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Radical transformation: re-imagining engineering education through flipping the classroom in a global learning partnership

Final report 2017

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www.uq.edu.au/teach/flipped-classroom/olt-transforming/index.html

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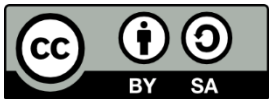

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Last but not least, we'd like to thank the OLT for taking the risk in supporting yet another overly ambitious research and development project. Your confidence in the team provided vital reassurance that the team's work is valued, which is sometimes all that is needed to ensure much needed educational reform continues.

List of Abbreviations

AAEE	Australasian Association for Engineering Education
ALTC	Australian Teaching and Learning Council
ANU	The Australian National University
ATN	Australian Technology Network of Universities
BE	Bachelor of Engineering
CEIT	Centre for Educational Innovation and Technology (UQ)
CoP	Community of Practice
CI	Chief Investigator: CI-1 Carl Reidsema, CI-2 Lydia Kavanagh, CI-3 Phil Long, CI-4 Abelardo Pardo, CI-5 Roger Hadgraft
CQU	CQUniversity
CRG	Core Research Group (for OLT Project)
DVCA	Deputy Vice-Chancellor (Academic)
EAIT	(Faculty of) Engineering, Architecture and Information Technology (UQ)
ECU	Edith Cowan University
ELESIG	Evaluation of Learners' Experiences of e-learning Special Interest Group (London)
eLIPSE	(Centre for) eLearning Innovations and Partnerships in Science and Engineering (UQ)
ENGG1200	Engineering Modelling and Problem Solving First Year Course (UQ)
FC	Flipped Classroom
Go8	Group of Eight
ITaLI	Institute for Teaching and Learning Innovation (UQ)
ITS	Information Technology Services (UQ)
ME	Master of Engineering
NCSU	North Carolina State University
NSF	National Science Foundation
OLT	Office for Learning and Teaching
PI	Partner Investigator: PI-1 Mary Besterfield-Sacre, PI-2 Robin Adams; PI-3 Larry Leifer
RMIT	RMIT University

RTR	Radically Transparent Research
SECaT	Student Evaluation of Course and Teacher (UQ)
STEM	Science, technology, engineering and mathematics
SoEE	School of Engineering Education (Purdue)
T&L	Teaching and Learning
TEL	Technology Enhanced Learning
UNE	University of New England
UniSA	University of South Australia
UNSW	The University of New South Wales
UQ	The University of Queensland
US	United States
USC	University of the Sunshine Coast
USQ	University of Southern Queensland
USyd	The University of Sydney
UTS	University of Technology, Sydney
UWS	Western Sydney University (formerly, University of Western Sydney)

Executive Summary

Office for Learning and Teaching (OLT) project *Radical transformation: re-imagining engineering education through flipping the classroom in a global learning partnership* (ID13-2480) aimed to explore the benefits and barriers to openly sharing practices of flipping the classroom and to more thoroughly understand how conceptions of the Flipped Classroom (FC) affect its adoption.

The project was driven by a number of key findings:

1. There is a continuing unmet need for engineering curriculum that integrates both fundamental engineering knowledge and professional practice (King, 2008).
2. Disruptive technologies are changing what and how we are able to teach.
3. Transformational change in higher education is both slow and seen to be critically dependent on executive leadership (Graham, 2012).
4. There is a lack of viable promotional pathways for curriculum innovators as academic success is almost solely measured through publications and grant success in non-teaching research.

The FC – where students' first exposure to content is online in preparation for on-campus learning activities designed to facilitate active and collaborative student learning – allows findings #1 and #2 to be addressed. A fundamental question within this paradigm shift is the extent to which the FC can deliver both theory and practice learning outcomes. A radically different FC course was designed and developed over an extensive 18-month period and first implemented at The University of Queensland (UQ) in 2012 for a large (1,000+) cohort of first year engineering students. The course, ENGG1200 *Engineering Modelling and Problem Solving*, was used both as a reference point as well as a collaborative test bed to further understandings of the benefits and effectiveness of this pedagogy throughout the OLT project.

The other key aims of the project were in respect to findings #3 and #4. There is a strong community sense that disseminating Teaching and Learning (T&L) innovations through the traditionally accepted practice of high impact journal publications is too slow in supporting the growth and development of much needed high level T&L leadership and is biased in favour of theorists, further disadvantaging academic innovation in curriculum design and development. The rate at which disruptive technology is challenging higher education's way of doing business suggested the adoption of a Radically Transparent Research (RTR) framework to allow the project team to explore ways in which to openly share research more quickly, widely, flexibly and with equal or greater impact. However, pooling expertise through a Learning Partnership whose aims were towards the open sharing of practice met with limited success. Current competitive academic culture, designed to reward, and thus reinforce, individual accomplishment over that of teams, worked strongly against the RTR aims and hence the framework was all but abandoned.

Over the past three years of the OLT project, a significant amount of work was achieved towards better understanding the requirements, limitations and strengths of a FC pedagogy. Many of these findings are documented in an in-press book entitled *Flipped Classroom Practice and Practices* as well as within the many academic publications that the Core Research Group (CRG) generated. In addition, guidelines for staff to design their own FC were created in the form of a workbook which underpinned workshops delivered to over 1,400 academics worldwide.

The ENGG1200 FC has had a dramatic effect on UQ's physical teaching spaces with a new dedicated teaching building containing only flat floor classrooms currently on the drawing board. It has also been identified as a key enabler within UQ's Student Strategy White Paper (Institute of Social Science Research, The University of Queensland, 2016) and similarly as a signature pedagogy in a recent Royal Academy of Engineering report *Thinking like an engineer: Implications for the education system* (2014).

The ENGG1200 FC has acted as a catalyst for rapid growth in Technology Enhanced Learning (TEL) and has resulted in the establishment of an eLearning centre, the Centre for eLearning Innovations and Partnerships in Science and Engineering (eLIPSE), that has substantial funding as well as 10 academic-led (and funded) TEL projects. Some of these projects have been previous Australian Learning and Teaching Council (ALTC) and OLT funded projects which address a range of active curriculum needs (e.g. teams, assessment, evaluation, curriculum mapping, student feedback and communication and learning analytics). The Centre is directed at continuing the aims of the FC project specifically rolling out the eLearning tools that have emerged alongside the project with the support of both the US and Australian Learning Partnerships that have been activated.

The project achieved a high level of national and international engagement and involvement by highly ranked universities in Australia, Southeast Asia, United Kingdom and the USA. Without exception, the greatest impact that this project has had on the higher education sector has been through the face-to-face transfer of practice provided by the first Chief Investigator Carl Reidsema (CI-1) and the second Chief Investigator Lydia Kavanagh (CI-2) through the extraordinary number of invited workshops, keynote presentations, online webinars and interviews over the duration of the project (July 2013 to June 2015). Invitations continue to be received post-project resulting in no less than 27 invited activities having been completed consisting of 15 workshops, nine keynote presentations, two webinars and filmed interviews for Epigeum's online academic course in blended learning.

The primary goals of the FC workshop were to provide participants with an active experience of what it means to be a student in a FC. This approach generated triggers for actively engaging the participants with the issues (barriers, opportunities and challenges) involving teaching via authentic practices in different contexts.

Analysis of workshop data suggested that this worked to:

- Promote change: The workshops helped to move participants from focusing on barriers, emotional blocks and not knowing how to begin, to believing in possibilities and in thinking about how to begin.
- Promote Understanding: The workshops helped participants to understand more fully what a FC is, and the steps required for designing one.

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Project Context

Maintaining both quality and innovation within engineering higher education in Australia has historically been a collaborative effort between all 32 Australian universities that offer undergraduate degrees and Engineers Australia, the professional body that represents engineering industry stakeholders. This collaboration is effected through engineering degree programs being subject to regular (five-yearly) quality audits in a well-documented and mutually agreed upon process of accreditation. Whilst voluntary on the part of the engineering faculties, the process ensures that a high level of transparency and importance is maintained by all relevant stakeholders. Despite the significant degree of effort that goes into this process, there have been persistent concerns that adequate change to ensure best practice is limited by quality processes that are both "voluntary" and "inspected in" rather than "built in" and more directly tied to financial drivers.

In the 1996 national review, *Changing the culture: engineering education into the future*, which was funded by the (then) Commonwealth Department of Education, Training and Youth Affairs, one of the most concerning findings of the review was that:

> *The present emphasis on engineering science resulting in graduates with higher technical capability, has often limited their appreciation of the broader role of engineering professionals.* (p.7)

In a 2008 Australian Learning and Teaching Council (ALTC) funded report *Engineers for the Future: addressing the supply and quality of Australian engineering graduates for the 21st century*, Emeritus Professor Robin King, revisiting the landscape of engineering education over a decade later, found that not much had changed in relation to the ability of Australia's higher education sector to provide engineering undergraduate students with a balanced curriculum of both science and practice. Curriculum that integrates both the required engineering fundamentals theory termed "Knowledge and Skill Base" and professional practice skills has been both a longstanding concern expressed by industry and a significant challenge to academia despite these aims being explicitly agreed upon, and signified in Engineers Australia Stage 1 Competencies through the learning outcomes categories: "Engineering Application Ability" and "Professional and Personal Attributes". In his report, King called for significant curriculum renewal of engineering education in Australia and made specific recommendations referencing examples of best practice in engineering education that should be implemented, including:

1. *A more adequate understanding of students' learning styles, practices and desires*;
2. *Increasing recognition of pedagogically sound, innovative and inclusive curricula;* (p.95) and

3. *Define curricula more strongly around engineering problem solving, engineering application and practice, and develop the themes of design, model-and network-centric engineering, the engineering life cycle, complex systems, project management, global workflow, and multidisciplinarity*. (p.95)

A subsequent ALTC funded project PP8-919 *Design based curriculum reform within engineering education* (2008-2010) set out to investigate the landscape of engineering design education at four universities - three from the Group of Eight (Go8) and one from the Australian Technology Network of Universities (ATN) - in order to determine the extent to which the mix of engineering science fundamentals and design teaching reflected best practice as recommended in the King report through:

> *Recommendation 3: implement best-practice engineering education. Engineering schools must develop best-practice engineering education, promote student learning and deliver intended graduate outcomes. Curriculum will be based on sound pedagogy, embrace concepts of inclusivity and be adaptable to new technologies and inter-disciplinary areas.* (King, 2008, p.iv)

The aims of project PP8-919 were to gain a preliminary understanding of what constrains the development of best practice in engineering education, if in fact best practice can be defined as "curriculum which has an appropriate balance of technical and professional competencies as defined by Engineers Australia's Stage 1 Graduate Competencies" (Goldsmith & Reidsema 2011).

Despite a long history of stakeholder demands for change, as indicated in the above reports, the PP8-919 project team arrived at the conclusion that, without exception, there was a disjunction between the theory taught at university and the engineering practice abilities expected by both industry and students. This disjunction had resulted from a well-documented history of institutional and cultural practices of preparing undergraduates for research rather than for industry. These historical trends reflect what one would expect to see; the dominant culture reinforcing existing practices, in this case research, which is seen as the real purpose of academics. The curriculum thus exemplifies and is reinforced by academics, to whom the dominant engineering science paradigm pays dividends through the rewards of institutional rankings and promotions. This leads one to the conclusion that it is the prevailing epistemological beliefs and pedagogical practices of engineering academics that are the critical barriers to change, external government funding drivers notwithstanding. Out of this project, the team identified barriers to change that cut across cultural, institutional and epistemological areas. The team also identified a significant lack of design-based courses, low numbers of appropriately qualified academic staff, and a majority of programs that had come to rely on the few design courses that did exist to carry the bulk of the claimed learning outcomes for "Engineering Application Ability" and "Professional and Personal Attributes".

The appearance of the Tertiary Education Quality and Standards Agency has in some ways provided engineering faculties with the motivation to examine, in more detail, the ways in which learning outcomes are delivered across the programs that they offer. Whilst there have been relatively few publications (but see Carew & Therese, 2007 and Campbell, Dawes, Beck & Wallace et al., 2009) on the sector's progress in graduate attribute mapping, recent work by Cameron and Birkett (2012) at The University of Queensland (UQ) points to the development of more effective visualisation software tools that will allow academics to acquire a greater understanding of how the sequences of individual courses that students take over the duration of their degree programs deliver learning. Whilst the rationale for this effort is largely an externally-driven desire to ensure that programs meet the Australian Qualifications Framework regulations, there will soon be sufficient quantitative evidence to bring to bear to the question of how well professional practice-oriented learning outcomes are delivered. Despite regular reports suggesting significant gaps in the ability of engineering academics to deliver a balanced and high quality educational experience that meets stakeholders' demands, there seems little to suggest that engineering faculties across the sector are not slowly and incrementally grappling with the need to change. The questions are whether or not the rate of change is sufficient, and whether the sum of all of this will produce a curriculum that isn't just more of the same. In the book *Educating Engineers*, Sheppard, Macatangay, Colby & Sullivan (2009) strongly questions the viability of this incremental approach to change suggesting that it will not result in education that aligns with the demands of the future engineer. Similarly (Graham 2012) states that *widespread lasting change is rarely the product of incremental reform* (p.1).

The question for those responsible for leading change in the engineering curriculum appears then to hinge upon not whether continuing along the path of incremental change will produce a suitable balance of both rigorous technical competencies and authentic practitioner skills, but how one might more quickly (perhaps radically) transform the curriculum. Graham (2012) suggests that successful change is a mixture of internal demand, external demand and a culture of innovation. If this is true, then academics are confined to leveraging those rather rare opportunities when the executive leadership embarks upon significant internal reforms with the support of well-qualified and passionate change agents located within institutions that already have firmly in place a well-developed culture of innovation.

Such was the case with the Faculty of Engineering, Architecture and Information Technology (EAIT) at UQ in 2010. EAIT had just completed a year-long major review of its engineering curriculum to examine the effectiveness of its existing programs as a basis for creating a new five-year combined Bachelor of Engineering/Master of Engineering (BE/ME) program. The end product was envisaged as a competing model to the Bologna style 3+2 curriculum that had only recently been developed at other Go8 research-intensive institutions such as The University of Melbourne and The University of Western Australia. The BE/ME would, instead of providing a three-year "Science-oriented" foundation, extend the existing four-

year BE degree and retain focus on achieving a distinctive engineering theory-practice program "identity". A major objective of the curriculum review was, though, a recommendation that the existing first-semester common first-year cornerstone course (ENGG1100 *Engineering Design*) be enhanced and then complemented by a subsequent second-semester common course that developed design theory-practice skills (ENGG1200).

Reflecting this overall vision, the final report of the internal curriculum review recommended:

> *In developing the new curriculum, more extensive use should be made of pedagogies based on engineering design, build and test that are engaging and relevant, incorporate authentic, active learning in realistic situations, are technically rigorous and incorporate professional behaviour outcomes.*

It is not often that engineering educators get blank canvas opportunities to innovate, as was the case at UQ in mid-2010. The simultaneous occurrence of both strong leadership support for curriculum change from within the faculty executive, which is a well-documented success factor (Graham 2012), combined with a well-developed teaching-focused academic culture at UQ (Probert 2013) played a significant role in providing both the time and resources for this innovation to be successful. CI-1 on this project (ID13-2840) was a strategic appointment for the primary purpose of directly collaborating with CI-2 to engage in designing, developing, operating and evaluating the new course. This course would aim to reflect current "state-of-the-art" or "best practice" in a first-year compulsory engineering course through hands-on design and build, preparing students for entry to their chosen disciplines in second year. Both CIs were award-winning, teaching-focused academics with extensive "pre-postgraduate" industry experience, academic teaching qualifications, significant publications in engineering education and a record of successful pedagogical innovation extending over a decade at both The University of New South Wales (UNSW) and UQ. This aligns with King's (2008) recommendations 1 and 2 which focus on the quality of the pedagogy employed, the course coordinator qualifications, and skill sets required.

The resulting FC course, ENGG1200, was built on a long history of innovative project-based learning curriculum in engineering at UQ (Crosthwaite, Cameron, Lant, & Litster, 2006) and was intentionally aligned to many of the recommendations from the King Report through a curriculum design and development process which extended over an 18-month period. This unusually long upfront planning stage allowed for a significant amount of research and investigation to be conducted, including an explicit mapping of Community, Course, Coordinators and Cohort Characteristics (5Cs) that evolved from work completed in ALTC project PP10-1647 *Curriculum Renewal in Engineering Through Theory-driven Evaluation*, at www.olt.gov.au/resource-curriculum-renewal-engineering-through-theory-driven-evaluation. This ensured that the end product would be well aligned to the context in which it would operate. This upfront planning also included consulting widely through internal surveys and workshops and externally through visits to institutions within the international

community where various elements of selected best practice were known to have occurred such as Olin College; Purdue University and North Carolina State University (NCSU).

The ENGG1200 course was designed to replace an existing traditional (lecture-based) course in engineering materials science and took all 1,150 first year engineering students at UQ through a semester long, authentic design and build experience. This was done in order to achieve a realistic alignment between EAIT's objectives for increased active learning and student engagement as well as realise the recommendation of King (2008):

> *Define curricula more strongly around engineering problem solving, engineering application and practice, and develop the themes of design,…* (p.95)

A project-based learning approach was adopted requiring students to learn engineering fundamentals (materials and problem solving concepts) concurrently with tackling a major semester long open-ended design problem (Reidsema, Kavanagh & Jolly, 2014). Fully utilising on-campus teaching time in collaborative workshops, with hands-on learning experiences instead of passive lectures, created the need to explore ways in which "off-campus" time could be utilised to deliver the necessary content in online modes. The extent to which blended learning could ensure an adequate delivery of both theory and practice learning outcomes led to the decision to employ a FC approach where the essential, yet under deployed Engineers Australia Stage 1 Graduate Competency of "3.5 Orderly management of self, and professional conduct" would form an integral component of the course narrative in the guise of "Ownership of Learning".

With the intention of developing an innovative online learning environment at scale by maximising the amount of active learning on campus, collaboration with UQ's (now defunct) Centre for Educational Innovation and Technology (CEIT), was sought out. Phil Long (CI-3) led a small group of eLearning developers who were tasked by the Deputy Vice-Chancellor (Academic) (DVCA)'s office with identifying and supporting technological innovation in learning across the university. At the same time, EAIT appointed one of the first UQ funded faculty educational designers, in large part to support the planned effort to increase online learning capabilities within the faculty.

The collaboration with CEIT began several years (2011) before the current project proposal was made (2013) and had developed into an effective, if somewhat informal, working relationship. A major strength of this emergent collaboration was in the shared vision for how the future of technology-enabled learning should support new pedagogies like the authentic student-centric pedagogy that had emerged as a model for learning in this new course that could meet stakeholders' needs into the future. Having this jointly shared vision was in itself a noticeable strength which led to intra-institutional funding support from both the DVCA and EAIT for a project entitled *Changing the Culture: Demonstrating individual in-depth technical competencies through authentic learning for large first year cohorts*.

The Changing the Culture project laid out a framework for significant pedagogical change being led by EAIT with the support of CEIT towards designing an innovative active learning course where student learning goals were aimed at developing in-depth technical engineering concept knowledge as well as student self-efficacy. In order to achieve this, a unique, innovative online learning system would present to the student short, structured learning "chunks" coordinated with the lecture narrative arc, and provide departure points for content surrounding the collaborative learning workshops. Student progress through these learning activities would be continuously monitored and tracked in individual student learning dashboards. Online resources that required development included video libraries demonstrating engineering concepts and project components, plus feedback tools that identify areas where students experience difficulty along with the concepts that are associated with them. This early partnership positioned ENGG1200 as a collaborative test bed to explore the potential of learning analytics to better understand the relationship between student engagement and interaction with the online environment within a course that emphasised "self-efficacy" in a team-based, semester-long, open-ended design problem.

This degree of mutually aligned, broad and multi-level (university/faculty/school) support early in the development of the FC initiative was crucial in supporting what is without doubt, an example of successful institutional change. In fact, there are a number of criteria for successful and transformational change that set the basis for the current project (Graham 2012):

1. *Successful change is ambitious and aims high.*
2. *Successful change is interconnected and wide-ranging.*
3. *In the majority of cases, coherent and ambitious programmes of reform involve project-based education within authentic professional engineering contexts. This pattern is evident regardless of country or institution type.* (p.2)

The course as it was delivered in 2012 was a radical departure from the ways in which students traditionally learn in their first year of university, particularly so within the research-intensive Go8 group of universities. As Graham (2012) again notes:

> *Successful changes typically involve the development and adoption of a new approach, developed in-house. Although it may be influenced by existing examples of good practice, it is deliberately designed to be distinct and developed to fit the priorities, resource constraints and student demographic of the host institution.* (p.1)

The origins of the Office for Learning and Teaching (OLT) funded project that is the focus of this report stemmed in part from the successful implementation of ENGG1200 and a conversation that occurred not long afterwards. Having just completed the first iteration of the large scale FC ENGG1200 at UQ, CI-1 and CI-2 gave a presentation to colleagues on the results of this ambitious initiative. All of their time and energy resources had been expended

from August 2010 to November 2012 in planning, developing and running the first iteration of this course. The DVCA and EAIT Executive Dean warmly congratulated the ENGG1200 team on its success but then advised the need to write it as a journal paper. It became clear that this suggested method of pursuing academic recognition was going to be necessary for the team and for others pursuing similar endeavours. This presented a major challenge given the limited resources available.

