delivery model of university level courses and programs. It does this by first providing a description of the flipped classroom methodology and then demonstrates how flipped classrooms can introduce a parity of learning experiences for both on- and off-campus students, in a manner that blurs the distinction between these different modes of learning. Clearly framed within a constructivist pedagogy, this paper details with the application of learning technologies and the role university teachers can play in facilitating their students' engagement with learning.

Each case study describes, from a different perspective, the change leadership processes required to lead an institution from a delivery model based on traditional lectures and tutorials to a flipped classroom model and a transformed approach to student engagement. It demonstrates the importance of adequately preparing both teachers and students for participating in flipped classrooms. It also highlights that to be successful in this transition to a new mode of learning requires both, holistic institutional planning based within a coherent student learning journey model and sustained development of resources by a team of centralised support staff, including technology experts, librarians and learning designers. However, all this would potentially fail if not supported by a solid infrastructure of learning technologies that can be used to facilitate active and interactive learning in the online space. The conclusion drawn by this paper is that the flipped classroom is a useful summary concept that can facilitate real change.

Setting the stage

The flipped classroom approach has become an increasing popular approach for the re-visioning of student learning opportunities in universities, particularly since the widespread adoption of online learning environments has made it much easier for students to access information online and study independently of the traditional classroom. The flipped classroom approach is described in this paper through a series of four case studies, developed from current practice at the University of Southern Queensland (USQ) in Australia. This institution has specialised for many years in widening access to tertiary education through flexible, technology-enabled learning opportunities for all its students. With some 73% of it 27,000+ students studying off-campus and online, USQ has centralised much of it practice around the use of its Moodle learning management system (LMS), which is further supported by a suite of online tools such as, virtual classrooms, ePortfolios and multiplatform online media presentation systems.

The university also places a very strong emphasis on its student support systems, designed to foster a coherent approach to the student learning journey (Hunt & Peach, 2009). In broad terms there is a focus on the key categories of the USQ student learning context including, domestic students studying either in an on- or off-campus, or online mode, international students studying in Australia, or in their home countries, again studying in one of the three modes. For each of these groups planning focuses on ten key interaction points of the student learning journey (see Figure 1 below) from decision to enrol, through the first year learning experience, which is crucial to student retention and progression, and on to work-ready graduation, or preparation for further study (Sankey 2012), and all facilitated in the online space.

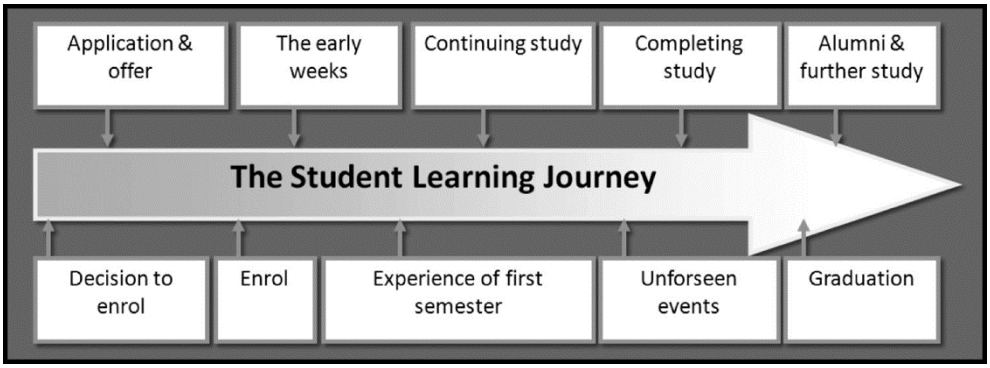

Figure 1. Key stages of the student learning journey (Hunt & Sankey 2013, p. 263)

Given USQs intense focus on off-campus and now online education that has been sustained for over three decades, it has been necessary not just to keep pace with developments in learning technologies, but to look for innovative ways in which to work in this online space. Its investment in learning technology infrastructure and methodology was described in generational terms by Taylor (2006) some seven years ago, and still rings true today. The first generation Taylor describes was the print based correspondence model, followed by the multi-media model that incorporated audio and videotape and computer-based learning. The third generation model, 'telelearning', adopted audio-teleconferencing and videoconferencing, while the fourth generation, flexible learning, engaged students with online interactive multimedia and internet-based access to resources. Taylor's final generation model is based on 'intelligent flexible learning'. Add to this mix computer mediated communication, using automated response systems and campus portal access to institutional processes and resources, and you have a pretty good picture of where USQ currently places itself within the higher education marketplace. All this to say that USQ has consciously planned an infrastructure of learning technologies designed to get the context right to support student learning. This is important because as Scott (2005) indicates, to learn effectively, students want, 'efficient and responsive administrative, IT, library and student support systems actively working together to support … operation[s]' (p. 13). For USQ, this is what underlies the ability to fully embrace a flipped classroom approach.

Flipped classrooms

The learning technology infrastructure and the planning processes at this university set the stage for this series of case studies based on USQs adoption of flipped classrooms. The term 'flipped' refers to the provision of tailored online resources and learning activities that facilitate student preparation for classroom study time which is then focused on application and consolidation. 'Essentially, what was traditionally completed at home as homework has been flipped to become the focus of classroom learning' (The Queensland Government 2012). Or as Pink (2012) puts it 'Lectures at night, "homework" during the day' (p.38). In simple terms, flipped university classrooms represent a move away from standard lectures and tutorials and a move towards

scaffolded learning experiences based on a series of activities and workshops, or by mediated online discussion. It makes sense, as Boyer (2013) noted, because 'It does seem ironic that so much time is spent in class 'teaching', and then students are sent home to struggle through the actual 'real work' on their own without any assistance'. However, this characterisation of 'home' work, or private study, as 'application' and 'consolidation' represents only half the story, because in universities, with or without learning technologies, private study has also been used as preparation for interactive discussion and analysis in class. However, the important feature of flipped classrooms is not that they are new, or that they represent a move away from traditional lectures, or even that they use technologies. Rather, the issue is that flipped classroom approaches combine pedagogy and learning technologies in ways that extend to large numbers of student's opportunities for deep learning through application and consolidation.

The flipped classroom is a form of curriculum design that shifts students from passive to active learning. It is designed to foster deep learning, which Angelo (2012, p. 99) defines as, 'learning that lasts and can be recalled and used effectively after the… [course] has been completed'. Flipping classrooms has been described as: 'providing students with a video that explains the concepts, structure and skills, so that when they get to class… they can get into a real 'workshop' of learning. In this way, the teacher is on hand to give practical assistance, check progress and pick up common errors' (Boyer, 2013, p. 28). Educause (2012, p. 1) also refers to the use of videos in flipped classrooms:

> Short video lectures are viewed by students at home before the class session, while in-class time is devoted to exercises, projects, or discussions. The video lecture is often seen as the key ingredient in the flipped approach, such lectures being either created by the instructor and posted online or selected from an online repository. While a pre-recorded lecture could certainly be a podcast or other audio format, the ease with which video can be accessed and viewed today has made it so ubiquitous that the flipped model has come to be identified with it.

However, the identification, or association of flipped classroom technology with video use is somewhat simplistic. It is also limiting pedagogically because there is a risk that the videos remain a didactic presentation of content because, 'You can't magically transform an ineffective lecture by transferring it to video' (ISTE 2012, p. 10). 'Dumping content' online via video or text is not much of a change from traditional university lectures. However, one analysis (ISTE 2012, p. 10) indicated that 'A glimpse of the videos shows … that these teachers are taking full advantage of the medium to create instruction that goes far beyond chalk and a blackboard'. In this context, the importance of the university case studies, described in this paper, is that the use of learning resources is varied beyond videos, as the teaching strategies are interactive and their resources extend to use of open source material. Further, the case studies demonstrate how learning management systems are used to provide opportunities for discussion and debate, both online and in class, in a melange that blurs the so called distinctions between 'home' work and classroom learning. They also show how off-campus students can benefit from the same levels of so-called classroom interaction as on-campus students. What the case studies demonstrate is that anytime-anywhere learning using a flipped classroom approach can facilitate equal learning opportunities for on-campus and off-campus students.