The amount of work required to design and develop ENGG1200 was both prolonged and substantial. The workloads of teaching-focused academics in Australia reflect a very high contribution to teaching that constrains efforts to do research (Probert, 2013). There are a relatively small number of journal publications supporting research (applied or theoretical) in what is a rather new and always contested discipline of engineering education and even fewer A-ranked publications. The sole A-ranked academic journal (*Journal of Engineering Education*) has developed into a journal that favours "rigorous" research articles (theory-grounded research on learning) rather than articles that focus on how effective an innovation or intervention has been and what might have been learned (Felder & Hadgraft, 2013). Within Australia, there is little evidence of research strength in engineering education and like most colleagues, the ENGG1200 team didn't have an educational researcher at its disposal. Time required to publish in engineering education is longer than technical research yet there is strong institutional pressure to publish. This drives output towards generating a token number of easier to achieve conference papers. Finally, there are valid questions that might be asked regarding the impact that can be achieved through one or two highly-ranked journal papers should that be possible to achieve over the Australian non-teaching summer period between December and February the following year. After that, setting up and running the curriculum dominates the teaching-focused academic's weekly calendar.

In keeping with the imperative of evidence-based scholarship, the decision to pursue impact through a research and development project proposal (despite a relatively low success rate of 20 per cent) needed to be guided by the most effective communications channel for the target audience. As part of an ALTC Discipline Scholarship for Engineering and ITC, a survey of N = 613 Australian engineering academics was implemented in order to get a snapshot of both the demographics and attitudes of academics to engineering education (Wright, Hadgraft & Cameron, 2010). When asked about what would be beneficial means of providing assistance to academics in a teaching role, respondents identified two prime areas of assistance. These were *face-to-face opportunities to informally discuss teaching and learning issues with colleagues* (77 per cent: desired + highly desirable), and *accessing high quality, validated teaching and learning materials via respected repositories* (70 per cent: desired + highly desirable). Other areas that were highly ranked were *personal assistance in developing courses … and teaching and learning materials*. Lower ranking issues related to *easy access to HE educational literature …*, and *staff development to enhance verbal and visual communication skills*. It is interesting that informal Teaching and Learning (T&L)

discussion ranked very highly, possibly suggesting that these opportunities may not be present within the life of many schools or departments.

Consequently, the most effective means of achieving impact would be to explore alternative ways in which to effect change by disseminating the results which led to the project proposal, *Radical Transformation: Reimagining Engineering Education through Flipping the Classroom in a Global Learning Partnership*.

The key objectives as reflected in the Project Initiation Document for OLT Project ID13-2840 were as shown in Table 1:

Table 1: Project goals and objectives

Goals	Objectives
This project will focus on the open sharing of experience and research data in order to identify mechanisms that are most effective in transferring practice of the unique features of the UQ Flipped Classroom approach. *It will also seek to understand how student and staff conceptions of teaching, perceptions of learning performance, and institutional barriers posed by the paradigm shift of the Flipped Classroom affect its adoption.*	1. *It will produce an analysis of key characteristics of Flipped Classrooms in different contexts with consideration to their scaling properties.* 2. *It will produce a description and demonstration of open source development practice models for reconceptualising engineering education flipped course design, data gathering tools and evaluation practice.* 3. *It will develop and disseminate insights on Flipped Classrooms and Learning Partnerships through workshops, publications, and collaborative action arising out of the open-source sharing of information and techniques.*

Project Approach

The project was carried out by a multi-national/multi-institutional Learning Partnership led by the Core Research Group (CRG) located at UQ. The CRG consisted of Associate Professor Carl Reidsema, team leader and Chief Investigator (CI-1), Associate Professor Lydia Kavanagh (CI-2), and Professor Philip Long (CI-3). The CRG was supported by Miss Ellen Juhasz, Project Manager and Dr Lesley Jolly, Senior Researcher.

The Learning Partnership Group consisted of an Australian Group: Dr Abelardo Pardo (CI-4) – The University of Sydney (USyd); Professor Roger Hadgraft (CI-5) – RMIT University (RMIT), later CQUniversity (CQU), then University of Technology Sydney (UTS) and a United States Group: Associate Professor Mary Besterfield-Sacre (PI-1) – University of Pittsburgh; Associate Professor Robin Adams (PI-2) – Purdue University and Professor Larry Leifer (PI-3) – Stanford University. This high level of international engagement and involvement by highly ranked universities was seen as validation of the timeliness and relevance of the ideas, aims and approach proposed in the project.

Based on previous ALTC project experience, and due to CI-1 having significant alternative funds earmarked for T&L at his disposal, the CRG decided to retain control of the full funding amount at the lead institution rather than distribute partner funds up front. A decision was also made to appoint, as two fractional positions, a project manager with extensive institutional experience and a senior researcher with extensive engineering education experience, rather than appoint one person at full-time to perform both roles. The decision to split the roles turned out to be a fortuitous one which resulted in the CRG being able to work consistently and effectively within the lead institution over the duration of the project with regular meetings supported by consistent and extensive documentation and communication. The structure of the full project team is provided in Appendix B.

An Advisory Committee, comprising Professor Caroline Crosthwaite, Associate Dean (Academic), EAIT, Professor Richard Felder, Hoechst Celanese Professor Emeritus of Chemical Engineering, NCSU, Associate Professor April Wright, UQ School of Business and the Evaluator for the project, was formed. They were both kept advised of the project's progress and consulted in relation to project direction and alignment across international, national and institutional dimensions. The evaluator's report is provided in Appendix C.

An initial workshop at Stanford University, which was funded through the CI-1's development funds prior to the OLT project commencement, enabled the project to gain momentum very early. A number of useful outcomes were achieved including the Visual Diary (Appendix D) and the sharing of Flipped Classroom Maps (Appendix E) that have proven to be a useful tool to aid the academic in planning a FC project. The agreement by the project partners at Stanford University to adopt the more complicated (yet more suitable and longer term beneficial) case study approach led to the later decision to amalgamate a wider collection of case studies by an expanded Learning Partnership into a book of best practices. The Stanford University workshop also provided the agreement that led to the first Australian-held workshop at UQ that gave the project immediate national prominence and has resulted in the numerous invited workshops within Australia and the expansion of the Learning Partnership with the inclusion of University of Technology Sydney (UTS), Griffith University, and many other institutions.

By the end of 2013, the progress of the project against the proposed plan (albeit ambitious), was not only thought to be achievable, but also clearly ahead of schedule up to the end of March 2014 when a number of critical events occurred. The first significant event was when the Senior Researcher resigned at the beginning of April 2014. There are extraordinarily few qualified and experienced researchers available in the field of engineering education in Australia and this resignation was a severe blow to the project. Work on the UQ case study was left in disarray and efforts to accomplish the planned comparative analysis of selected courses at the University of Pittsburgh and Purdue University against the UQ ENGG1200 course were discontinued.

At about the same time, it became apparent that the ability to appoint a research assistant at Purdue University to support PI-2 in developing the Purdue case study and the RTR work became untenable. There appeared to be a number of issues that were unable to be resolved which could be ascribed to political, cultural and financial factors which were not apparent in the early formulation of the grant proposal.

When the original project aims to collect and characterise learner interaction data representing online engineering learning design patterns from the FC was conceived, the CRG was reasonably confident that the software architecture that had been developed by CI-3 would be ready for the Phase 2 work with Stanford. This online software system was intended to deliver data that captured student interaction with the FC concept videos which would form the basis of the joint research with Stanford's Design Research Team in mapping and analysing learning design patterns within ENGG1200. As it happened however, UQ's central Information Technology Services (ITS), unbeknownst to the CRG, had decided that it would (in response to a growing university-wide demand for improved video storage and delivery), change the existing corporate video delivery platform, thus rendering the associated learning analytics software inoperable.

In hindsight, one can more clearly see the dramatic changes that the ENGG1200 FC has had on UQ's physical (teaching rooms) and virtual resource capacities. As an example, in previous years (prior to 2013) at UQ, the courses with the highest usage of video delivery (assuming correlation with the total number of student hits on UQ's learning management system, Blackboard) were from medicine and biology with student cohort sizes of 900 and 1,400 respectively. These courses achieved student hits ranging between 400,000 and 600,000 hits. In 2013, ENGG1200 with 1,170 students accumulated 2,500,000 hits.

Last but not least, project team continuity can often be a problem even for projects that only extend over two years and in this case one of the chief investigators within the Australian Learning Partnership (CI-5) moved from RMIT to CQU to take up a more senior role as Deputy Dean of Engineering, before moving to UTS.

Figure 1 (Rambur 2009, transcribed in Brew, Boud, Lucas & Crawford, 2013) shows the relationship between the complexity of the project interface in international research collaboration and the time required to achieve research outcomes.

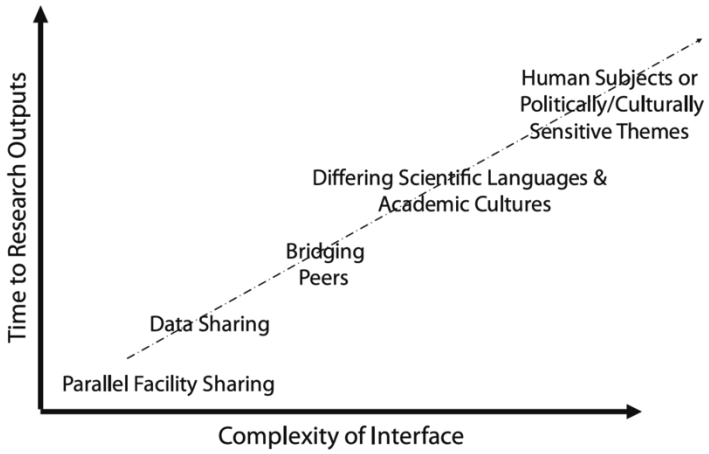

Figure 1: Conceptual framework for multinational research collaborations (from Rambur 2009, p. 84)

The project team had originally perceived its research collaboration to be located in the less complex and shorter time to research output category of *data sharing* (see Figure 1). On further reflection and in hindsight, the project team believes that it was in fact located quite strongly in the *human subjects or differing academic cultures* category (Figure 1).

It was initially thought that there would not have been that much difference between the United States (US) and Australian academic cultures, but that would seem to be not the case. Despite the similarities between the US and Australian cultures, there are distinct differences at play which work to restrict what might be possible given similar levels of good will. The US university system is both massive (over 5,000 institutions) and keenly competitive with courses that are not as open and transparent as can be found in Australia. Similarly, the amount of funding that can be derived from the US National Science Foundation (NSF) is significantly larger than what can be obtained within Australia and that makes it difficult to motivate US partners financially. There are similarities however in the academic workloads between the two countries, making it very difficult to find sufficient time to discuss and negotiate the level of shared understanding that is required to ensure project goals are clear and able to be adapted as changes occur. Taking the Purdue/UQ collaboration as an example, while there were many similarities:

- number and cohort characteristics of first year students,
- common first year, and
- collaborators having a shared background in engineering education and design research,

there were just as many, if not more differences:

- Purdue School of Engineering Education (SoEE) owning the first year curriculum versus a negotiated sharing arrangement between four engineering schools and the Faculty of EAIT at UQ,

- disparate research strengths (significant numbers of engineering education research academics and competitive publication and funding objectives with the SoEE),
- Purdue ENGR131 course taught in up to 12 sections by different academics versus ENGG1200 taught in entirety by two academics, and
- NSF (equivalent to the Australian Research Council) funding amounts for higher education research projects are a magnitude of order greater than that available from the OLT.

In hindsight, given these cultural differences, the project team was always going to be facing a longer time to achieve useful research outputs than the original two-year project duration. The collaboration with the University of Pittsburgh however, remained both strong and productive over the course of the project despite reservations that were expressed by PI-1 regarding their involvement should the Purdue relationship reach a dead end. These initial reservations were overcome, however, through refocusing the partnership towards a less complex approach; i.e. rather than through data sharing, the partnership was realised through sharing conference publications as proxy in-progress case studies, as adequate funding for a research placement at Pittsburgh wasn't able to be achieved despite significant efforts from CI-1.

The key lessons that have come out of the project team's attempts to collaborate internationally can be found in relation to the unanticipated cultural differences suggested by Brew, Boud, Lucas & Crawford (2013) as well as from Kotter's framework for leading change (Kotter 1996, Reidsema, Hadgraft, Cameron, & King, 2011). If the combined national and international project team is envisaged as an example of Kotter's "Powerful Guiding Coalition" then one could expect by virtue of the quality of the team's composition, that there was an unlikely shortage of vision, influence or ability to achieve the project aims that were proposed. There were, however, barriers in both the project duration and funding that should have been requested (or provided for) up front in order to fully achieve the original aims of the project. An additional year to adapt to the unexpected and externally imposed delays in acquiring student interaction data at UQ as well as an additional $200,000 to appoint (or embed) researchers at either Purdue or Pittsburgh would have been sufficient to have overcome these rather minor barriers and would have made a significant difference to the project's outcomes. Whether this would have produced a better result for the OLT and the Australian higher education community of practice cannot be ascertained.

Although the project had clearly begun to look terminal at this point, the earlier decision to retain funding with the CRG ensured that the project team retained sufficient autonomy to be able to adapt and replan. The CRG, in revisiting the projects' original objectives, agreed that regardless of the originally-proposed set of explicit deliverables, the aim was primarily to *… pool expertise from… a Learning Partnership to situationally analyse, develop and fast track dissemination of this (Flipped Classroom) transformation in real time*.

Moving forward, the project team could therefore shift tack slightly and capitalise on developments by:

1. purposefully developing a learning partnership;
2. pursuing open sharing of resources and knowledge developed to active learning partners;
3. developing the UQ case study and making comparison with other studies where possible; and
4. developing a set of guidelines for best practice.

The CRG reaffirmed its growing understanding of several of the key principles from Baxter Magolda's work on learning partnerships as a means by which effective grassroots change leadership (now reduced in scope to that of the Australian Learning Partnership Group with one US partner) might still succeed (Baxter Magolda & King, 2004). Maintaining a focus on doing everything transparently and collaboratively was still seen to have merit in successfully transferring practice. It was also considered essential that despite frustrations, the project team retained the core principles of Baxter Magolda's learning partnerships that underpin successful collaborative learning and the benefits that this has in co-constructing knowledge (Baxter Magolda & King, 2004). These core principles are:

- a validation of the academics' ability to know;
- situating learning within academics' experience; and
- mutually constructing meaning.

These were important considerations for the project team to address in order to ensure that the focus continued to be maintained on the primary project aims of sharing practice within a competitive academic culture designed to reward, and thus reinforce, individual accomplishment over that of teams. As the project team moved into the second year of the project, this purposeful reflection on the learning partnership principles allowed the team to conceive of this mutual co-construction in terms of how it would engage the unexpected interest that eventuated through an Australian learning partnership. A less complex interface based on data sharing through the development of a book of case studies that could be foregrounded by the CRG's knowledge generated over the course of the project was seen not only as a good outcome, but also one that was aligned to these three learning partnership principles. It is interesting to note that the idea of a "co-constructed artefact" (in this case the book) was a contribution made by the Stanford University partner (PI-3) at the Stanford workshop and is reflected within the Visual Diary (Appendix D; Figure D.10 Planning Ahead) that was now more relevant to the team's replanning efforts. A key principle of Stanford University's d.School design thinking model is in the role that doing takes in relationship to thinking. Sharing publications also aligns with one of the primary functions of an academic and, due to the growing reputation of the project, allowed the

project team to quickly expand the number of partners over the number that had originally commenced in the project.

At the end of 2013, the project began to move in an unanticipated, but quite productive direction with a large number of invited workshops, keynote presentations, webinars and requests for information and support. At the project kick-off workshop at Stanford, the project team undertook an agreement to share and alternatively host two workshops between UQ and Purdue University. The first workshop would be held to coincide with the Australasian Association for Engineering Education (AAEE) conference on the Gold Coast in the first week of December 2013 and the second would coincide with the American Society of Engineering Education (ASEE) Conference in Indianapolis that Purdue was hosting in June 2014 and was initially also intended to be hosted by Purdue, but ultimately held at NCSU.

Project Outputs

Workshops and Invited Presentations

Without exception, the greatest impact that this project has had on the higher education sector has been through the face-to-face transfer of practice provided by CI-1 and CI-2 through the extraordinary number of invited workshops, keynote presentations, online webinars and interviews from July 2013 to June 2015. No less than 26 invited activities were completed consisting of 12 workshops, nine keynote presentations, two webinars and one set of interviews for the Epigeum online academic teaching course in blended learning as shown in Figure 2.

The project had originally only planned for two webinars to share project progress, so being invited to deliver workshops and presentations with most costs covered at a rate of over one event per month far exceeded expectations. In total, over 1,263 academics and staff either worked through the process of designing their own FC or were able to engage in active conversation on key issues pertaining to the FC.

Feedback on the overall impact of the project in their institutions was received from CI-4 (USyd) and the Associate Dean (Education) in the Faculty of Engineering at Monash University, and is given in Appendix F.

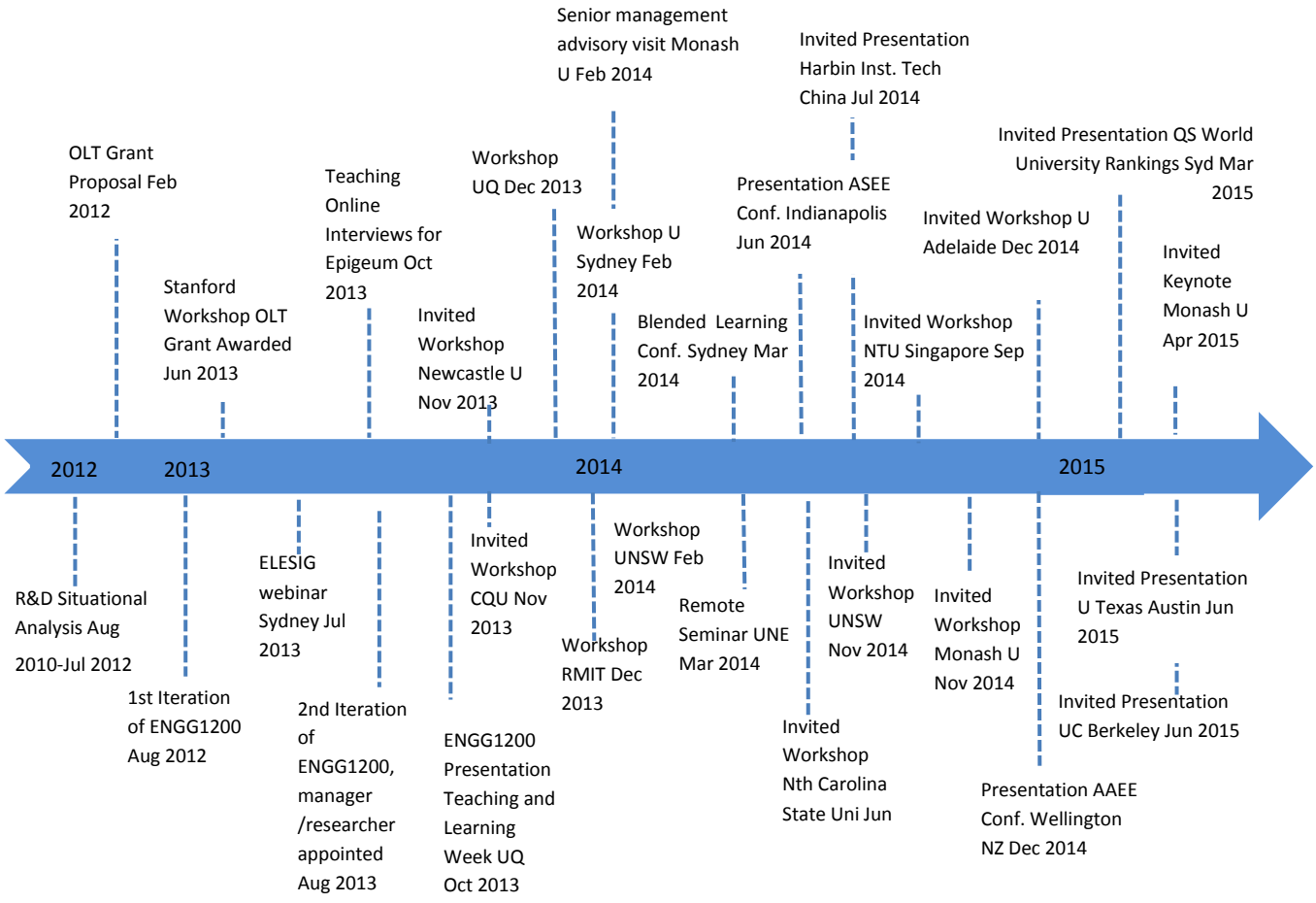

Figure 2: Workshops and keynote presentations

UQ Workshop

The first FC workshop *How to Flip a Classroom and Land on Your Feet* proved to be tremendously successful. Because an event of this magnitude was not part of the original project budget planning, it was decided that costs would be borne partially by delegates, who were asked to pay $120 (excluding Goods and Services Tax). This strategy allowed the CRG to appoint (on a short-term casual contract) a final year business student in the role of communications officer, who brought much needed event management skills. The project manager was tasked with supporting CI-2 and the senior researcher to create a high quality workshop booklet and flyer which were subsequently re-used for each future workshop. The cover of the workbook for the workshop is shown in Appendix G, Figure G.1, and the full workbook is available on the project website as a shareable resource, under the tab "Resources", at www.uq.edu.au/teach/flipped-classroom/olt-transforming/.

A deliberate decision was taken by the planning committee to open the workshop attendance to all academic disciplines and only cap the numbers to the size of the venue - 192 seats arranged into 32 round tables of six. Despite not having any prior experience in

running an event of this type, or any certainty of the sector demand for knowledge about the FC, the resulting attendance of 168 delegates was a complete surprise.

The 168 delegates came from every Australian state and territory as well as from New Zealand (Figure 3), representing 31 separate institutions covering a wide spread of disciplines.

Figure 3: Catchment for the first flipped classroom workshop, UQ, Dec 2013

The largest percentage was from the engineering discipline (26 per cent), which was expected considering that the project was led by engineering academics. Also, a conscious and deliberate decision was made to hold the workshop on the day immediately prior to the commencement of the 2013 conference of the Australasian Association for Engineering Education on the Gold Coast. What was unexpected however, was the breadth of disciplines that were non-engineering (64 per cent) and non-STEM (38 per cent). Eight broad academic discipline groupings were represented, as shown in Appendix H, Figure H.1, with a significant representation from academic teaching roles (64 per cent) and the rest consisting of associate deans of teaching and learning and curriculum support staff such as educational designers.

The one-day workshop was delivered collaboratively by all project partners with the exception of the PIs from Stanford and Pittsburgh who had other commitments at the time. Strong support by professional staff from UQ's Tertiary Educational Development Institute, now the Institute for Teaching and Learning Innovation (ITaLI), was provided with staff running afternoon breakout sessions on topics including developing professional support for academics engaged in flipping and selection of best online technology and learning tools for the FC.

Subsequent Workshops and Presentations

Not long after the UQ workshop, invitations began to be received, resulting in a series of 11 further workshops over the remainder of the project (Appendix I). The strong demand for information about the FC was (the CRG believes) due in large part to word of mouth from attendees of the successful first UQ workshop in December 2013. Feedback from seven of the organisers of workshops is presented in Appendix J.

The workshops were augmented by nine further invited keynotes/presentations in Australia, the USA, China and Singapore. The locations in which events over 2013-2015 were conducted (including the UQ workshop) are shown in Figure 4.

Figure 4: Expansion of events enabling promotion of flipped classroom method

A strong indicator of the international level of awareness and positive valuation of the work undertaken by the CRG was evidenced by not just the number of invited presentations but also by the institutions and countries that extended these invitations and provided funding for them (Table 2).

Table 2: International reach

Country	Institution
Australia	UNSW Australian Graduate School of Management
Australia	QS World University Rankings by Subject International Forum
Australia	Monash University, Victoria
Australia	Blended Learning Conference, Sydney
United States	University of California, Berkeley
United States	University of Texas, Austin
United States	Texas A&M, College Station**
United Kingdom	"Teaching Online" interviews for Epigeum, Imperial College, London
China	Harbin Institute of Technology/Go8 China-Australia University Summit on T&L
Singapore	Nanyang Technological University, Singapore
Spain	Universidad de Murcia, Murcia**

** - invitation was unable to be accepted

Whilst a number of these invitations were accepted on the basis of raising awareness of the project, several of them (e.g. the University of California, Berkeley) had strategic actions as an end goal (Southwell, Gannaway, Orrell & Chalmers et al. 2010). The lead CIs on this project have recently acquired an internal UQ T&L grant of $110,000 towards the development of an innovative online peer learning tool that will strengthen the wide variety of eLearning tools that have coalesced around project ID13-2840.

Workshop as Transfer of Practice

Overview

The pedagogical design of the FC workshop has proven to be every bit as innovative as the ENGG1200 FC course from which this project originated. The primary goals of the workshop were to provide participants with an active experience of what it means to be a student in a FC. This approach generated triggers for actively engaging the participants with the issues (barriers, opportunities and challenges) involving teaching via authentic practices in different contexts. The workshop utilised a number of different strategies including:

- asking participants to complete online pre-learning prior to the workshop including watching videos, exploring resources and responding in writing to short answer questions;
- using workshop time for active, collaborative, multidisciplinary group work; and
- using a series of FC design tasks utilising a structured workbook to scaffold and clarify each task (Appendix G, Figure G.1).

Workshop Pre-Learning

The FC is a form of blended learning in which there is an expectation that students will do some preparatory learning around a topic or small set of topics before attending an active learning session on campus to further explore or apply what they have learned (Abeysekera

& Dawson, 2015). One of the major concerns of workshop participants has been in regard to whether or not students will "engage" with this pre-learning. As a means of dealing with these concerns, the workshop facilitators, working with a colleague from UQ's ITaLI, developed a website that combined ITaLI's own internal T&L support (resources and academic workshops) for the FC, with the OLT Project. Participants were asked to watch a video prepared by CI-1, www.youtube.com/watch?v=-I2bYaDvdiI, and respond by answering two questions regarding what they believed the main ideas were within the video and how these applied to their own particular context and situation. Participants could also read or watch up to three additional documents or videos that had been compiled as optional pre-learning resources (Appendix K).

Pre-learning data was collected for 265 out of a total of 686 workshop participants. On average, 69 per cent watched the mandatory videos while only 35 per cent answered the pre-learning questions. These figures were reversed for the optional pre-learning (where data was gathered from other institutions). Overall, the average completion rate of the pre-learning resources was only 38 per cent (Table 3).

Table 3: Percentage of participants completing the online pre-learning

Pre-learning Resources	**Percentage of delegates completing**	
	Videos	**Questions**
Mandatory (n=265: UQ, UniSA, NCSU)	69	35
Optional (n= 198: RMIT, UNE, UNSW, USyd)	23	57
Average Proportion (n=463)	**33**	**42**
Overall Average Proportion	**38**	

This finding regarding the low percentage of attendees having completed the pre-learning was used to provide an intentional and reliably predictable "teachable moment" that allowed the facilitators to demonstrate how to effectively handle students who did not fully engage with the request to complete their pre-learning. By analysing the key ideas that participants identified and submitted in their pre-learning before each workshop, the facilitators were able to compare these results with those of workshops that had been run earlier as well as the work of the CRG to (in most cases) validate the participants' thinking and the concerns regarding implementing the FC across a wide variety of academic institutions and cultures.

Comments regarding the participants' appreciation of this teaching moment were given in the feedback comments after the workshop, and are described in more detail later.

Active, Collaborative Group Work (de Bono)

The full workshop ran over three to four hours in collaborative learning (think-pair-share) mode organised into tables of four to six participants. The first half of the workshop focused on systematically and actively engaging participants in activities that gave voice to their concerns. Discussions around the changes required for adopting the FC was achieved by

leading the participants through a selection of de Bono's Six Thinking Hats exercises (de Bono, 1999). This technique allowed for discussions concerning the changes required to adopt the FC as well as establishing group norms of the delegates' conceptions and concerns (what they think and feel) about the FC.

- Black Hat – Negative thoughts, barriers, things that could go wrong
- Red Hat – Feelings, intuitions
- Green Hat – Creative/new ideas, possibilities
- Yellow Hat – Benefits and gains

While data from all of the Hat activities were collected, discussions are restricted to the Black (cognitive barriers) and Red Hat (affective responses).

Black Hat

The Black Hat activity elicited participants' negative pre-conceptions (barriers) to implementing the FC in their institution's context. The issues were discussed and itemised by groups at tables, then summarised for each workshop as a whole. The summaries of Black Hat Issues were recorded for many but not all of the workshops. In order to investigate these barriers, a grounded theory approach was taken by thematising the items from Black Hat workshop summaries using NVivo. The analysis revealed (Figure 5) that there are five main areas of perceived barriers to the uptake of FCs which could be allocated against five different stakeholder areas within universities; i.e., issues that are owned by teachers, the institution, by students, by technology, and by learning spaces. These five main areas of ownership were identified by how often they were mentioned across the workshops. For example, workload which is owned by teachers was mentioned a total of 11 times. The figure also shows the main subthemes mentioned within each area of barrier ownership, which are described in more detail in Appendix L.

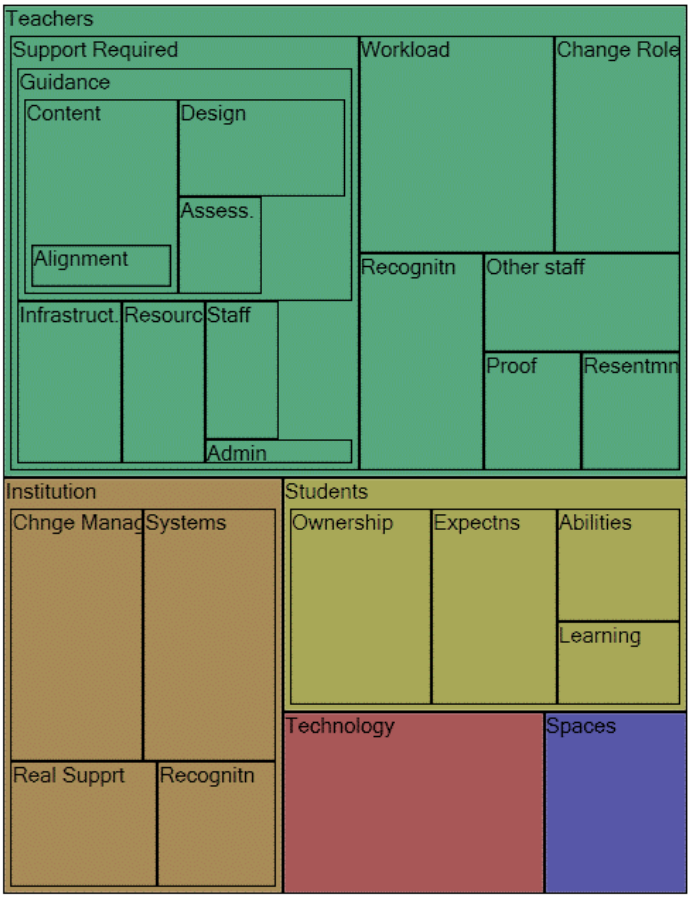

Figure 5: Perceived barriers to flipped classroom adoption

Synergy with required drivers for change

It is noted here that the Black Hat issues easily cluster around the three over-arching barriers to change that were identified in the 2008 ALTC project PP8-919 (Figure 6). This is not totally unexpected due to the deliberate focus by the CI-1 on understanding what barriers to change prevent universities from moving from traditional didactic T&L approaches towards practices which are student-centred, active, and which employ modern, up-to-date learning technologies.

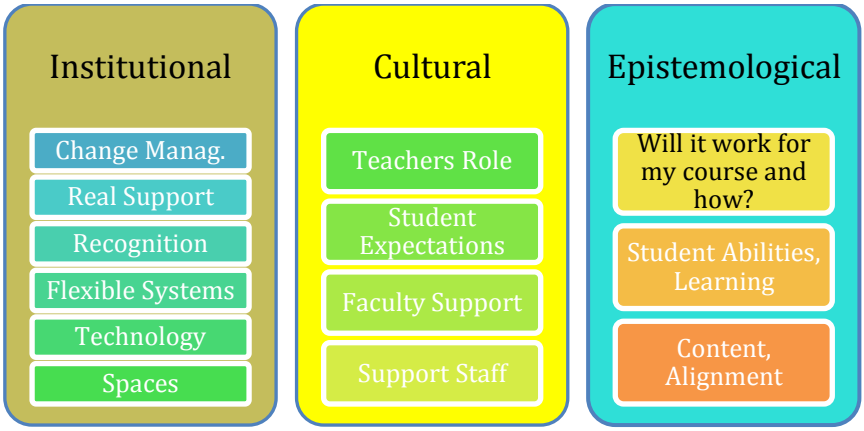

Figure 6: Synergy between over-arching change barriers and bottom up barriers emerging for workshops

Further detail however is revealed when examining the much larger data set representing a broader (cross-disciplinary) cross section of academics who are responding to more current and pressing concerns. These are perceived as institutionally imposed changes affecting not only their workloads, but also their practices and their beliefs about what constitutes learning. The main difference between the earlier investigation and the categories revealed by the bottom up Black Hat issues is the call for practical hands on guidance and support with the design of courses and with the use of technology. This is not so much a barrier to change as it is an identification of need (that becomes a barrier if not provided). The finding supports that of Cameron et al (2012), which concludes that the most beneficial means of providing assistance to academics in a teaching role, include "accessing high quality, validated teaching and learning materials via respected repositories", and providing "personal assistance in developing courses … and teaching and learning materials".

The main categories of Black Hat issues emerging from the workshops have been used to both evaluate which of the stated main barriers were thought to have been addressed by the FC workshops on the day, and which remain issues for the institutions themselves.

Red Hat

The Red Hat was used to gauge both the participants' personal positive and negative feelings about the FC. Each participant was given a blue (yes) and orange (no) card to register their feelings by raising them in the air so that the entire room could see where they were in relation to the cohort.

Overall, most participants did not feel daunted, nor did they admit to feeling pressured, although there were minor variations across workshops where participants had not had much previous experience with flipping the classroom (Table 3). While the majority of participants expressed excitement about the possibility of flipping, an equal majority felt that students would resist moving to a pedagogy that required them to accept a greater responsibility for owning their learning.

Table 4: Red Hat responses (indicative)

Question	Response
Do you feel daunted (by flipping)?	< 40%
Do you feel excited (by flipping)?	> 80%
Do you feel pressured (by flipping)?	< 50%
Do you feel students will resist (flipping)?	> 60%

Workshop Evaluation

Each workshop was evaluated using a two-sided survey (Appendix M) allowing participants to respond by:

1. rating the workshop using a five-point Likert scale of SD - Strongly Disagree; D - Disagree; N/U - Neutral/Undecided; A - Agree; SA - Strongly Agree; and

2. providing their constructive feedback by answering four open-text questions.

These responses were used to evaluate how helpful the workshop was in preparing participants for designing a FC and how effective the activities and processes were in achieving a change in mindset and learning of FC concepts and skills. The average ratings given for Questions 1 to 10 are shown in Figure 7 and the breakdown per institution is given in Figure 8.

Q1: The workshop (including the pre-learning) allowed me to understand educational rationales for flipping the classroom
Q2: The workshop (including pre-learning) allowed me to understand the implications for me and my students of flipping the classroom
Q3: The workshop (including its delivery) allowed me to begin thinking about how I would design a Flipped Classroom
Q4: The workshop inspired me to explore the educational possibilities offered by the Flipped Classroom
Q5: My contributions were valued by the presenters and other participants
Q6: The design of the workshop and its operation facilitated my learning about the Flipped Classrooms
Q7: There was adequate time for discussion and networking
Q8: I learnt from working collaboratively with people from my table
Q9: The Presenters did a good job in facilitating the workshop
Q10: The venue and facilities were appropriate for the purpose

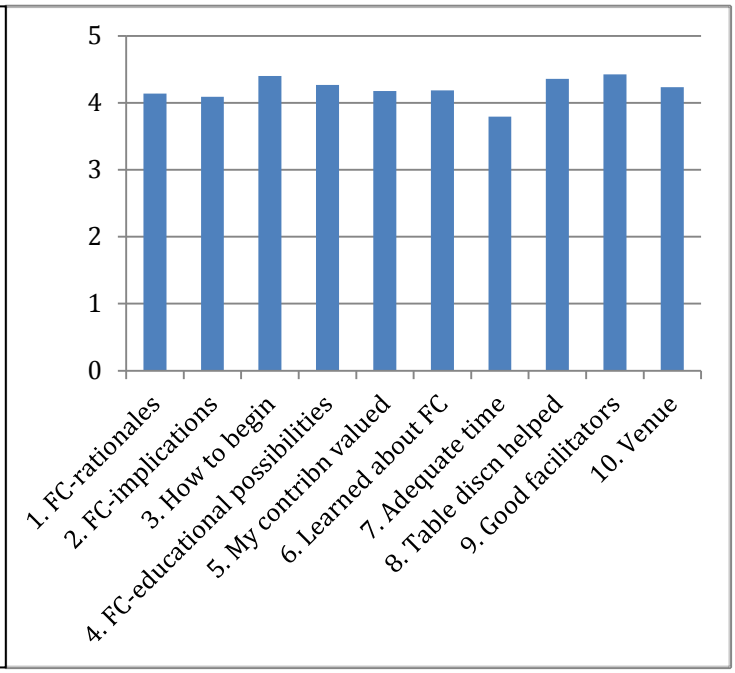

Figure 7: Q1 to Q10 workshop ratings averaged across all participants from all workshops

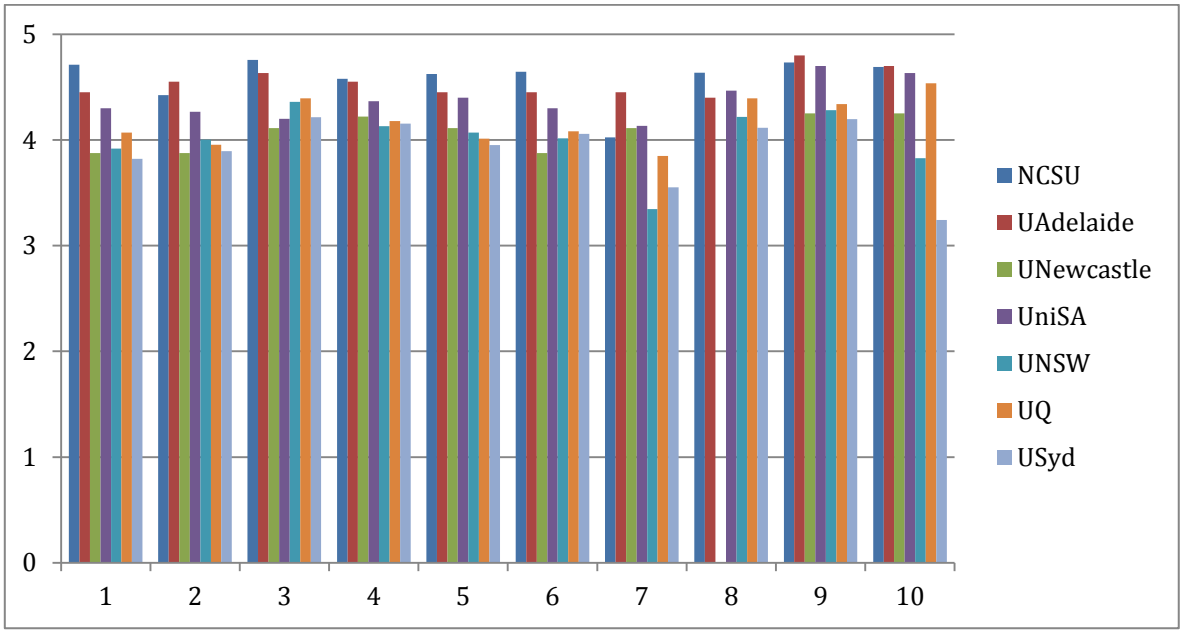

Figure 8: Q1 to Q10 workshop ratings for each institution

Figure 7 suggests that overall, the workshops were well rated, with most questions being rated as agree or strongly agree. The strongest ratings (Q3, Q8 and Q9) indicated that the workshops helped the participants to begin thinking about how they might design their own FC course, with the table discussions and the workshop facilitators helping their learning. The FC rationales and implications were less strong, with the weakest point being insufficient time. This pattern was consistent across all institutions (Figure 8). Ratings were most favourable for NCSU and The University of Adelaide, with the least favourable being UNSW and USyd who were less happy with the time available and the venue in which the workshop was held.

Open Text Questions

Participants were asked to respond to the following open-ended questions:

1. What aspects of the workshop did you find most thought provoking?
2. What aspects of the workshop did you find least helpful?
3. What suggestions do you have for improvement for future workshops?
4. Any other comments?

Surveys were collected and transcribed from six Australian and one US institution. The University of Newcastle, UQ, UNSW, USyd, NCSU, University of South Australia (UniSA), and The University of Adelaide. In total, 296 participants provided feedback.

The participants' feedback comments were investigated using the Black Hat emergent issues to see whether the workshops were able to address any of the issues that had been named by participants as the major barriers (Appendix L). In addition, the comments were categorised to investigate any other themes that emerged naturally from the data regarding the participants' experiences in the workshops.

Appendix N shows that there were comments relating to the five main Black Hat themes of teacher, student, institution, technology and spaces. There were important sub-themes emerging that related to the workshop process: changing roles, collaborative work, doing the flip, sharing of resources, and case studies and concrete evidence needed. Appendix O sets out a full summary of the themes that emerged from the workshop surveys.

These comments and the themes that emerged from them, helped to give the CRG insights into what worked and what was missing in terms of achieving the objectives of change and of teaching using a FC through authentic learning methods:

- Promoting change: The workshops helped to move participants from focusing on barriers, emotional blocks and not knowing how to begin, to believing in possibilities and in thinking about how to begin. This was done by use of the de Bono's Hats, the collective energy that came from working in teams, and the real help that was given by peers and through the workshop activities.

- Promoting Understanding: The workshops helped participants to more fully understand what a FC is, and the steps required for designing one. This was achieved by 'doing the flip'; i.e., the use of the collaborative design work, working through the steps of design and planning using the structured workbook as a resource, and trialling various tools and technology that would be of assistance in team activities or production of online materials.

Workshop Outcomes

As a follow up from those who attended the UQ workshop, Appendix P shows different groups of people working along a flipping continuum:

- UTS became a partner in the situational and cross-comparative case study analysis along with Edith Cowan University (ECU), CQU and Griffith University.
- There are people leading the way in Australia/NZ along with UQ. There are papers already published or in press.
- Some people began flipping just before or just after the workshop and are developing other projects and ventures as a result: workshops, reading groups, data collection, publications, and two OLT projects awarded (UniSA/University of the Sunshine Coast (USC).
- Some people began flipping partially, especially at UQ. This may have been the biggest impact from the workshop at UQ.
- Small changes are being made in places as a result of the workshop/subsequent presentations.
- Flipped classroom changes have been given the credit for good accreditation outcomes.

Learning Partnership/Community of Practice

The UQ workshop in December 2013 demonstrated that there was a great need for practical advice and support for the sector on flipping the classroom. At the time there was a clear opportunity to form a national Community of Practice (CoP) for the FC which participants and their colleagues could join to obtain and share assistance. Attempts by the CRG towards establishing an online CoP to support existing and potential learning partners was unsuccessful. Academics are generally too busy to participate and research on the subject of developing communities of practice suggests that the appointment of a dedicated CoP manager would be a necessity in order to facilitate conversations, follow up on requests and synthesise opportunities as they develop.