According to Educause (2012, p.1) 'The flipped classroom is a pedagogical model in which the typical lecture and homework elements of a course are reversed'. This definition of the flipped classroom, as pedagogy, accords with Hattie's (2009) thoughts about the need to 'Attend first and foremost to the fundamentals of effective teaching and learning, keeping pedagogy ahead of technology'. Reeves and Reeves (2012, p.114) summarised Hattie's (2009) meta-analysis of 'the foundational building blocks of any robust learning environment, be it a face-to-face, a completely online or a blended model'. Given that the results refer to any learning environment, they are applied here to flipped classrooms. The results show that effective learning is facilitated by:

- teacher clarity in explaining content;
- high academic challenge;
- time-on-task;
- timely feedback to students; and
- positive teacher–student relationships.

Among the least effective elements of teaching were:

- computer-assisted instruction;
- simulations and games;

- audiovisual methods;
- programmed instruction; and
- web-based learning.

It would appear that, when it comes to student learning, it's not what you've got, but the way that you use it (pedagogy) that counts. Accordingly, the case studies in this paper illuminate the effective use of technology and their integration with appropriate pedagogy and varied learning activities conducted in a manner that enhances student learning outcomes.

So what are the elements of pedagogy that have been identified with flipped classrooms? They normally include active learning and student engagement, both of which fall into the broad category of constructivist learning theory, which, according to Stewart (2012, p. 11): 'Emphasise[s] student-centred, active learning and the role of the teacher as facilitator. They include:

- an emphasis on students being active in constructing their understanding of knowledge;
- a focus on discovery, exploration, experimentation and developing and testing hypotheses;
- project work, research-based learning, problem- and enquiry-based learning methods (see Brodie 2012; Jenkins & Healey 2012);
- awareness of the learning process through use of reflective learning activities, self assessment and evaluation;
- the role of the teacher as a guide, providing 'scaffolding' to learning – that is, to ensure the student has the requisite knowledge, skills and support to negotiate a new piece of learning – and prompting the student through questioning or modelling.'

One final element in setting the stage for discussion of these case studies of flipped university classrooms concerns the role of the teacher, or lecturer. Goodwin and Miller (2013, pp. 78-79) noted that:

> Advocates of the flipped classroom claim that this practice promotes better student–teacher interaction. For example, Bergmann and Sams (2012) point out that when teachers aren't standing in front of the classroom talking at students, they can circulate and talk with students. If teachers use inverted classrooms this way, they are likely to better understand and respond to students' emotional and learning needs

In flipped classrooms, teachers become coaches, focusing more on facilitation than lecturing. This changed role was described by Hunt, Chalmers a Macdonald (2012, p. 27) as a shift from being a sage on the stage to a guide on the side, but, more importantly, to being a meddler in the middle:

> The shift in focus from didactic teaching, sometimes described as the 'sage on the stage' model to the 'guide on the side' model, has been challenged by McWilliam (2008) who argues that teachers should be 'meddlers in the middle'. These are teachers who challenge students to think and understand differently. To do this, university teachers need a repertoire of activities that will engage students actively in learning. Scott (2005) found in his study of nearly 95, 000 graduates that students appreciate a range of interactive classroom learning strategies such as buzz groups, debates, lectures and small group work for peer learning, independent study and negotiated learning.

The role of meddler and the variety of teaching strategies described here sits well with the flipped university classroom described in the case studies in this paper.

The four case studies described

The following four case studies of flipped university classrooms refer to three courses (or units/subjects/papers) of study and to the use of this methodology to progress flipping a whole degree program. These examples were chosen to represent different uses of the flipped classroom approach and to demonstrate how it has been integrated with students' needs at different points of their learning journey. For example, we discuss how Associate Professor Jill Lawrence uses the flipped classroom approach in an introductory nursing course on academic skills development, a course designed to prepare students for university study. Later in the learning journey, Steven Goh uses flipped classrooms to create authentic learning experiences that prepare students for professional life. The paper then discusses another model of flipped classrooms used by Eleanor Kiernan in a

core communications course used across multiple programs. In the final example, Associate Professor Karen Noble outlines what has been happening in the Education Faculty, in an ongoing journey to flip a whole degree program as part of a faculty initiative to move all their courses online.