The CRG discovered that attempting to keep up with the large number of requests that were being made would require far more academic resources than had been requested for the project. A listing of the requests for information on the learning partnership that was provided on the OLT project website is provided in Appendix Q, Table Q.1. Out of a total of 110 requests made, 80 provided contact details. The majority of requests emanated from

Queensland with 73 per cent of all requests coming from New South Wales and Queensland combined. The request locations represent over half (24) of the 43 universities in Australia, and five out of the eight Go8 universities who are listed also issued invitations to deliver workshops on their campus.

Website

A significant positive outcome has been achieved through the internal support that was informally acquired and provided by ITaLI who set up and maintained the OLT Flipped Classroom Project website. The website has been instrumental in delivering pre-learning resources as well as analytics data for all of the invited FC workshops that have been held. An analysis of the website traffic (Appendix R) suggests that it has played a key role in raising the profile of the OLT Flipped Classroom project and aiding dissemination of the project to national and international audiences.

Over the past year, the ITaLI website has averaged more than 3,000 visitors per month, with over 68,000 visitors. The most popular page is the "What-is-a-flipped-classroom" page which had approximately 44 per cent of the traffic since the start of the site in August, 2013. This page acts as a launching page to the OLT Flipped Classroom Project page where over 3,000 visitors have used specific OLT project pages from most countries (Appendix R, Figure R.3) - this represents around 12.5 per cent of the site traffic (since tracking was able to be implemented on the OLT section in late August 2014).

ASEE Conference Award and Flipped Classroom Video

In June 2014, the paper *Flipping the Classroom at Scale to Achieve Integration of Theory and Practice in a First Year Engineering Design and Build Course* was selected as a top five finalist in the best papers category representing the Design in Engineering Education Division at the ASEE conference in Indianapolis, Indiana in the United States. Considering that the conference regularly attracts over 2,000 submissions, this was a significant achievement highlighting the innovation that this project aimed to support.

To accompany the award winning paper, EAIT provided over $20,000 in financial support towards the production of a video of the UQ Case Study course (ENGG1200) which was played (and uploaded to YouTube) as part of ASEE TV:
www.youtube.com/watch?v=L8C4iG5oS4Y&list=PLGVe6BxyFHNV7oYIU7_3okX_yk4lw6J9G&index=11

Publications

The project team were able to maintain a consistent and effective output of publications primarily through conference papers as well as some journal articles. While the bulk of the publications (~80 per cent) were generated by the CRG at UQ, the additional output was generated by project partners at the University of Pittsburgh's Engineering Education Research Centre and USyd. These publications represent the early work on developing the

case studies that were originally planned between UQ, USyd and the University of Pittsburgh. The full list of the project's publications is contained in Appendix S.

In addition, a major output and resource from the project exists in the soon to be published book, *The Flipped Classroom: practice and practices* which has been accepted for publication by Springer Science+Business Media Singapore Pte Ltd. The contract has been signed and all chapters have been submitted to Springer, due for release in early 2017. Neville Smith (research officer who replaced the senior researcher) and CI-5 coordinated the production of the book across a broad number of national and international contributors, many of whom had either attended one of the workshops or had become aware of the project through the OLT Flipped Classroom Project website.

The original proposal for the book, while initially conceived of as a set of guidelines (in the OLT Project Proposal) morphed into a collection of case studies supported by the outcomes that the project has generated over the course of the project. The book will contain four case studies from UQ, one from USyd, one from the University of Pittsburgh, two from RMIT, one from Griffith University, one from UTS, one from Nanyang Technological University, and one from ECU. Disciplines covered are business, engineering, education, health sciences, public health, clinical medicine, surveying. Chapter synopses for the book are contained in Appendix T.

eLIPSE Centre

A significant and direct impact from the project can be found in the establishment of eLIPSE in the UQ School of Mechanical and Mining Engineering. As a result of CI-3 departing for the University of Texas, Austin, to become Associate Provost of Teaching and Learning, the CRG faced a huge challenge in developing the innovative eLearning tools that the flagship FC (with over 1,100 students and no lectures) and its aims of understanding learning design patterns relied on. The CRG met this challenge by creating eLIPSE, which was approved in July 2015.

The Centre has substantial funding as well as 10 academic-led (and funded) TEL projects. Some of these projects have been previous ALTC and OLT funded projects which address a range of active curriculum needs (teams, assessment, evaluation, curriculum mapping, student feedback and communication and learning analytics). The Centre is directed at continuing the aims of the FC project specifically targeted at rolling out the eLearning tools that have emerged from flipping the classroom at scale with the support of both the US and Australian Learning Partnerships that have been activated.

eLIPSE has substantial research and development support and is funded until early 2017. The Centre has two faculty educational designers, three (soon to be four) full-time developers, three student developers, a centre administrator and one senior educational researcher. It also has the Pro-Vice-Chancellor (T&L) and the Director of ITS on its Advisory Panel.

An extract from the proposal to establish the Centre is given in Appendix U.

We believe that we achieved a significant amount over the course of the two year project.

Project Evaluation Summary

Evaluation and Project Goals

The ways in which the discoveries made during the course of the project helped to meet the project goals, are as follows:

(i) *This project will focus on the open sharing of experience and research data in order to identify mechanisms that are most effective in transferring practice of the unique features of the UQ Flipped Classroom approach.*

The initial goal to ascertain best practice via the international collaboration and sharing of data was unable to be realised. However, via the unexpected demand in Australia and across the world (see Figure 4) it was discovered that workshops were the best mechanism for transfer of practice in the current climate or knowledge and uptake (see Project Approach, pp. 12 - 18).

(ii) *It will also seek to understand how student and staff conceptions of teaching, perceptions of learning performance, and institutional barriers posed by the paradigm shift of the Flipped Classroom affect its adoption.*

The de Bono hats exercise run within each workshop in institutions across Australia and the world provided insightful data regarding current thoughts, emotions, barriers to change, and possibilities. The exercise helped to shift current positions held to those that are more positive and informed. In addition, it provided us with rich information regarding the current issues for uptake. Thematic analysis of the Black Hats data revealed that there were issues that were the responsibility of institutions, teachers and students for bringing about uptake of FC methods (see Appendix L, Figure 5, and Table 3).

Analysis of the feedback from the workshops revealed that the workshops successfully addressed Black Hat issues related to cultural or epistemological beliefs and needs; i.e., the need for guidance with design and content, alignment of creative use of technology and spaces, changing roles, fears about student engagement and methods for student engagement. Some remaining issues that need to be addressed in a follow up workshop are designing FC assessment activities and the need for proof and for examples (see Appendix N).

Issues that could not be addressed in the workshops, as they are the responsibility of schools and faculties were alignment of FC course with rest of curriculum, reactions from other staff, and the need for information technology and administrative support and flexibility, and equipment resourcing. Issues that could not be addressed in the workshops as they are the responsibility of institutions were the need for real recognition (financial,

promotional) real support in terms of personnel, reduction in time for other responsibilities and change management across the university at all levels, including promotion of administrative flexibility (e.g., room bookings, time-tabling). If the need for IT support and FC-spaces are added in, institutional issues together made up three quarters of the issues named by participants (see Figures 5 and 6, and Appendix O).

Evaluations and Project Improvements

During the course of the project, feedback from participants that was associated with the workshop surveys was used to make future adjustments, as follows:

- Feedback from each workshops was taken into consideration in order to make adjustments to each workshop format; e.g.:
    - timing of different sections was decreased or increased,
    - participants were helped more with organisation of ideas in brainstorming sessions (via grouping into clusters); and
    - designing your own FC session was given more facilitation and guidance through each section of the worksheets;
- The ITaLI website resources were used to help prepare participants for workshops regarding the issue of whether or not students will engage with the pre-learning; and
- Request for resources in the earlier workshops facilitated the creation and sharing of resources:
    - A workbook for workshops was created (see Appendix G). This was well received in future workshop comments; e.g., “Love having the workbook as a resource.”;
    - ITaLI created and maintained the OLT Flipped Classroom Project website used to deliver pre-learning resources as well as collect analytics data for all of the invited FC workshops (see Appendix R, Figure R.3, Figure R.4)

Evaluations and Impact of Project

- The project has had an impact on disseminating information and interest in FCs from countries all over the world (see discussion on page 30 and appendix R, R.3 and R.4)
- The common request for case studies motivated the creation of a book of case studies (in press, see Appendix T), and ENGG1200 has been evaluated and written up as a case study (in press)
- The project follow up has been used to map out the state of FCs across Australia. The data reveals a flipping continuum as follows (quotes and details of the institutions involved, are given in full in appendix P):
    - Have begun / developed further projects and ventures since the workshop;
    - Already flipping who were helped by the workshop to develop their skills and motivation;

- Had started to think about it and then began to flip fully;
- Had started to think about it and then began to flip partially;
- Flipping has been useful for accreditation; and
- Motivated by the workshop and made small changes.

Overall the feedback revealed that FCs are advancing where people are working in teams or are supported by their faculty. This information may be useful for future work in this area.

Critical Success Factors

1. Team structure is critical. Hiring specialists in project management and discipline-specific researchers at fractional contributions is far superior to appointing a single person to perform both functions. A project manager with extensive institutional administrative experience who can ensure that meetings are well documented and the project is well resourced within the institution is invaluable. Additionally, appointing a senior researcher in the discipline who can quickly pull together the research framework and can generate quick conference papers representing the project's progress is essential.
2. Maintain control of the project funds. In Australia, a common cultural practice appears to be for the project lead to distribute small ($10,000-$20,000) chunks of funding upfront in order to execute the originally funded proposal as it was written. One of the reasons given has to do with the academic belief that their contribution to a Category 1 Research Grant is not recognised without funding being transferred to the collaborating institution. There is also a cultural belief that says that there is a better chance of success in the funding rounds if there is a large number of institutions involved. When total project funds are tight ($220,000 over two years) and the project team is large, there is very little left over to appoint both an appropriately qualified project manager as well as a qualified postdoctoral-level researcher.
3. Augment the OLT funding amount. CI-1 was in a fortunate position to have had significant funding to deploy towards the project goals. Over the past four years (2012-2015) of OLT funding rounds, the average amount awarded to Innovation and Development Projects was $232,000 with an average of four institutions per project. An estimate of the non-OLT expenditure for ID13-2840 was $275,000.
4. Align to stakeholders. OLT projects are situated in complex cultures with differing aims, aspirations and needs. As such, the success of a project, more often than not, owes itself to a large extent to how well the academic project leaders are able to align the project's aims and aspirations with that of the institution. Project ID13-2840 built on a common faculty first year course (ENGG1200) supported by strong collaboration with UQ's central ITS and the DVCA's CEIT. Having the FC course as a central object of investigation and re-development created significant opportunities to generate institutional, industry and philanthropic funding allowing for the establishment of the eLearning centre, eLIPSE, which is now directed by two members of the CRG.

5. Build on earlier work. It is vital that scholarship in teaching and learning proceed from, and acknowledge the work of, others in the sector and that it is in keeping with best practice research and development regardless of discipline. This project continues the development of work begun by Robin King and the Australian Council of Engineering Deans and CI-1's 2007 submission to the Carrick Institute's *Addressing the Supply and Quality of Engineering Graduates for the New Century*, Discipline-Based Initiative project. Engaging with this project and subsequent collaboration with the ALTC Discipline-Based Scholars in Engineering project headed up by Ian Cameron and Roger Hadgraft provided a strong grounding for work conducted in the 2008-2010 ALTC Priority Project, PP8-919 *Design-based curriculum reform within Engineering Education*. This project, (despite some early criticism), provided the legitimacy, for undertaking the ENGG1200 experimental curriculum and assisted in maintaining a clear focus for the work that has been conducted in ID13-2840 *Radical Transformation: re-imagining engineering education through flipping the classroom in a global learning partnership*.

Future Work

The following areas are worthy of consideration for future work that can build on the success of ID13-2840:

1. Consideration should be given to capitalising on the wide Australian Learning Partnership which has grown out of this project. The Learning Partnership spans a broad range of disciplines and includes The University of Sydney, University of Technology Sydney, The University of Adelaide, The University of Queensland, and RMIT University (and a few others), who invited and paid for workshops at their institutions and who would be primed to continue engagement with a project that might now focus on ways to deploy Learning Analytics/Personalised Learning in a coherent and practitioner-based manner that is grounded in research;

2. A wide selection of eLearning tools that emerged from the work done in the FC and which are now funded out of the eLIPSE Centre could be better deployed to those in the sector who have expressed a strong demand and who don't have the advantages that the new Centre brings to academics seeking to improve blended learning at their institutions. These include tools that span a wide area of need including:
    - Team peer assessment
    - Written reflection
    - Curriculum mapping
    - Semantic analysis of open text responses
    - Learning assessment

- Learning analytics and visualisation tools (Learning Pathway)
- Synchronous Online Peer Assisted Learning (based on UC Berkeley's MOOCchat tool, which was created for edX courses (Ghadiri, Qayoumi, Junn, Hsu, & Sujitparapitaya, 2013);

3. UQ has a unique implementation of a large scale (1,100+ students) FC that has been running for four years and which has strong institutional support for its continuation with high visibility across the sector. For something this radical to have achieved "institutionalisation" says something about its alignment with future possibilities for blended learning. By virtue of its deployment supported by many of the prototype learning tools above, it acts as a flexible experimental environment worthy of further study. While this project sought to explore ways in which to transfer practice in the FC, there is much that remains to be understood in regard to students' conceptions of learning in this mode and the change processes that helped to bring about such a radical change in learning within a highly-ranked, research intensive university.

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Appendix A: Certification

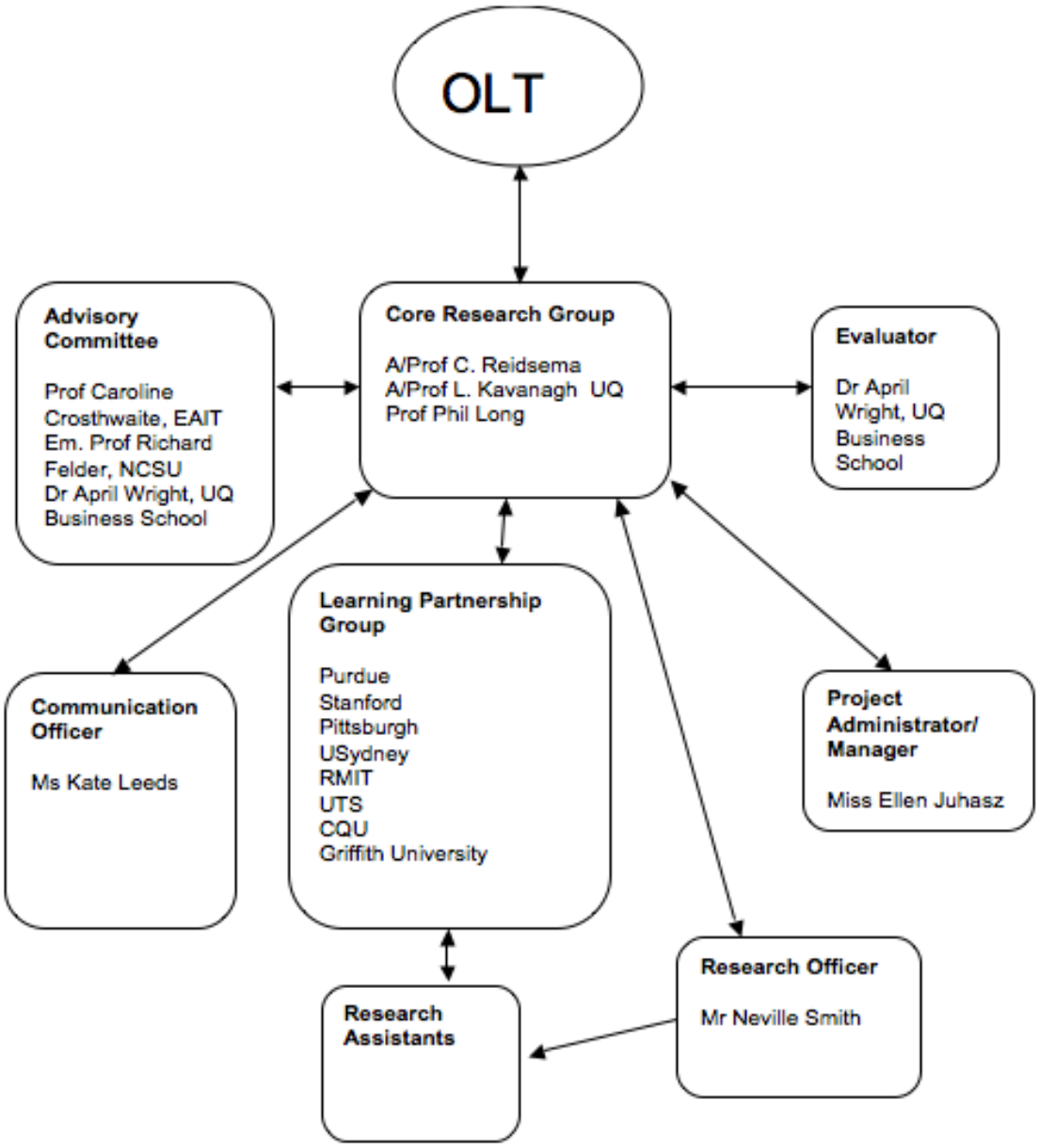
Certification by Deputy Vice-Chancellor

I certify that all parts of the final report for this OLT grant provide an accurate representation of the implementation, impact and findings of the project, and that the report is of publishable quality.

Name: Professor Doune Macdonald, Acting Deputy Vice-Chancellor (Academic)

Date: 24 May 2016

Appendix B: Project Team



Appendix C: Evaluator's Report

EVALUATION REPORT

Radical transformation: Reimagining engineering education through flipping the classroom in a global learning partnership

Lead institution: University of Queensland

Partner institutions: Pittsburgh University, Purdue University, RMIT University, Stanford University, University of Sydney

Project leader: Associate Professor Carl Reidsema

Evaluator: Associate Professor April Wright, UQ Business School, University of Queensland

1.0 Approach to Evaluation

As an outsider to the project located at the same university as the lead project team but in a different discipline area, my approach to evaluation is both formative and summative. I was a member of the Reference Group, attended numerous project meetings, kept regular contact and updates via email, and met independently with the project leader and research manager on occasion. I observed the significant impact and recognition the project had in 'reimagining' the teaching of large classes across Schools and Faculties at the lead institution of UQ through my role on the university Teaching and Learning committee. Finally, I applied my learning from my formative role as a project evaluator to my own teaching and re-designed a final-year capstone course using flipped classroom principles, insights and resources that were the outcomes of the FC project.

After providing formative feedback to the lead project team in the form of an interim evaluation report earlier this year, this report represents my summative evaluation of the project and its outcomes.

2.0 Evaluation Methods and Key Questions

The project team built an extensive amount of data collection activities and learning analytics into the project to measure the impact of the flipped classroom on student learning in engineering courses at the lead and partner institutions. They also collected questionnaire data from participants in Flipped Classroom workshops nationally and internationally, and sourced case studies from users of Flipped Classrooms for their book, as a substantive project output. In evaluating the project, I was given access to these data sources as well minutes of all project meetings, publications, reports, workshop materials, and the FC web-site. In evaluating the project, I have paid most attention to the outcomes of the project for two primary stakeholder groups – students as learners within flipped classrooms and teaching staff as users of flipped classrooms.

My evaluation addressed the following five summative questions:

1. *To what degree was the project implemented as planned and funded?*
2. *To what extent have the project stated outcomes been achieved?*
3. *What, if any, unintended outcomes have been identified?*
4. *What measures, if any, have been put in place to promote sustainability of the project's focus and outcomes?*
5. *How might future projects be improved?*

These questions are used to structure the narrative of evaluation report.

2.1 To what degree was the project implemented as planned and funded?

The project is described in detail in the project final report. These evaluator comments relate to the extent the project proceeded as planned. Processes for managing and administering the project were implemented early in the project to ensure momentum towards deliverables. Weekly meetings were held between the core research group of UQ-based investigators, research staff associated with this project and the spin-off Learning Pathways Project, and learning support staff from within UQ. I attended several meetings and observed high levels of engagement in, and commitment, to the project from all of those involved.

Processes for communicating and disseminating the Flipped Classroom project within the Engineering School and Faculty and broader University ensured excellent internal support for the project. There was regular contact with CI Long, now based at the University of Texas, and with CI Pardo (Uni of Sydney) and CI Hadgraft (who relocated from RMIT to CQU). Processes for collaborating with international partners at Pittsburgh, Purdue and Stanford Universities in the US were less embedded than with national partners due to distance and other institutional barriers, as described in the Final Report. The book project was helpful for strengthening collaboration and advancing the proposed cross-case comparison of Flipped Classrooms at the project sites.

Processes for open sharing of data, which was one of the key aims of the project, were not effective as initially proposed, although not through lack of effort on the part of the core research group of investigators. The aim itself was an ambitious one and perhaps ahead of its time compared to the current level of development of institutional and academic thinking around intellectual property rights and ownership and publishing of research data. As a result, the investigators modified their processes regarding transparency of practices and open sharing of a literature review library, student survey, data and methods.

UQ, University of Sydney, Pittsburgh and Purdue universities performed cross-case comparison of Flipped Classroom design and learning outcomes. There was limited involvement from Stanford and progress at RMIT was slowed due to CI Hadgraft's relocation from RMIT. While these barriers have meant Global Learning Partnership processes among the six original partner universities were ultimately less effective than had been proposed, the core research group developed other processes for communicating, disseminating and collaborating with an expanding group of universities in Australia through the Learning Pathways online project, the Flipped Classroom website and OLT Learning Project website, and through workshops nationally and internationally.