Case studies normally draw on 'a number of data-gathering measures' (Berg, 2001, p. 225). Accordingly, the data for these case studies arises from two sources, a series of one-on-one interviews and documentary evidence. The four recordings that serve as the basis of these case studies are available online (Kiernan and Sankey, 2013, Lawrence and Sankey, 2013; Goh and Sankey, 2013; Noble and Sankey, 2013) under a Creative Commons, attribution, non derivative license. The purpose of these four case studies is to share 'well-documented experiences … not by blind adoption, but by critical adaptation' (Wals, Walker and Blaze Corcoran, 2004, p. 347). The purpose is to also engage with the transformative agenda of integrating learning technologies with constructivist pedagogy to enhance student centred learning.

Academic skills development

In her account of flipped classroom methodology in a first year nursing course focused on developing academic skills (Lawrence & Sankey, 2013), Associate Professor Jill Lawrence notes that students are provided with little content in terms of readings and lectures. Learning is activity-driven (e-tivities) (see Figure 2) and she utilises open-source resources, such as TED (www.ted.com) and YouTube, because, as she puts it, "There are gurus and experts all over the world". Jill therefore sees little point in reinventing the wheel by creating yet more resources. She makes available a series of short audio enhanced PowerPoint presentation each week to contextualise the forthcoming weeks work. The essence of each week's study lies in one to three student-learning activities. Each activity starts with a 'spark' (idea), then a stated purpose, and then she provides a stimulus, such as a YouTube video, then a task for students to complete, which usually take the form of a 100 word reflection about the activity. Each activity is closely linked to assignments so that students who fail to engage with the continuous learning associated with activities might find it difficult to complete assignments. They will also have little on which to fallback, because learning outcomes are vested in the learning activities and not in lectures, videos and readings; though these do add some value to learning.

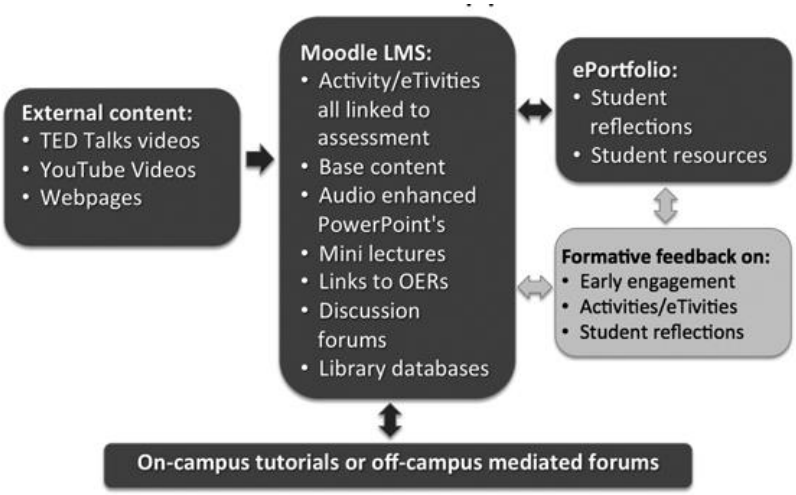

Figure 2. The flipped classroom model used by Lawrence

Early in the semester Jill has a learning activity that asks each student to interview a more experienced student to find out how they have successfully negotiated their university study. Students are also invited to respond to an electronic questionnaire about their learning style and to reflect on their own learning strengths and weaknesses. They are also asked to post on the discussion board, in the LMS, brief points arising from their activities. For example, after the first week of study they document their learning strengths and identify possible support people. Tutors working in the discussion groups provide early one-on-one feedback to students, and peer feedback is also invited. The outcomes of activities are discussed in class and in online discussion forums. Dr Lawrence reports that students, particularly mature-aged students, generally provide negative feedback about these online forums early in the semester, but most of them become more positive by the end of semester, once they have mastered the medium. She notes also a correlation between participation and success, and poses as her next challenge, innovations that will engage unwilling participants.