The core research group developed alternative avenues to collect data (eg UTS as a case site in place of Stanford) and adapted to the capacity and resource constraints that limited the levels of participation and engagement by Purdue and Pittsburgh universities. Given the volume of learning analytics and other data generated by the project, some of the budget was re-directed to employing more research support staff, which was both appropriate and important for maximising the project's outcomes.

2.2 To what extent have the project stated outcomes been achieved?

The project achieved its aim of communicating and disseminating FC design and thinking through forms that are practical, accessible and have wide reach, via websites, workshops, and conference presentations. In terms of publications, the book represents a significant achievement in terms of its wide range of contributors (national, international, and multi-disciplinary) and its blend of both theory and practical case studies.

The project has successfully generated interest and enthusiasm in experimenting with Flipped Classroom designs among the national and international community of educators across disciplines. An impressive number of workshops have been conducted nationally and internationally, with overwhelmingly positive feedback from attendees. The FC project website has been accessed by a wide range of users and has provided a forum for sharing resources (given barriers noted above) among the community of educators interested in FC.

There is noticeably strong take-up of FC at UQ as a result of the project and ongoing commitment by the university to allocating and refurbishing more of the university's teaching rooms into collaborative learning spaces to support flipping classrooms, both in smaller courses and at scale in very large courses. Case studies of FC conducted at UQ, The University of Sydney, Pittsburgh and Purdue in course sizes ranging from 80 to 1200 show more active and interactive student participation. Learning Pathways has emerged from the OLT project as a key spin-off project for achieving the original project's e-learning aims, and has gained a high level of additional funding support from within UQ ($460 000).

2.3 What, if any, unintended outcomes have been identified?

While project was originally proposed as a Global Learning Partnership, the project evolved into a much more extensive national learning partnership than originally anticipated while retaining some of its international collaborative flavour. The global partnership was weaker than originally proposed due to Stanford's disengagement and the effect of cultural and institutional differences on the nature and scope of collaborations with other international partners.

Nationally, however, the project had a powerful impact as a learning partnership, with new partners coming on board for inclusion in cross-case comparison (eg UTS) and in the Learning Pathway project (eg Edith Cowan, CQU and Griffith Uni). The very high number of workshop invitations was perhaps also unanticipated but is a positive outcome of the project. The FC book, which has won support from publisher Springer and advances pedagogical theory and practice of FC, is expected to further expand the geographical and disciplinary reach of the project and to help embed and reinforce FC in day-to-day teaching and learning practice.

2.4 What measures if any have been put in place to promote sustainability of the project's focus and outcomes?

As noted above, the project's focus and outcomes are being sustained through more universities coming on board as learning partners in cross-case comparisons and through the Learning Pathway spin-off project, which has received additional funding support from UQ ($460 000). Re-furbishing teaching rooms into collaborative learning spaces to support flipped designs (which, as noted above, is occurring at UQ) is also a key element of sustaining long-term changes in practice from the project.

In addition, the book is expected to play a major role in sustaining practice change from the project. The FC book has a diverse range of practical examples across disciplines, institutions and countries that offer guidance on both 'why to' and 'how to' implement a course flip. The following quote from one of the book's reviewers highlights its potential for sustaining the project's focus and outcomes:

> *What particularly appeals to me about this proposal is its balance between theory and practice. Few of the instructors I know who have flipped their classrooms are aware of the prior educational innovations that flipped classrooms build on. At the same time, very few are aware of the epistemological shift, and associated possibilities and pitfalls, that teaching in a flipped manner can lead to, i.e. from a simple knowledge transfer model to co-constructing meaning. For these reasons I think that a book that focuses on the practical issues of flipping, alongside theoretical considerations, has the potential to have a major impact on the community.*

2.5 How might future projects be improved?

While this has been a very successful project, there are a few possible improvements. First, the project has generated a solid number of conference papers and a potential area for improvement would be to progress some of the papers from this pipeline into journal review. There is increasing interest in advancing the pedagogical theory and practice of flipped classrooms and the project team is well positioned to push theorising forward both in general education journals and engineering education journals more specifically.

Second, there are clear lessons to be learned from this project about the challenges of sustaining global learning partnerships after the period of initial creation. While all partners in the project entered the arrangement with good intentions and motivation to engage in ongoing commitment, this enthusiasm did not translate into the anticipated ongoing global partnership. There is an opportunity for future projects to examine the individual-level, organizational-level, institutional-level and cross-cultural differences that help and hinder the implementation of global learning partnerships. More work is needed around the structural processes and mechanisms that can be introduced to embed closer connections as well as the characteristics of investigators, partner organizations and partnership forms that are more likely to lead to successful outcomes.

Third, this project offers lessons about open sharing of data pertaining to educational innovation. Although the philosophy and principles of open sharing would seem to be highly consistent with the OLT goals and mission, much remains to be learned about how this

philosophy can be translated from abstract ideal into concrete practice in the day-to-day of university education. The outcomes of this project suggest that much more investigation and development is needed around intellectual property issues pertaining to open sharing of data in teaching and learning projects.

Finally, the project provides an example to future projects of how to leverage momentum in one sphere of teaching and learning to promote advances and institutional support in related spheres. By connecting the flipped classroom pedagogy to the configuration of university teaching space, this project was able to create a compelling case for institutional support that will embed long-term improvements in student learning outcomes in flipped classroom practices. Given that active learning pedagogies are heavily dependent on the spatial configuration of university teaching facilities, this project provides an exemplar for future projects seeking institutional support for pedagogical innovations that are dependent on access to teaching space.

3.0 Conclusion

This was an ambitious and important project. While the project may not have achieved its intended aims in terms of the global learning partnership and open innovation, the project has produced major advances in the thinking and practice of flipped classrooms at scale. Notably, the project has been successful for two key stakeholder groups – students and teaching staff. It has improved learning outcomes for students in courses that have flipped at scale and provided teaching staff with motivation and resources to experiment with flipping classrooms. Importantly, the project has built a national community of practice – and contributed to an emerging international community of practice - for flipped classroom users both within the STEM disciplines and across other disciplines, including health care and business. It has initiated institutional support for reconfiguring teaching spaces to support flipped classroom designs.

Evaluator: Associate Professor April Wright
Date: 2 August 2015

Signature: A. L. Wright

Appendix D: Visual Notes from Stanford Workshop

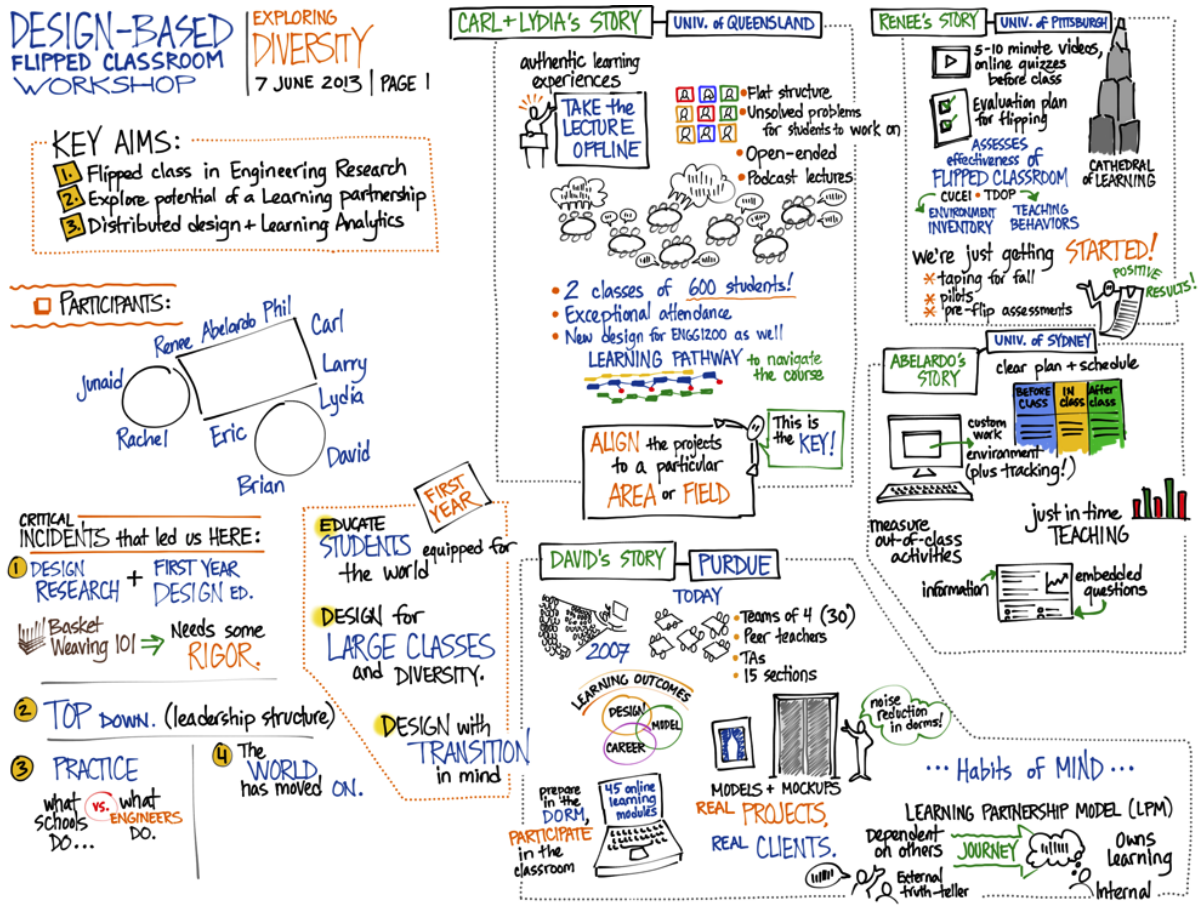


Figure D.1: Exploring Diversity

Figure D.2: Grant Overview

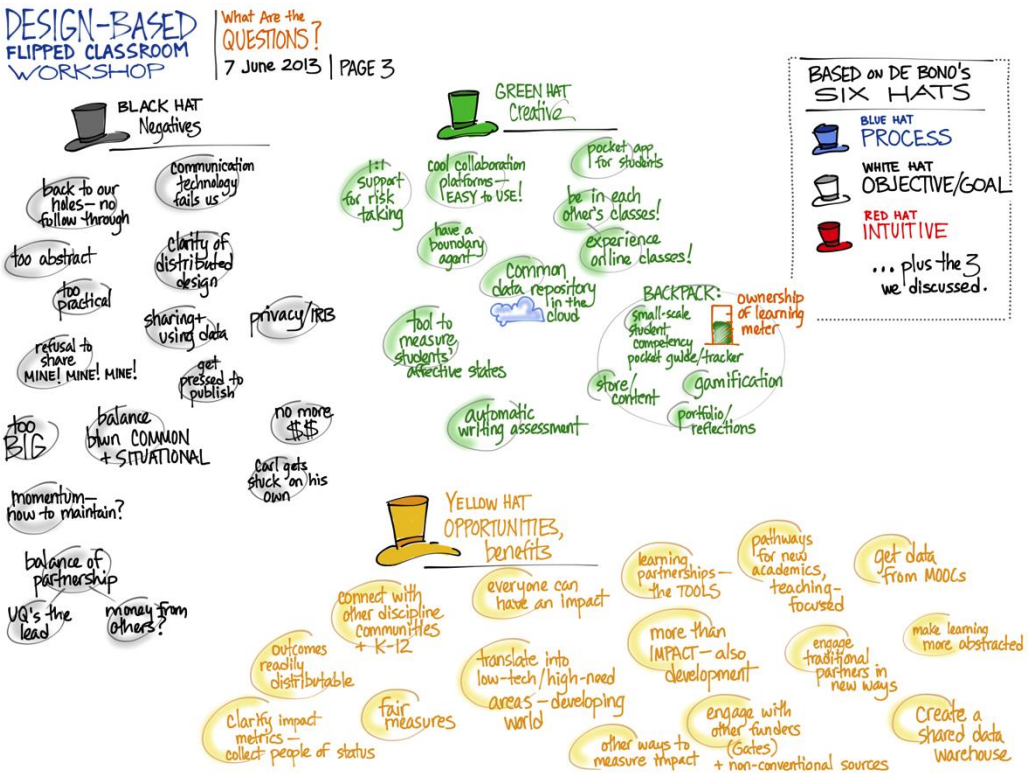


Figure D.3: Six Hats

Figure D.4: Data

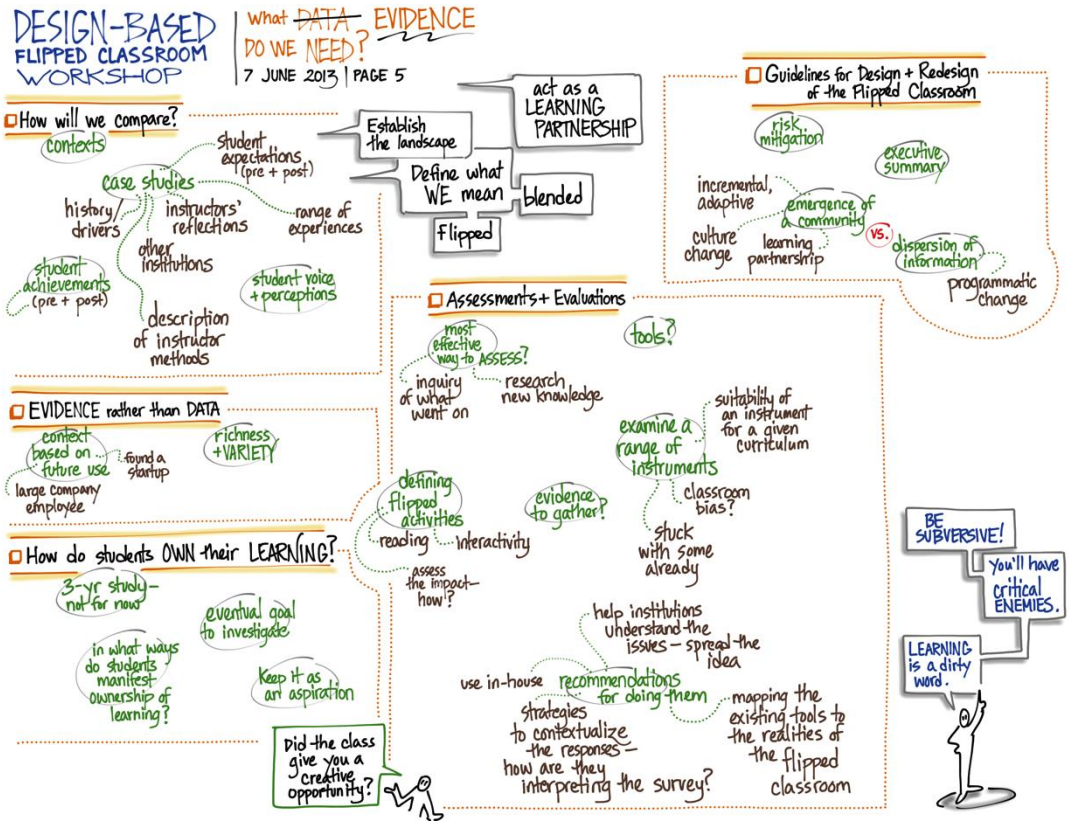


Figure D.5: Evidence

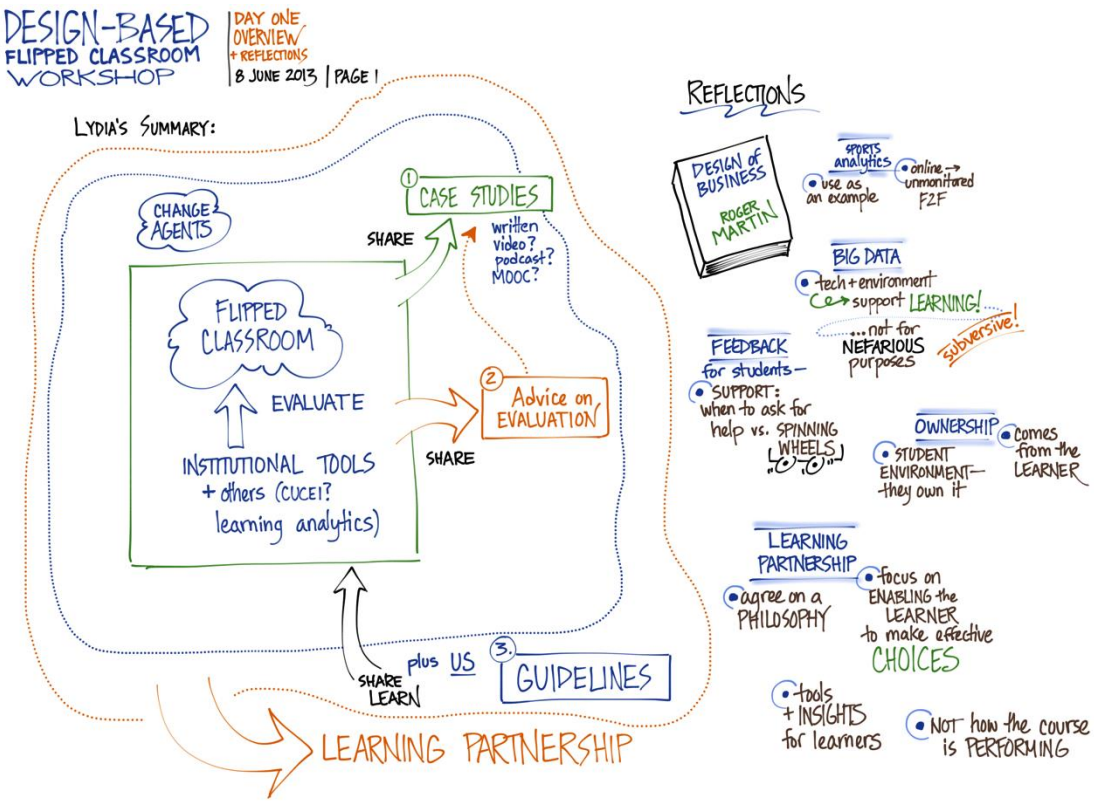


Figure D.6: Day 1 Overview

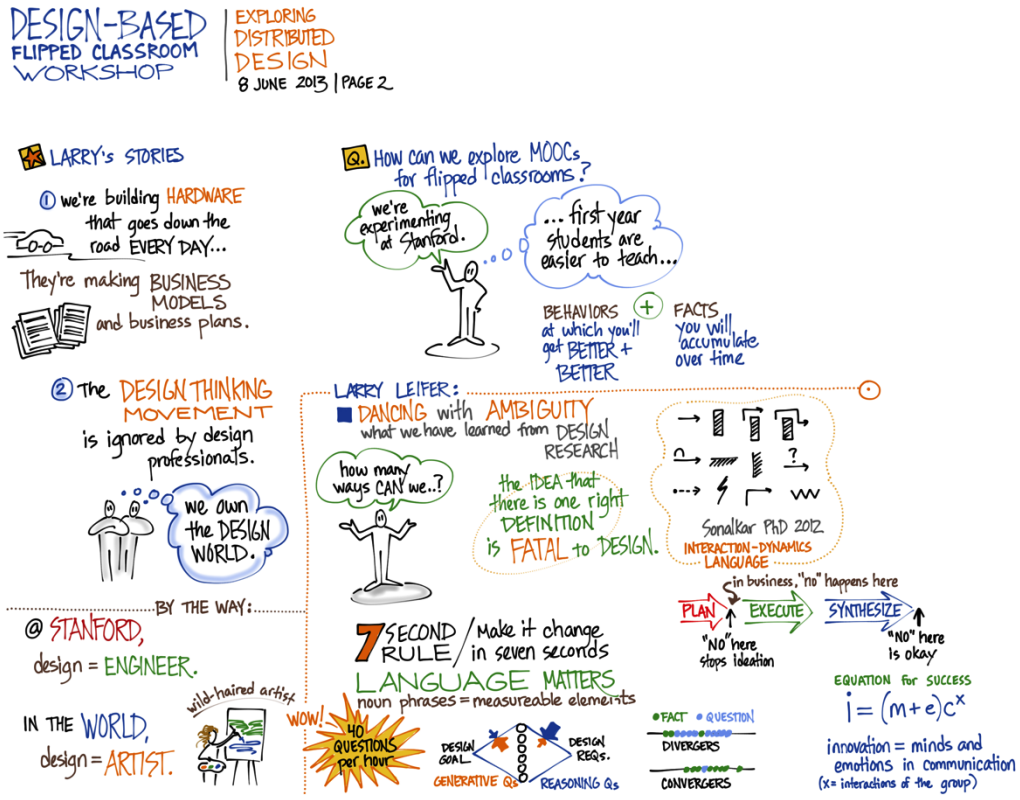


Figure D.7: PI-3 Larry Leifer (Stanford U)