In her paper about empowering online pedagogy for commencing students Lawrence (2013, p.8) provides

evidence of student feedback indicating that the combination of discussion forums and e-tivities increases student engagement:

> *"For me the forums have also been an excellent way to interact with fellow students through the sharing of opinions and feedback. It made me feel like I was learning collectively with other students, much like a classroom situation (portfolio reflection)."*
>
> *"The use of short e-tivities and YouTube clips … has provided a positive experience for me because of the variety, which tends to keep my attention (forum post)."*

Lawrence (2013) believes this flipped classroom approach has been largely successful over a five-year period, but she acknowledges that this it an iterative process involving constant change, and that 'for a minority of students online engagement remains problematic' (p.9). This leads her to conclude that there must be an opportunity for students to be 'tracked and confronted explicitly' (p.9) when they are not fully participating, noting that she has identified a direct correlation between the level of online student engagement and the attainment of successful outcomes for the students in this course (Lawrence and Sankey, 2013).

Authentic learning

Steven Goh was inspired to flip his Materials Technology course to address the low engagement of students and what he perceived to be surface rather than deep learning. He wanted a shift to authentic learning pedagogy: 'from engineering science to engineering practice' (Goh & Sankey, 2013). He also wanted students to learn how to source databases of information (something they must do in the world of work), rather than rely on traditional study guides and textbook material. So he decided to 'introduce an authentic learning activity based on a true life case study' (Goh, Cochrane & Brodie, 2012, p.2). He now uses open source material, such as YouTube and TV programs that describe cases of materials failure. For example, in airline crashes, or in bridge building failures. He creates links to the world of work by inviting crash investigators to share their knowledge, and then he takes students on site visits. Initially students didn't like the course declaring that the course coordinator was not doing enough teaching. This resulted in Steven providing more scaffolding for the activities and resources, making it explicit to his students that his aim is to help them to become professionals (see Figure 3). Goh (2013, p. 2) believes that, 'if students are immersed in a rich and authentic professional environment with real-time input from industry practitioners, they are more engaged with the learning experience as desired and designed for'.

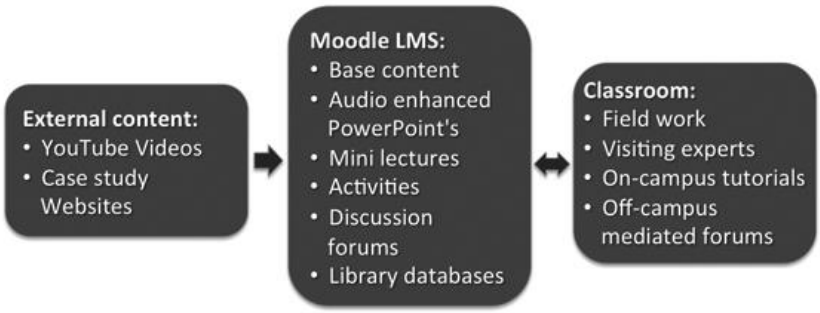

Figure 3. The flipped classroom model used by Goh

The flipped classroom approach in this Materials Technology course began in 2008 and, although early student feedback was negative, Steven pushed through, believing this to be a more authentic way to learn. This had been the first time something like this had been tried in his faculty and students were not used to it. They wanted traditional lectures and course materials. In response to this, Steven concentrated his efforts on preparing students for the new style of learning, noting that, "Students need somewhere to start". Essentially he set about managing students' expectations, not by giving them more reading materials, but by providing a series of short audio enhanced PowerPoint presentations in which he verbally deconstructs and contextualises his expectations (aspirations) for them. He does this by focusing their attention on the learning outcomes of the course and by establishing the relevance of the course to professional practice. Most importantly, he worked at establishing a credible relationship with his students though classroom and online discussion. Very quickly, he began to notice that traditional distinctions between on-campus and distance education (external) students began to blur. Oftentimes, on-campus students chose not to attend on-campus tutorials, electing instead to join-in with online discussions. On the other hand, Steven always made transparent when and where on-campus tutorials would

happen and many so-called external students decided to travel in to engage with his on-campus students. As a result of relationship building and the management of expectations, student feedback became more positive, thereby vindicating Steven's perseverance with flipping the classroom to create scaffolded, blended learning opportunities for students of Materials Technology.