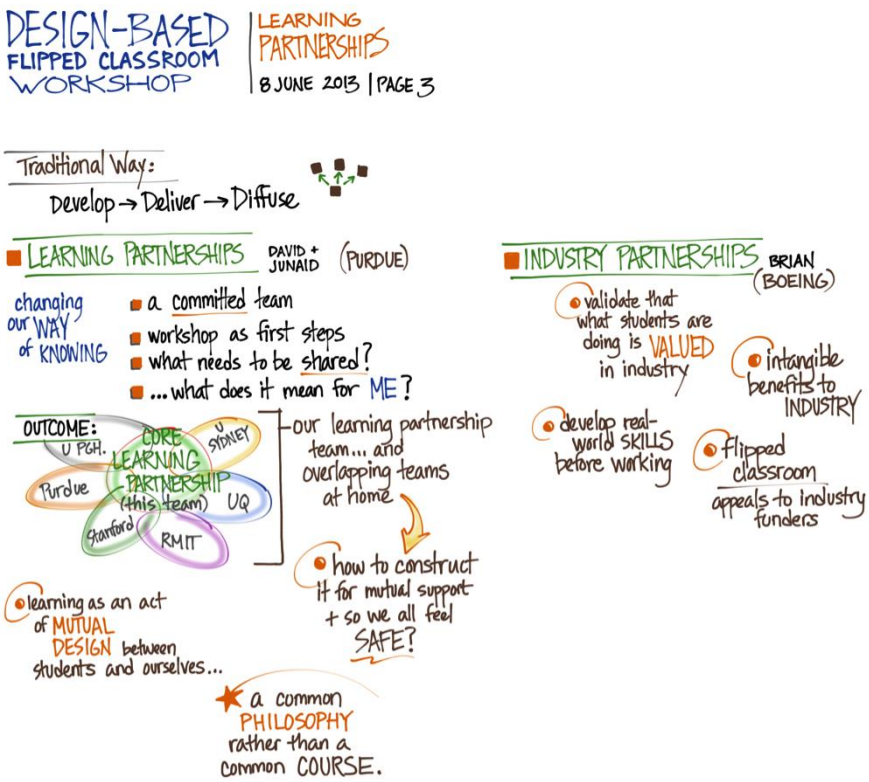


Figure D.8: Partnerships

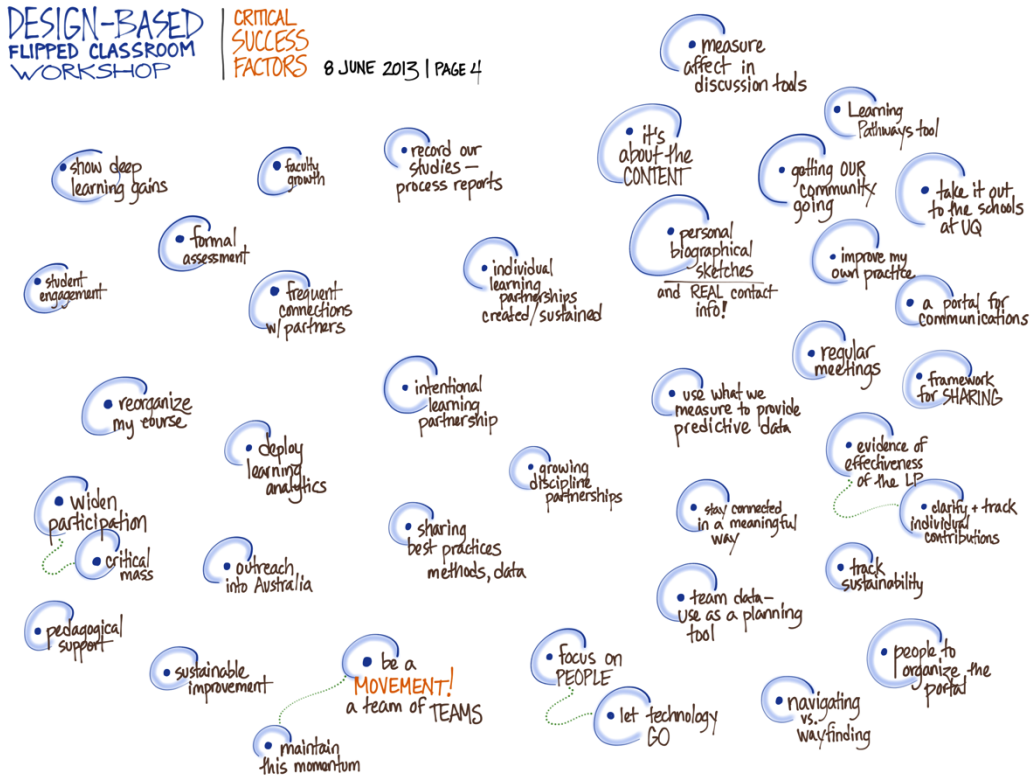


Figure D.9: Success Factors

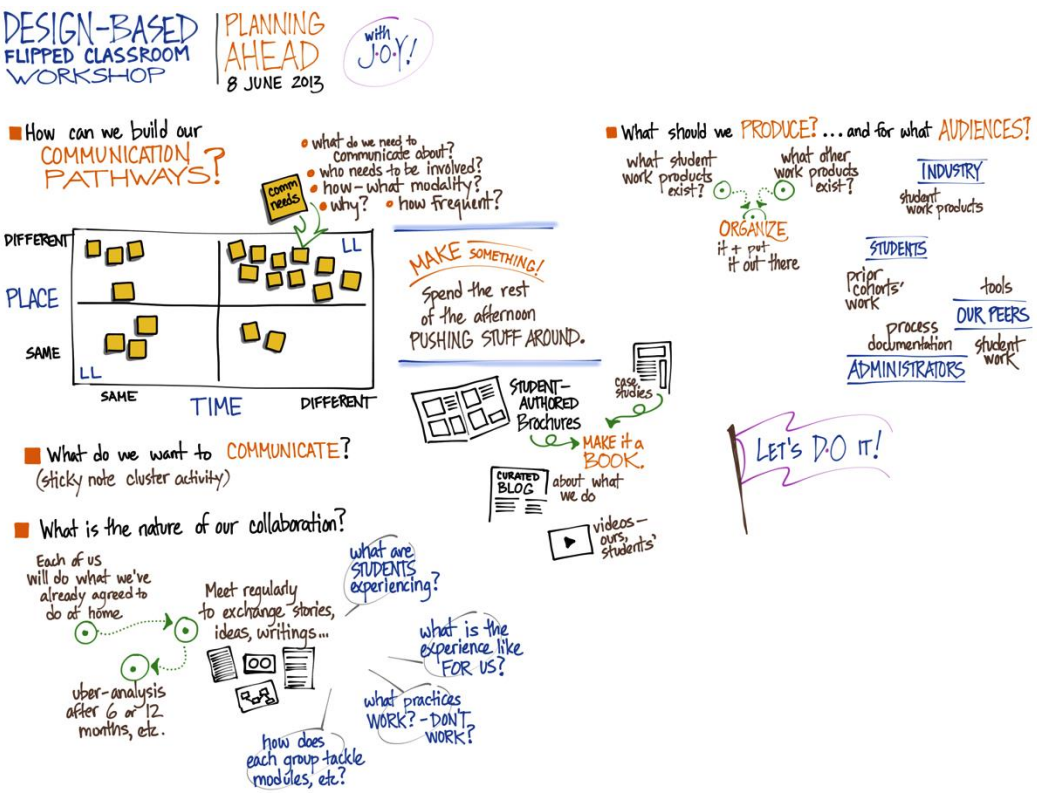


Figure D.10: Planning Ahead

Appendix E: Flipped Classroom Situational Maps

ENGG1200 – Engineering Modelling and Problem Solving– Semester 2, Year 1

Institutional Context • Public funded/research intensive • Ranked 2nd (Australia) and in the top 100 internationally • 100 years old • Recent edX member • 1200 students enrolled annually in engineering • Teaching Focused (TF) academic program • Strong but informal SOTL strength in engineering and science	**Course Design/ Delivery** • Engineering Modelling and Problem Solving through authentic team based major design/build projects • Flipped Class mode with engineering materials concepts delivered through online videos • Entirely active learning/no lectures • Balanced individual/team learning	**Instructor Characteristics** • Professorial leadership with extensive industry experience • Award winning TF academics • Learner/student focused • Change agents • Project leaders and tutors carefully selected – enthusiasm, desire to work with first years, ability to challenge students • Teaching team ~40	**Student Characteristics** • 100% transfer from ENGG1100 with similar demographics • Multiple engineering disciplines • Mix of engineering statics, thermo, electrical fundamentals • Mix of 1st year maths ability • Improved social networks • Improved conceptions of degree major
Community Expectations • Engineers Australia (EA) • Emphasis on theory-practice, critical thinking, engineering ability • Grow Industry funding through student project sponsorship (Boeing, ABB, Barnes Foundation etc.);	**Learning Objectives** • Appreciation of mathematical/ virtual/physical modelling • Application of engineering materials behaviour in design • Demonstrated ownership of learning • Reflective writing for design thinking and planning • Effective team skills • Use of design process	**Instructor Motivation** • Largely intrinsic rewards for degree of effort • High probability of promotion through change leadership • Opportunity to engage in research around design learning and transformational change • High degree of ownership but significant teaching team autonomy	**Student Motivation** • Still predominantly strategic learners • Strong desire for authentic learning and experiences • Seeking relevance • Developing levels of ownership and identity • Critical team players
Curriculum Context • Course Evaluation results • EA commendation • Academic conceptions of technical rigour • Industry recognition • National awards received • Balance research intensive image with real world authentic learning	**Assessment** • Varied assessment types • Online MCQ/written reflections • Team design reports • Structured activity templates • Demonstration of final designed product performance • Team peer review	**Teacher Behaviours** • Emphasis on teaching as facilitation and coaching • Emphasis on experiential learning • Extensive use of PG/UG tutors • Extensive use of Facebook/email/ LMS communication modes • Strong emphasis on developing student's agency	**Student Behaviours** • Predominantly strongly motivated • Mixed cohort of epistemological developmental levels (3-4 Perry) • Accepting of challenges • Struggle with teaching vs learning • High degree of participation

ENGR 0145– Statics and Mechanics of Materials 2– Year 1

Institutional Context	Course Design/ Delivery	Instructor Characteristics	Student Characteristics
• Research intensive institution • Carnegie rating: RU/VH • Pitt to offer 5 MOOCs via Coursera (Nuclear Science, Accountable Talk, Clinical Terminology, Disaster Preparedness, and Nutrition/ Physical Activity) • Flipped classroom promoted by Dean of Engineering via internal grants to instructors	• ENGR 0145 covers statics and strength of materials and internal stresses, strains, and displacements that occur with applied loads. • A course web site is used to make information (e.g. class notes) available. • Teamwork-intensive class, including in-class team quizzes and in-class graded design problems.	• Internal grant recipient for flipped classroom implementation • Associate Professor of Mechanical Engineering • Respected instructor • Research focuses theoretical solid mechanics, strain gradient plasticity, processing of sintered materials, the mechanical behavior of collagenous materials, and life prediction models for turbine airfoils.	• Estimated 30 students in class (Fall 2013). In Spring term, increases to 120. • Sophomore mechanical and materials engineers • 78% male • 78% White/Caucasian • 17% Black/African American • 4% Hispanic
Community Expectations	**Learning Objectives**	**Instructor Motivation**	**Student Motivation**
• Accredited program (ABET) • Dean of Engineering is anticipating an increase in active learning techniques using Pitt's state-of-the-art classrooms in an optimal manner	• Increase engagement, excitement, and investment in learning the concepts in this course. • Development of a physical intuition for the concepts and equations. • Ability to apply knowledge in future courses and beyond.	• The instructor feels too many students are completing the course without mastering the fundamental skills. • The instructor would like to "reach" the lower performing students via flipping. • Longer and more in-depth team activities during class.	• Although the instructor is aiming for increased engagement and excitement, the motivation level of the students is generally still good.
Curriculum Context	**Assessment**	**Teacher Behaviours**	**Student Behaviours**
• This is a required sophomore level, 3-credit course. • This course typically meets 3X/ week for 50 mins each day.	• This instructor currently assesses based on formal exams (60%), team quizzes (10%), in-class team design problems (20%), and homework (10%). • To assess the flipping, we may possibly track performance in two follow-up courses in the curriculum.	• Using the TDOP, this instructor lectures with a combination of PPT slides and a laser pointer, diagrams and equations drafted on the white board, and demonstration of the topic using a physical object. • Instructor very well known and appreciated for his clarity in teaching and conveying knowledge.	• The students appreciate the chance to work in teams. • The learning at times tends to be rote learning of equations and solution methods; hence, the instructor's motivation to increase engagement and depth of understanding.

Appendix F: Additional Impact from Sydney and Monash Universities

THE UNIVERSITY OF SYDNEY

Q: I'm wondering though whether you could add some thoughts on the project in regard to the impact that it had for your work with the Flipped Classroom initiatives that you've been pursuing in the first instance, and any thoughts that you could provide on how you think the project was impactful on the sector from your perspective?

A: Regarding the project and the impact on my work. Absolutely. The main change that the project brought about was to expose a new design framework to approach courses that put the emphasis on active learning. When shifting an already existing course or designing one from scratch (I did a bit of both with mine) considering a flipped learning methodology changes substantially the way in which you approach how students learn. You have now a context with more detailed stages, areas or spaces, and your activities and the overall design need to make the most of them.

In my case the project made me realize the importance of combining blended learning methods to create the right learning conditions before a face to face session. It also made me aware of the completely new space that opens up when face to face meetings with students are assuming certain preparation. The project has helped me map these elements to my first year course and redesign it almost completely.

This methodology is complex because it requires the combination of a much broader set of resources, tools and contexts. The project exposes all these new dimensions to take into account when adopting new active methodologies in engineering.

Cheers.

ABELARDO PARDO | Senior Lecturer

School of Electrical and Information Engineering

Honorary Associate, Faculty of Education and Social Work

THE UNIVERSITY OF SYDNEY

MONASH UNIVERSITY

Q: Could you give us your thoughts on the influence that the lead CI had on the Flipped Classroom initiative that you were heading up at Monash?

A: In 2014 and 2015, the Faculty of Engineering at Monash University conducted a holistic review of our first year program. The program itself was entirely re-imagined, and our philosophy for education was altered significantly, such that we now have a fully flipped approach in many of our first year units. Our approach was inspired by the work of Dr Reidsema, and the various programs he has led,

in particular, his OLT funded project.

Dr Reidsema has been instrumental in providing exemplars and expert critique. This has been crucial to mold our revised first year program in Engineering at Monash University. Dr Reidsema visited Monash University twice to provide his expert insight, and was in regular contact with me, the Associate Dean (Education) throughout our transition. Dr Reidsema was kind enough to share many learning materials and several quantitative and qualitative evidences of the success of the flipped approach.

Dr Reidsema's influence was critical in:

The construction and interplay of units within the program;

The constructive alignment of learning outcomes with assessment regimes;

The flipped delivery of learning materials, in conjunction with providing evidence to support our transition to student-led learning in large class environments;

Our approach in developing and delivering the multimedia learning materials we relied upon, in addition to our in-class approaches, and design-based projects.

Based on Dr Reidsema's support of our course redevelopment, I invited Dr Reidsema as the keynote speaker to a symposium on "Flipped classrooms for STEM faculties". His presentation was very well received by many, and ensured that his approaches were widely shared beyond our Engineering Faculty.

Sincerely,

Kris Ryan

Associate Dean (Education),

Faculty of Engineering
Monash University

Appendix G: Flipped Classroom Workshop Material

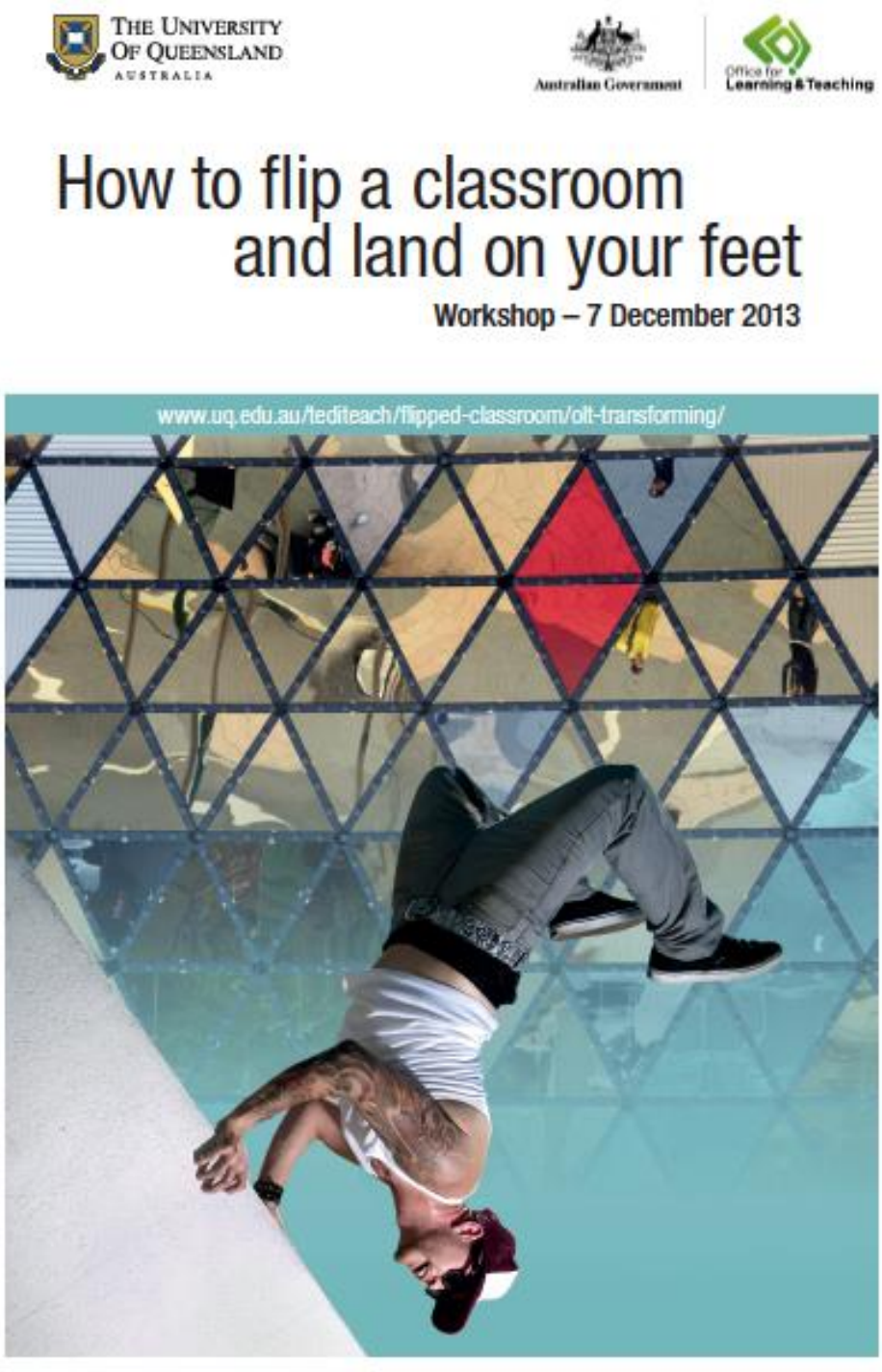


Figure G.1: Cover of FC Workshop Workbook - Full workbook can be viewed at www.uq.edu.au/teach/flipped-classroom/olt-transforming/ under tab "Resources"

Figure G.2: Sample Flyer for FC Workshop

Figure G.3: UQ Flipped Classroom Workshop, December 2013

Appendix H: Workshop Participants – Disciplines and Roles

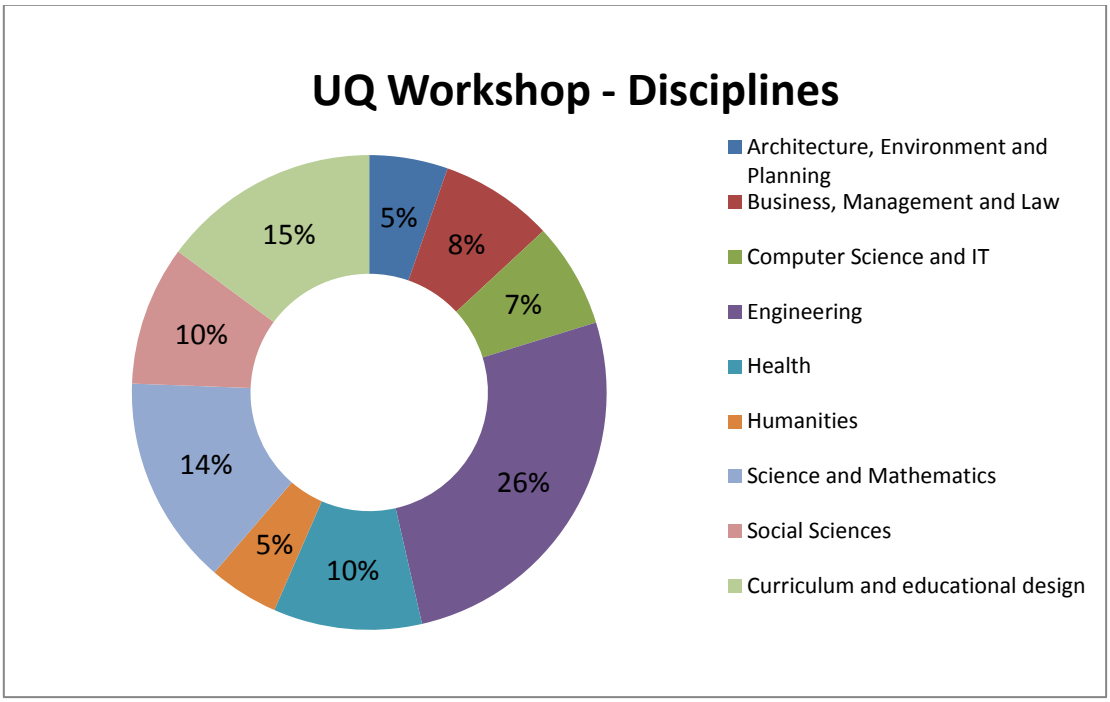


Figure H.1: Academic disciplines of attendees at UQ workshop 7 December 2013.