Helping first year student's transition to study

Communications and Scholarship (Com Schol) is a Core course offered by the Faculty of Arts and used by other faculties as their basic course to introduce first year students to fundamental communication principles and academic writing skills. In 2005 Com Schol moved away from its traditional face-to-face delivery model, based on a two hour lecture and a one our tutorial, to a flipped classroom approach that did away with the lecture and focused rather on providing coherent media-rich resources upfront, along with a two hour tutorial (or online discussions). Eleanor Kiernan (Keirnan & Sankey 2013) believes this model is particularly well suited to communication style subjects. In this course the materials are provided upfront in the form of a self-contained online study package, heavily supported by the LMS. The package is in the form of a navigatable website that contains textual information and is heavily augmented by a range of pre-recorded interviews with experts, audio enhanced PowerPoint's, audio recording, interactive multimedia, quizzes, exercises, animations and readings. Both on- and off-campus students are expected to engage with these material prior to either coming to the two hour tutorial, or by participating in a series of facilitated online discussion forums (see Figure 4).

While the two hour tutorial for on-campus students briefly goes over some of the key points in the course materials, it is made very clear that the tutorial does not contain all the information they are required to engage with during the course. Typically the key concepts within in any given week's work are discussed in class, or online, in a context that relates directly to the students lives (personalised). This is an extremely new concept for many students and as this is, in may cases, the first course a student will do when coming to USQ, there is significant scaffolding provided to all the information the students require to be successful in this course. For the first time (in 2013) since Com Schol was flipped (2005), off campus students where provided their own discussion space, separate to the on-campus students. This allowed the tutors to fully focus on this cohort and run a series of online activities designed to replicate some of the activities that would happen in the on-campus tutorials. Kiernan believes this strategy has 'worked really, really well' (Kiernan & Sankey 2013).

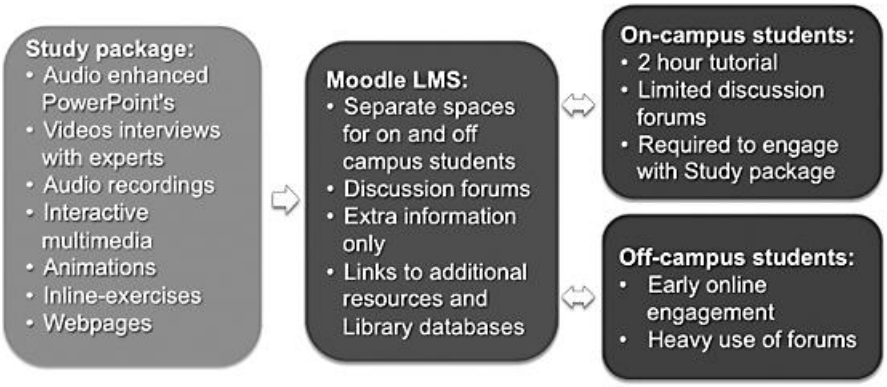

Figure 4. The flipped classroom model used by Kiernan

However, when asked to reflect on how this course has progressed over the years it was noted that 'Rome was not built in a day' and that it actually took a few years to build this course up to a point of its current sophistication. Having said that, this build-up has comes with a legacy; Kiernan believes there may now be to many resources and to many readings in the course, leading to some repetition of content. She believes that this could, inadvertently, lead to some confusion for the students, by them not knowing how to discriminate between all the resources.

Notwithstanding that, Kiernan also believes that putting in the effort upfront, in developing a coherent set of course materials, has paid dividends in the longer term. But she then warns against leaning on ones laurels, noting materials need to be checked on a regular basis. This is particularly true for the interactive and media based materials, those that are not text based – these need to be kept up-to-date. To help the materials stay somewhat current, Kiernan avoids information that may quickly date a presentation, such as mentioning dates and referring to current topical activities that may not be so topical in a year or so.

A flipped degree program

The Faculty of Education took an opportunity two years ago to begin the journey of flipping its 148 courses. Associate Professor Karen Noble and a number of key academics within the faculty have led this change and her story 'Flipping a Faculty' (Noble & Sankey, 2013) provides detail about change leadership processes that have proved successful in developing a flipped classroom model for the Faculty.

One motivation for flipping classrooms in the Education Faculty was to maximise the learning outcomes of students' on-campus time. The faculty wanted something better for its students than traditional lectures and tutorials. There were also concerns about parity of experience between on-campus and external students. Traditionally this parity had been achieved (somewhat dubiously) by capturing on-campus lectures and making these available to off-campus students. However, the quality was poor and it is was seen as less than engaging for students to listen to one-hour lectures online. A decision was taken to design for online study "first and foremost", creating a balance of synchronous and asynchronous learning opportunities for all students. Many courses are now largely process-driven by students' by using learning activities. They still have online lectures, but these are purpose-made and broken into short and sharp presentations described as "less naïve and more sophisticated". As this is an education faculty that trains teachers, it was deemed important to model good practice. Consequently many of the courses model critical reflection in a pattern of learning described as "deconstruct, confront, theorise and think otherwise".

Karen notes the importance of "institutional support and tools" in flipping classrooms in the Education Faculty (see Figure 5). Specifically she refers to the importance of designing these courses with the 'online first' approach. To achieve this the Faculty required strong support provided by the Learning Innovation and Technology Enhancement (LITE) teams. These teams are made up of learning and teaching designers, technology experts, librarians, and multimedia developers. However, their help is stretched thinly across the many demands of faculty staff. To help avoid this, a community of practice (Macdonald et al. 2012) was established in the faculty through which early adopters and mentor colleagues could model/demonstrate specific techniques and strategies that have worked for them in their flipped classrooms. This has resulted in a move from dependence to independence in the ongoing maintenance of many courses. Part of the change leadership involved re-educating students to the new process-driven approach. But the faculty is now at the stage where many students have only ever experienced the flipped classroom methodology. In other words it is fast becoming business as usual.

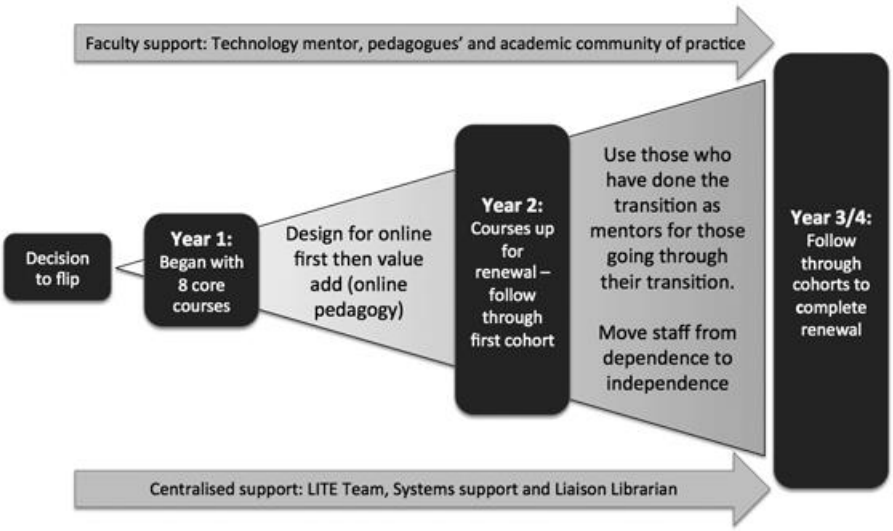

Figure 5. Change leadership strategy to develop program-wide flipped classrooms

Discussion

The four case studies described in this paper reveal common, successful elements in flipped university classrooms. Each demonstrates an effective integration of constructivist pedagogy while utilizing a range of learning technologies. All noted a shift from lecture driven courses to process-driven curriculum design, based on learning activities. This gave rise to a corresponding shift in the role of university teachers, as they now

became facilitators that guide student learning. The application of flipped classroom methodology to on-campus, distance education and online courses is of particular interest in these case studies, because it shows how this approach can create a parity of learning experience and provide opportunities for 'anytime, anywhere' learning for all students. The case studies also demonstrated the application of flipped classroom methodology to generic skills, such as academic and communication skills and reflective practice, and to discipline-based courses, such as materials technology.