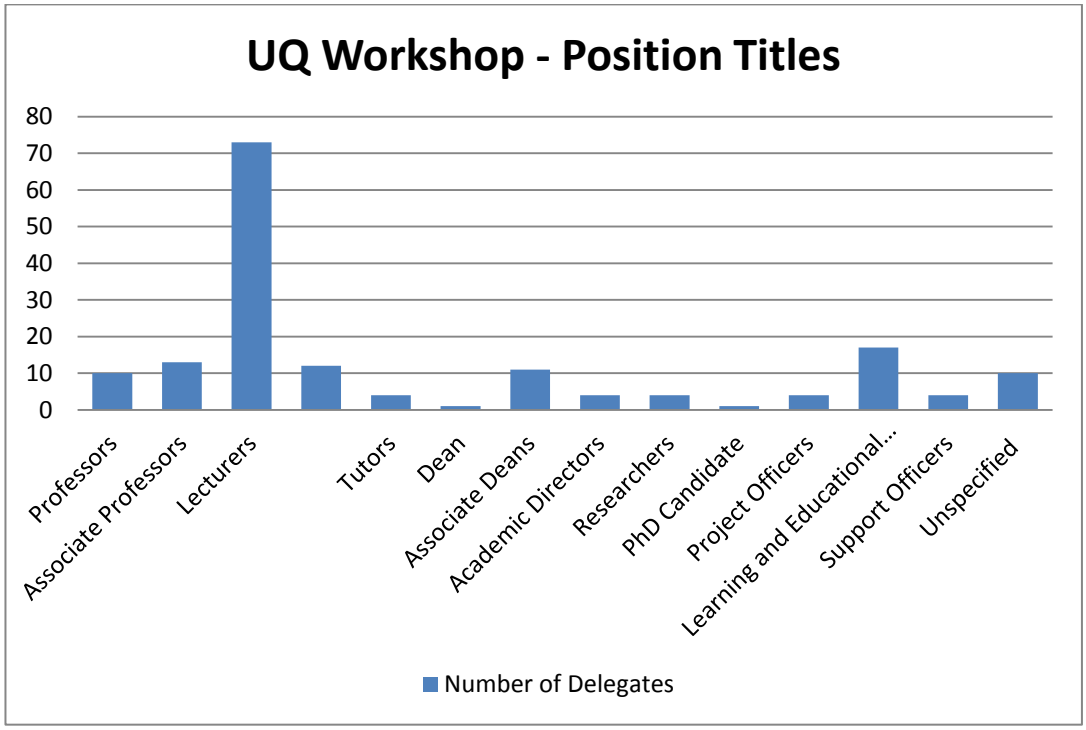


Figure H.2: Position titles of attendees at UQ workshop 7 December 2013.

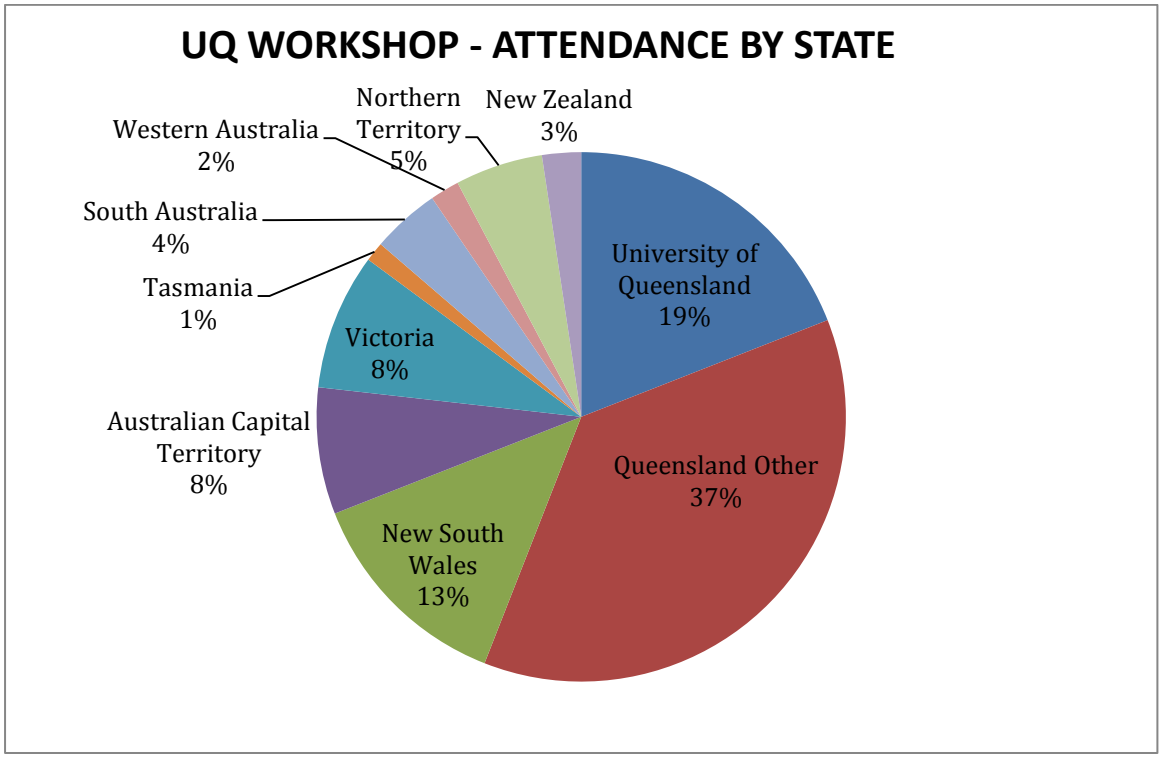


Figure H.3: Academic attendees by State at UQ Workshop 7 December 2013

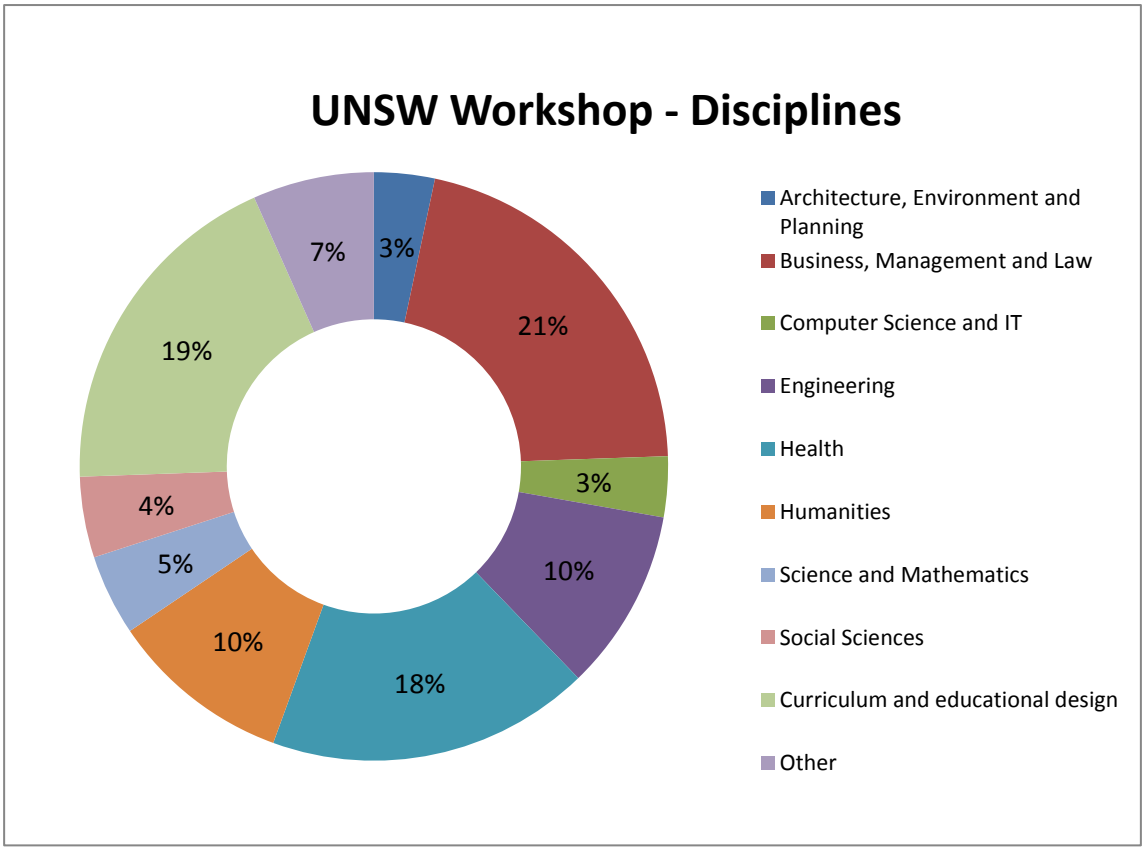


Figure H.4: Academic attendees by discipline at UNSW workshop 18 February 2014

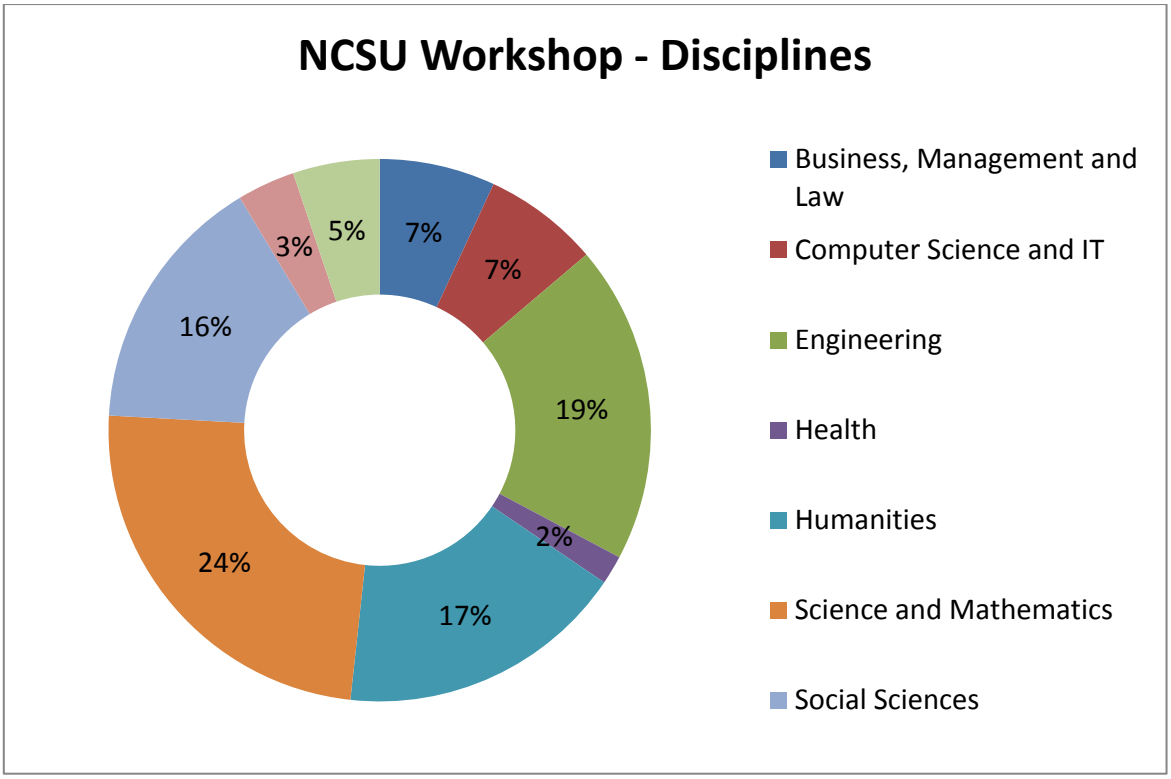


Figure H.5: Academic attendees by discipline at NCSU workshop 11 June 2014

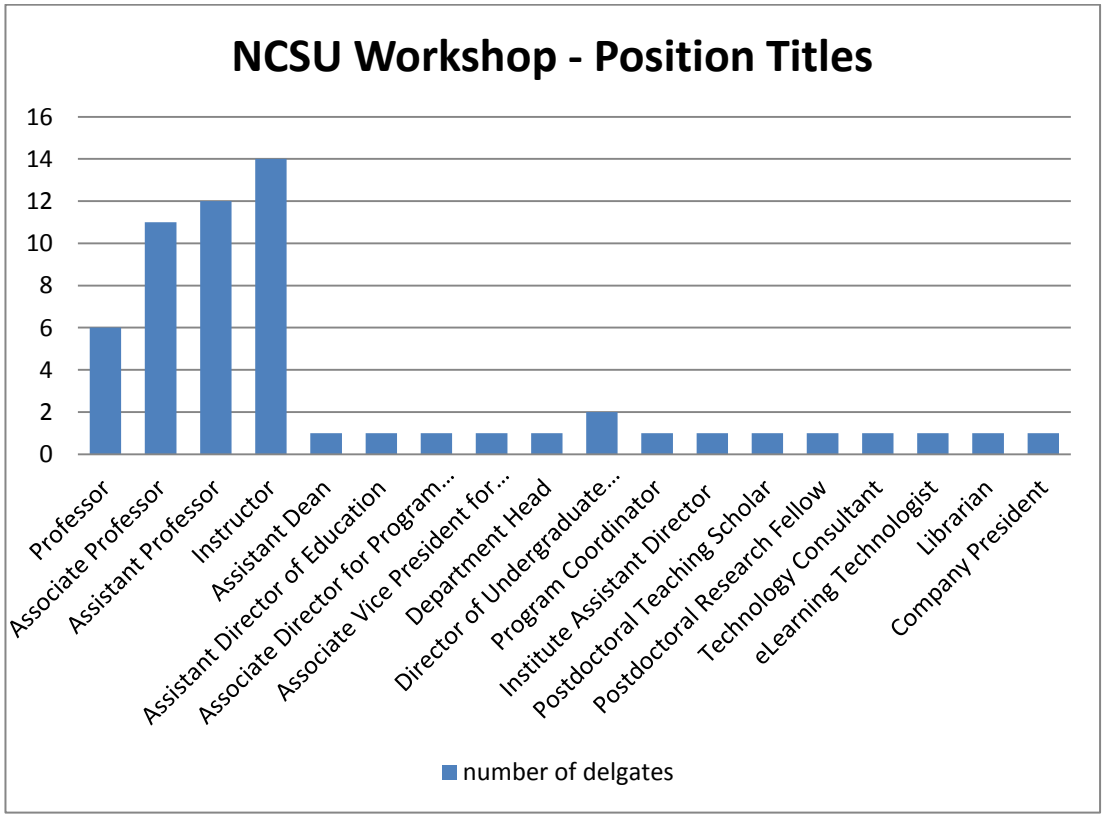


Figure H.6: Position titles of attendees at NCSU workshop 11 June 2014

Appendix I: List of Events Including Workshops

Event Date	Event/ Presentation title (location)	Brief description of the purpose of the event (host)	Number of participants	Number of higher education institutions represented	Number of other institutions represented
5 Jun 2015	Flipping the Classroom – Reimagining Education (Austin TX, USA)	Invited presentation (University of Texas at Austin)	53	1	0
4 June 2015	Flipping the Classroom at Scale (Berkeley CA, USA)	Invited Presentation (University of California – Berkeley)	48	3	3
10 Apr 2015	A Week in the Life of an ENGG1200 Student (Melbourne)	Invited keynote at Flipped Classrooms with Impact Symposium (Monash U)	64	1	0
18 Mar 2015	Flipping the Classroom at Scale to Achieve Integration of Theory and Practice in a First Year Engineering Design and Build Course (Sydney)	Invited presentation at QS World University Rankings by Subject International Forum (QS Intelligence Unit)	50	>1	0
9-10 Dec 2014	The importance of narrative: helping students make sense of what they're learning (Wellington, NZ)	Conference paper presentations (5 in all) at AAEE Annual Conference	105	>1	Unknown
2 Dec 2014	How to flip a classroom and land on your feet (Adelaide)	Invited workshop on flipping the classroom (U Adelaide)	40	1	0
12 Nov 2014	Transforming Learning – Mastering the Flip (Melbourne)	Invited workshop Civil Engineering School Retreat (Monash U)	40	1	0
3 Nov 2014	Transforming Learning – Mastering the Flip (Sydney)	Invited workshop on flipping the classroom (UNSW-AGSM)	30	1	0
30 Sep 2014	How to flip a classroom and land on your feet (Singapore)	Invited workshop on flipping the classroom (Nanyang Technological University, Singapore)	39	40	Unknown
29 Sep 2014	Learning Pathways: Aligning the Cloud to the Campus. The ENGG1200 Flipped Classroom Experience	Invited presentation on flipping the classroom (Nanyang Technological University, Singapore)	180	8	Unknown
14 Jul 2014	Blended Learning – Aligning the Virtual and Physical (Harbin, China)	Invited keynote at International Education Approaches to Shape the Smarter Students in the Future Globalized World (Harbin Institute of Technology/Go8 China-Australia University Summit on Teaching and Learning)	60	21	4
11 Jul 2014	How to design a scalable FC (Adelaide)	Invited workshop on flipping the classroom (U South	39	2	0

Event Date	Event/ Presentation title (location)	Brief description of the purpose of the event (host)	Number of participants	Number of higher education institutions represented	Number of other institutions represented
		Australia)			
17 Jun 2014	Flipping the Classroom at Scale to Achieve Integration of Theory and Practice in a First-Year Engineering Design and Build Course (Indianapolis IN, USA)	Presentation at American Society for Engineering Education conference in session featuring the 5 nominees for best paper, Design in Engineering Education Division.	100	>1	Unknown
11 Jun 2014	How to flip a classroom and land on your feet (Raleigh NC, USA)	Invited workshop on flipping the classroom (North Carolina State U)	58	10	0
28 Mar 2014	The FC: Opening the Conversation	Remote seminar (U New England)	10	1	0
25-26 Mar 2014	How to design a scalable FC (Sydney)	Invited presentation at Institutional Strategies for Blended Learning Conference	8	8	0
18 Feb 2014	How to flip a classroom and land on your feet (Sydney)	Invited workshop on flipping the classroom (UNSW-Learning Teaching Unit)	90	2	0
17 Feb 2014	How to flip a classroom and land on your feet (Sydney)	Invited workshop on flipping the classroom (U Sydney)	43	1	0
4 Feb 2014	Advisory visit (Melbourne)	Provide advice to senior management on re-design of first year (Monash U)	10	1	0
13 Dec 2013	How to flip a classroom (Melbourne)	Invited workshop on flipping the classroom (RMIT U)	60	1	0
9 Dec 2013	Reimagining the Dissemination of Engineering Education Practices Through a Global LP (Gold Coast)	Paper presentation + invited master class presentation at AAEE Annual Conference	40	>1	Unknown
7 Dec 2013	How to flip a classroom and land on your feet (Brisbane)	OLT Project workshop (UQ)	168	31 (including 4 NZ)	0
19-20 Nov 2013	How to flip a classroom (Rockhampton)	Invited workshops on flipping the classroom (CQU)	60	1	0
8 Nov 2013	How to flip a classroom (Newcastle)	Invited workshop/ presentations on flipping the classroom (Newcastle U)	20	1	0
28 Oct 2013	Disseminating the flipped classroom experience (Brisbane)	ENGG1200 Showcase presentation for UQ Teaching & Learning Week (UQ)	20	1	0
5 Oct 2013	Video recordings (Sydney)	"Teaching Online" interviews for Epigeum, a spin-out company from Imperial College, London	online		
Jul 2013	ELESIG webinar, (Sydney)	Invited key speakers on flipped classroom at webinar (City University, London)	online		
6-7 Jun 2013	Project initiation workshop (Stanford CA, USA)	Refine the project brief and start to build Learning Partnership (Stanford U)	8	6	0

Appendix J: Workshops – Feedback from Event Organisers

Where	Type of Event	Evidence
RMIT U (Melbourne)	FC Workshop (Invited)	*"Congratulations and thanks on a very productive and creative learning experience for our science, engineering and health College staff."* **Educational Developer, RMIT University**
UQ (Brisbane)	FC Workshop	*"Most thought provoking: the ability to allow the student to receive a better experience. The pre-work and sharing of resources."* **(Discipline: Education)** *"Hearing what others are doing. The resources were well organised and will allow me to follow this up at my own pace in 2014."* **(Discipline: Science)**
CQU (Rockhampton)	FC Workshop (Invited)	*"Thanks again to your contribution to CQ University staff learning. I've been hearing good things, and I was very pleased with the outcomes of the Heads of Program workshop."*
The University of Newcastle (NSW)	FC Workshop (Invited)	*"Your workshop...provided an important opportunity to share ideas and practise with the UNSW teaching community"* **Director of T&L, UNSW**
Sydney	ELESIG webinar (invited speakers FC) Global online audience	*"Carl and Lydia's team have an open source philosophy and are looking to share best practices. Their website has provided much more detail and illustrates teaching staff's experience."* **ELESIG webinar host** "*Open source thank you for sharing the materials."* *"Thanks. Very interesting!"* *"Thank you well appreciated."*
North Carolina State University (USA)	FC Workshop (Invited)	*"What I saw in the morning was very positive."* **Director STEM Education, NCSU**
Adelaide (SA)	FC Workshop (Invited)	*"Your workshop was a great basis to begin thinking about how they (staff) might go about doing so (Flipped Classroom Teaching)."* **Dean of Teaching and Learning, Business School, UniSA**