These case studies have demonstrated how the implementation of flipped classrooms at USQ was aided by a well established infrastructure of learning technologies. It also revealed the extent of change leadership and professional development required to prepare staff to manage both the technology and the pedagogy of flipped classrooms. This remains a continuing challenge for the university, which it is managing by just-in-time support from technology experts, librarians and instructional designers. As Anderson (2008, p. 68) noted, the task is 'to choose, adapt, and perfect, through feedback, assessment, and reflection, educational activities that maximise the affordances of the Web'. In addition, as the Education Faculty case study illustrated, each faculty has at its disposal staff willing to pull in the resources, collaborate and to make change happen at course level. The lesson is that flipped classroom approach is most successfully implemented in an organization that fully supports this approach to teaching and learning.

Interestingly, some of the case studies revealed considerable student resistance to the use of a flipped classroom methodology. This challenge was addressed by a range of strategies to increase what Anderson et al. (2001) call a cognitive and social presence in all learning environments. A key strategy was to organise students into online or on-campus discussion groups, with an instruction to tutors to respond quickly to students. This accords with Kift's (2009) transition pedagogy to enhance first year learning at universities. For example, she noted that first-year students should 'receive regular, formative evaluations of their work early in their program of study to aid their learning and to provide feedback …on progress and achievement'.

Student retention rates are a challenge for all universities, not only because students who dropout of university represent a loss of income, but also because it is a lost opportunity for each student who leaves. The first year of study is a particularly vulnerable time for students. To address this, Kift (2009) identified a transition pedagogy that included the recommendation that 'the first-year curriculum … have strategies embedded to monitor all students engagement in their learning …to identify and intervene with students at risk of not succeeding'. This series of case studies demonstrated that the affordances of a flipped classroom methodology, in particular the use of a learning management system and appropriately designed and scheduled learning activities, increased opportunities for staff to monitor students because their access to learning resources can be recorded: 'Use of the medium in this way will permit instructors to conduct assessments with greater granularity. Teachers can embed questions throughout materials to determine when and where students begin to struggle' (ISTE 2012 p11). This aligns with the literature on discipline-based learning and threshold concepts because teachers can monitor students' understandings of key concepts before moving on. According to Land (2012, p.42), a threshold concept:

> may be seen as a crossing of boundaries into new conceptual space where things formerly not within view are perceived, much like a portal opening up a new and previously inaccessible way of thinking about something. Successfully negotiating a threshold concept allows the learner to access a transformed way of thinking and practicing, a fresh mode of reasoning and explanation and new understandings, perceptions, discourses and conceptual terrain, without which the learner would find it difficult to progress within a particular field of study.

Another strategy to address student concerns about flipped classrooms was to manage students' expectations by focusing on learning outcomes and by establishing the relevance of the course to students' professional lives, particularly through authentic learning activities and assignments, the distinctive feature of which 'is the recognition of the potential of the activity, context and purposes of work to develop high-level knowledge and skills' (Garnett 2012, pp. 165-166). As Reeves and Reeves (2012, p. 117) observed, 'it is much more effective to engage students in tasks that reflect the ways their knowledge, skills, attitudes and intentions will be applied in the real world'.

Conclusion

In conclusion, these case studies have described the application of flipped classroom approaches to a series of university courses. The discussion of these case studies has also shown that these flipped classrooms are informed by constructivist pedagogy, which is part of a long tradition in higher education dating back more than

a century:

> [It is a] philosophy of learning known as 'constructivism', essentially a theory that knowledge can be constructed only in the mind of the learner. This reflected much of Dewey's thinking and was … given a stronger foundation through Piaget's work. The onus was clearly shifting to the learner as the creator of understanding.' (Stewart, 2012, p. 7)

The case studies have also shown that at USQ the infrastructure of learning technologies deployed in flipped classrooms is part of a decades' old tradition of constant renewal occasioned by the university's focus on distance, and more recently, online education. This has positioned the university well for adopting a flipped classroom approach. Even so, the organisation has faced considerable challenges of change leadership in which the summary concept of 'flipped classroom' proved useful because it 'has encouraged dissemination … [and] because it is short and memorable' (ISTE 2012, p. 10).

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