Appendix K: OLT Project Web Site Resources

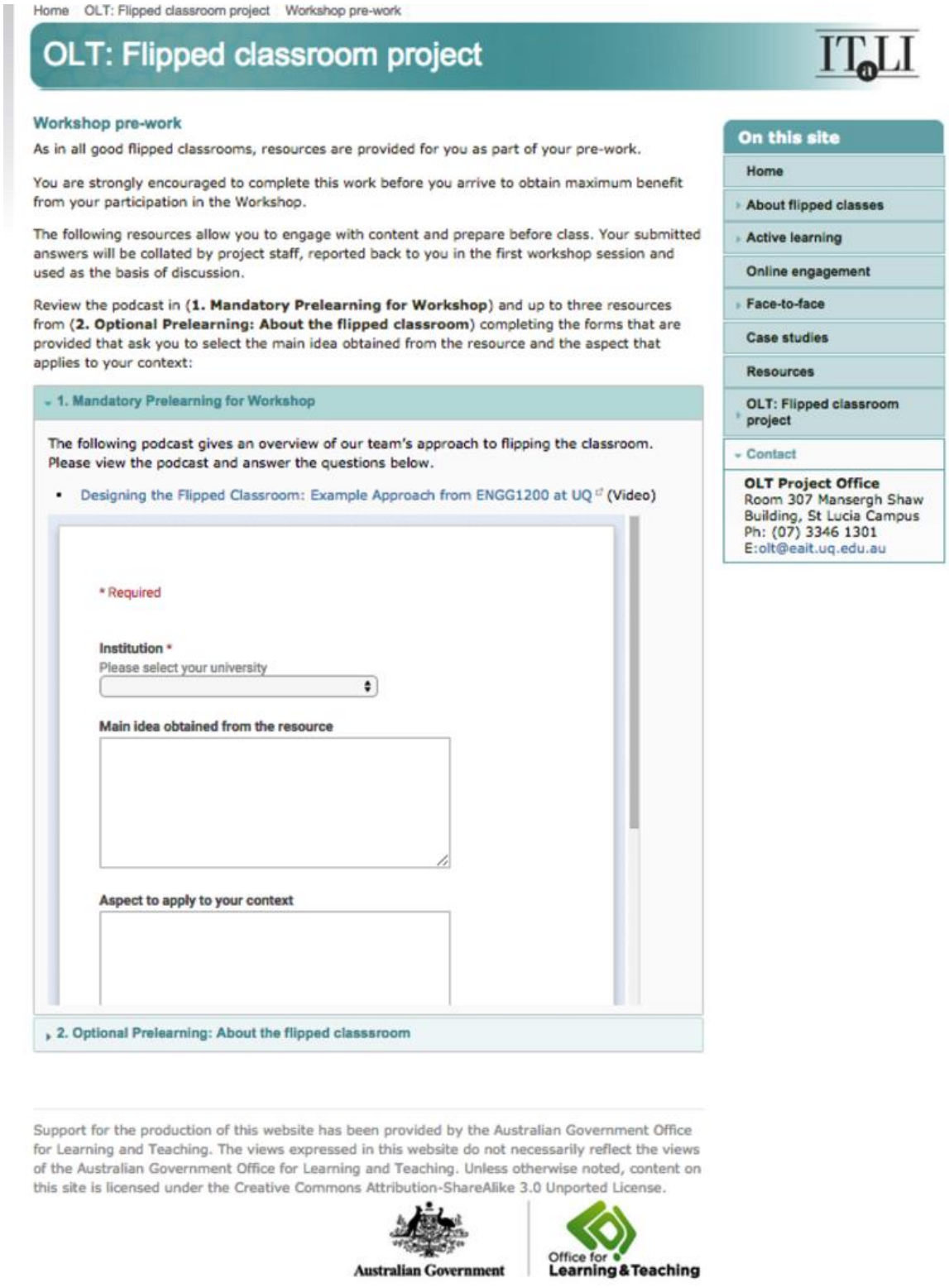


Figure K.1: OLT Project pre-work page – Pre-Learning Entry Page

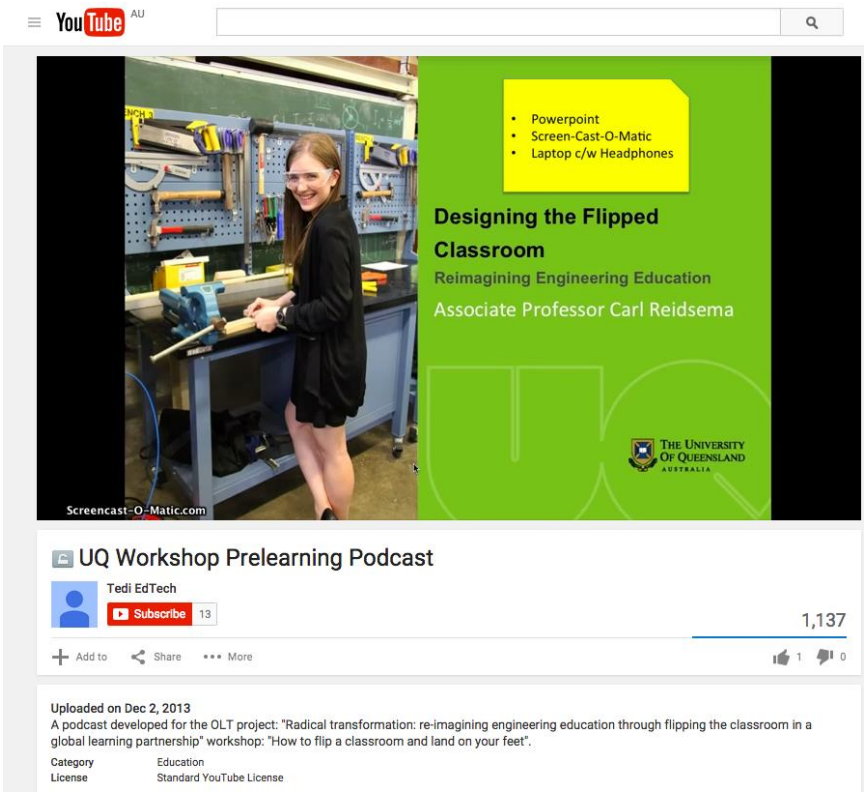


Figure K.2: OLT Project pre-work page – Mandatory Podcast

Figure K.3: OLT Project pre-work page – Optional Pre-Learning Resources

Appendix L: Itemised Black Hat Issues against Stakeholder Ownership

Issues for Teachers	**Items (No. comments = 75)**
Workload (11)	Huge workload; Time constraint; Time to prepare materials
Changing Roles (7)	Cultural expectations; Fear of change; chaos – control; Role definition; If already have tutes why should lectures change?; Fear of failure
Support Required (3)	Support Needed
Admin (1)	Administration (T&L constraints)
Guidance (3)	Guidance required
Assessment (3)	How to assess; How to change assessment
Content (8)	Sustainability; Too much content; Staff ownership of content; Copy write; Dumbing down - loss of content; Online environment; Content delivery
Alignment (3)	Lack of alignment
Design (6)	Creating groups or fixed groups; How will it work with my course? Materials / resources required; How to convert a trad class to a FC; How to ensure don't overload the students
Infrastructure (5)	Preparing stakeholders (students, staff, colleagues, support staff, admin, timetables)
Resources (4)	Time and resources required; Money, support, resources required but not given
Support staff (3)	Enough staff; training tutors; Staff capacity
Other staff (5)	Cooperation from other from staff required but not guaranteed; Academic conservatism; Cultural expectations; Colleagues want trad. Way; How to get colleagues to cooperate
Recognition (7)	Time required: not recognised, drop in research time; Staff time / recognition; Student SECaTs influence promotion; must deliver high pass rates; What if it doesn't work; Acceptance by faculty
Proof Needed (3)	Value-proof; Will it work with my course?
Resentment (3)	Resentment expressed
Issues for Students	**Workshop Items (No. Comments = 22)**
Expectations (7)	Student expectations; Student revolt; Pushback; I'm not getting my HECS (Higher Education Contribution Scheme) worth; Competitive vs collaborative
Ownership of Learning (8)	Lack of student participation; Students won't do pre-learning; How to get students to do their part of co-'ownership'; Student attendance; Students want to be spoon fed; Free-riding students
Learning (3)	Overkill? How do we know students have done the pre-learning; How do you know students have understood or have engaged?
Abilities (4)	Student ability; Students with disabilities; Insecure students; Students social skills not up to group work
Issues - Institution	**Workshop Items (No. Comments = 27)**
Change Management (9)	Change Management
Real Support (5)	Institutional direction and management; Institutional culture (academic and students); Preparing stakeholders (students, staff, colleagues, support staff, admin, timetables); Negative attitudes; Misinformation
Recognition (4)	Institutional real support (not just verbal); Money, support, resources required but not given; Enough staff
Systems and Infrastructure (9)	Time required not recognised; Drop in research time not recognised Student SECaTs influence promotion; Must deliver high pass rates; University infrastructure not up to speed; Timetabling support required
Technology (11)	Technology not up to speed; Technology access; Technology - staff and students need support and training; Skills required for technology; Technophobes; Technical knowhow; Technology price
Spaces (6)	Learning spaces required (not lecture theatres)

Appendix M: Workshop Evaluation Survey

Flipping the Classroom Workshop - EVALUATION

Your feedback is valued and will assist us to plan and facilitate future workshops.

Please tick your preference in the table below:

SD - Strongly Disagree; D - Disagree; N/U - Neutral/Undecided; A - Agree; SA - Strongly Agree.

Question	SD	D	N/U	A	SA
1. The workshop (including pre-learning) allowed me to understand educational **rationales** for flipping the classroom					
2. The workshop (including pre-learning) allowed me to understand the **implications** for me and my students of flipping the classroom					
3. The workshop (including its delivery) allowed me to begin thinking about how I would design a flipped classroom					
4. The workshop inspired me to explore the educational **possibilities** offered by the flipped classroom					
5. My contributions were valued by the Presenters and the other participants					
6. The design of the workshop and its operation facilitated my learning about flipped classrooms					
7. There was adequate time for discussion and networking					
8. I learnt from working collaboratively with the people at my table					
9. The Presenters did a good job in facilitating the workshop					
10. The venue and facilities were appropriate for the purpose					

I am interested in a continuing engagement with others working on flipped classrooms. [Register for the Learning Partnership at http://www.uq.edu.au/teach/flipped-classroom/olt-transforming/]	**Yes**	**No**

Other feedback

What aspects of the workshop did you find most thought provoking?

What aspects of the workshop did you find least helpful?

What suggestions do you have for improvements for future workshops?

Any other comments?

- Thank you for providing feedback -
Please hand your form to the presenters.

Appendix N: Workshop Experiences that Addressed Black Hat Issues

Emerging Theme and Description	Related Quotes
Issues for Teachers	
Learning by Doing: The workshop was run as a flipped classroom, which was appreciated by many.	*Most thought provoking: experiencing the flip. It's great to be on the receiving end.* *Best: walking the walk.* *Learning by doing - Great example folks!*
Change: The DeBono's Hats exercise was used to try to help move participants through resistance and roadblocks, and forward into possibilities. This method was well received and seemed to affect participants' emotions and thinking, in order to help facilitate change.	*Most thought provoking: I enjoyed the discussion of difficulties in a positive way, if that makes sense. To honestly discuss the drawbacks to the approach without invalidating the whole idea.* *.. gave me confidence to do more.* *Thanks - feel more able to flip now!*
Collaborative learning: Most participants appreciated working together, sharing ideas and learning from one another. They also experienced what it is like to be in a student team of strangers, and the process of working in a team. However, there was a substantial call for the process to be taken further, by (i) facilitators interacting with groups so as to give feedback (ii) bringing the group learning back to the whole group for whole group discussions and (iii) hearing from other groups	*Most thought provoking: Having to work in a team.* *Best: learning from my peers. Discussion with others helped me problem solve and share ideas and knowledge.* *Best: the opportunity to collaboratively create a plan* *Worst: Limited time for discussion and networking* *More time for comparison of material that was collected from the discussions*
Structured activities around designing and planning a flipped classroom. The process of working through these activities helped many participants to learn what is involved in designing and planning their own course. This set of activities seemed to be the best outcome of the workshop for many. As an improvement, many suggested that that the planning activity this process would be more beneficial in discipline specific	*Best: applying the design sessions to a course that I am responsible for.* *Best: group work on designing a flipped classroom* *I liked the workbook as an example of very structured learning.* *Most thought provoking: Design can be intricate.* *Most thought provoking: Designing an actual plan. Developing a narrative.* *How long it may take to plan activities well and then implement.* *It was difficult to contemplate the design activity without a disciplinary context - people should perhaps be in discipline groups*
Content The learning by doing and the activities in the workshop helped participants to learn about what they might put into their course, such as prelearning and in class activities. There were still some calls for help with how to assess, and how to give feedback in class time, and how to align a flipped classroom with the curriculum as a whole.	*Best: how important planning and aligning the curriculum/tasks and activities is* *Putting myself in the student's perspective….why are they not doing their prereading and does it matter?* *Best: how important the in-class tasks are.* *Most thought provoking: Importance of a narrative and keeping the students informed-d of why they are doing this kind of learning.* *Improvements: More on integrating assessment in the flipped model* *[need] examples of feedback mechanism that can be used for assessment in the classroom.*
Resources: Several requests for resources for the workshop to be shared (e.g. the learning pathway) were responded to by making these available online.	*Best: The pre-work and sharing of resources.* *Love having the workbook as a resource.* *Other: I liked the workbook as an example of very structured learning*

	Looking forward to seeing resources you develop on your site.
Issues for Students	
Student learning and Ownership of learning: The processes of collaborative teamwork, combined with structured design and planning, helped participants to think about how the FC method may help their students engage. The experiences of many not having done the prelearning helped provoke thinking around this issue. There were some questions on how to run a FC for fully online, distance, and cross-cultural student groups.	*Most thought provoking: the ability to allow the student to receive a better experience.* *Most thought provoking: Ideas about engaging everyone.* *Best: The idea of having a clear dialogue with your students about what your goals are and why you are trying to make a change - about more meaningful learning.* *..That student's work itself can become a resource for future/current students.* *Suggestions for improvements: Perhaps special focus on cross-cultured issues for international students in flipped classrooms - mentioned at the end of session.*
Issues for Institutions	
Institutional Support: Participants gained ideas for flipping even with lack of institutional support and in restricted spaces. However, there were still many requests for institutional issues, workload issues, and the required support of other staff to be addressed.	*Organising a flipped classroom, challenges* *Logistics of achieving change with large classes* *Most thought provoking: How to address resource acquisitions for building flipped classroom - lots of good ideas shared.* *Suggestions for improvements: More insight re alternative structures, associated budget models.* *Other: Tell us how long it actually takes to flip a lecture - you need to address black hat concerns to convince us to put in so much time.* *The need to collaborate in this form of curriculum.*
Spaces: participants were able to see how FC activities can be run in traditional learning spaces, yet there was still a call for better spaces to be made.	*Most thought provoking: Seeing the physical parameters of a non-lecture-theatre-style learning space. How can I use a lecture theatre effectively.*
Technology: Workshop exposure to helpful technologies helped raise awareness of what is available and pedagogically useful, though there were the usual glitches that reminded of the frustrations of using technology.	*I would have liked to hear more on how to integrate technology* *Most thought provoking: use of tools and analytics.* *..a lot of tech tools available - padlet, TexTT, f2f, showme etc.*
Proof: Many participants were able to learn about the flip by doing the flip, and appreciation was given for the use of this method. However, many participants stated that they needed more concrete examples, more evidence that the FC would work, and more case studies. This relates to needing to change thinking not just emotions. The book of case studies is our response to this need.	*Worst: Lack of concrete evidence that this method improved student learning in the short or long term.* *Improvement: A summary of evidence-based research showing an impact on learning even if this evidence is limited. Where is the student feedback on flipped classes? It would be good to know how the method is received and have this discussed as well.* *Improvements: more examples/case studies.* *Improvements: Discussion of real experiences, what went wrong, what was tried to fix it, how that worked.*

Appendix O: All Themes Emerging from Workshop Surveys - Summary

Theme	Subthemes	Comments
Changing Role	Hats	Most thought provoking: I enjoyed the discussion of difficulties in a positive way, if that makes sense. To honestly discuss the drawbacks to the approach without invalidating the whole idea. Most thought provoking: Green hat - possibilities. If there are no limits, what can we do with this? (Then need to bring back to bounded normality!)
	Emotion	.. gave me confidence to do more. Thanks - feel more able to flip now!
	Thinking	Other: This session greatly progressed my thinking and knowledge.
	Moving Forward	Other: My classroom is half half-flipped, and the workshop really got me thinking about how to do much more with my class time Perfect timing to focus on curriculum development for two courses I'm redeveloping
Proof and Examples	Concrete Evidence Needed	Worst: Lack of concrete evidence that this method improved student learning in the short or long term. Improvement: A summary of evidence-based research showing an impact on learning even if this evidence is limited. Where is the student feedback on flipped classes? It would be good to know how the method is received and have this discussed as well.
	Concrete Examples/Case Studies Needed	Improvements: more examples/case studies. Need examples of good and bad experiences of flipping the classroom Focussed examples we can learn from and adapt. Suggestions for improvements: Would be helpful to provide more examples of different thigs that have previously been tried with flipping the classroom, and how it worked out.
	More in Depth	Loved the active learning process and experiencing "how to do it" but I'd still like to hear more from the experienced presenters about their tips on what works and doesn't work.
	UQ Example Helpful	Most thought provoking: Seeing it done on the BIG scale. I've only ever done it on a much smaller scale.
	Challenges and Solutions	Improvements: Discussion of real experiences, what went wrong, what was tried to fix it, how that worked.
	Doing the Flip Helpful	Most thought provoking: experiencing the flip. Its great to be on the receiving end. Best: walking the walk. Best: all the little examples and ways of doing things: hats, coloured cards, Braincloud.
Collab. Work	Collective Energy	Group work was very useful and fun Working in groups made the experience even more enjoyable
	Group Work	Best: group work on designing a flipped classroom Most thought provoking: Having to work in a team.
	Sharing & Learning	Best: listening to the experiences of others with flipped classroom experience Discussion/sharing of what worked and what didn't. Best: learning from my peers. Discussion with others helped me problem solve and share ideas and knowledge. Best: the opportunity to collaboratively create a plan
	Variety of Experience	Best: really enjoyed working with people from other universities and listening to their ideas/experiences very valuable. Talking to others outside my school gave me insights into different ways to solve problems
	Facilitators	Best: collaborative approach of the facilitators
Closing the Loop	Facilitator Feedback Needed	Facilitators need to discuss with each team. Suggestions for improvements: The exercises were useful but often there wasn't feedback on what we had produced. ..a bit more feedback about how to achieve a flipped classroom would have been welcome.
Expanding the Community	Networking at Breaks/ Larger group Discussion/	Worst: Limited time for discussion and networking I would like to hear what other groups did. Maybe facilitate this exercise as one group (whole of class). Least helpful: More discussion on solutions to barriers - throwing it open to WHOLE workshop participants to come up with solutions? Report back Green hat possibilities - would have been good to share these as a whole group

Theme	Subthemes	Comments
	Hearing from Other Groups Needed	Need some way of capturing all groups' work More time for comparison of material that was collected from the discussions
Guidance	Design	Best: applying the design sessions to a course that I am responsible for. Best: group work on designing a flipped classroom I liked the workbook as an example of very structured learning. Most thought provoking: Design can be intricate. Thinking through a lesson with Bloom Importance of creating a good/effective design.
	Planning	Best: 0-5 steps of planning improvements: Most thought provoking: The number of steps required to design an effective flipped classroom. Most thought provoking: The importance of careful planning. Most thought provoking: Designing an actual plan. Developing a narrative. How long it may take to plan activities well and then implement.
	Discipline Groups	It was difficult to contemplate the design activity without a disciplinary context - people should perhaps be in discipline groups Improvements: divide into some discipline workshops such as engineering, social science workshops in parallel
	Various FC Approaches	Variety of approaches to flipping Seeing how FCs work in other contexts was good.
Content	Alignment	Best: how important planning and aligning the curriculum/tasks and activities is More about fitting within the whole course and curriculum
	Prelearning	Most thought provoking: The pre-learning made me think more about the opportunities for focus on active learning and stress less about online materials production Discussing the level of pre-engagement and its implications. Putting myself in the student's perspective….why are they not doing their prereading and does it matter?
	Online Content	How to easily build online resources
	In class Activities	Best: how important the in-class tasks are. Most thought provoking: Range of activities that were fun and applicable to the classroom and helped me learn about flipping through doing. Examples of flipped activities, working with others, Yes/No cards Modelling engaging strategies while delivering content was outstanding Hands on activities to put theory into practice - learn by doing
	Narrative	Most thought provoking: Importance of a narrative and keeping the students informed-d of why they are doing this kind of learning. The narrative concept is interesting - I will continue to reflect on this.
Assessment		Improvements: More on integrating assessment in the flipped model Most thought provoking: Discussion of methods for assessment - continued assessment of individual and group work.
Feedback		[need] examples of feedback mechanism that can be used for assessment in the classroom.
Resources	Prelearning	Best: The pre-work and sharing of resources. Worst: the prelearning activities were of little value.
	Activities, docs	Most thought provoking: The various 'docs' activities showcased by the team. Good activities and materials, helps in preparation work
	Workbook	The resources were well organised and will allow me to follow this up at my own pace in 2014….. Love having the workbook as a resource. Other: I liked the workbook as an example of very structured learning
	Sharing	Looking forward to seeing resources you develop on your site. The pre-work and sharing of resources. Share discipline-specific resources Please make the analytics and wordcloud tools available
	Learning Pathway	It was a shame the Learning Pathway could not be demonstrated. [want] Demo of Learning Pathway
Students	Learning	Most thought provoking: the ability to allow the student to receive a better experience. Other: Excellent reminders of meta-cognition throughout -> really helpful. Most thought provoking: Ideas about engaging everyone. Best: The idea of having a clear dialogue with your students about what your goals are and why you are trying to make a change - about more meaningful learning.
	As resources	..That student's work itself can become a resource for future/current students.

Theme	Subthemes	Comments
	Group work	Best: comments by the panel on teamwork. [NOTE: All of the 22 comments on group/table work in the collaborative work section are relevant to learning about group work[
	Expectations	get the students involved - it would be good to have them here and participate in the workshop..
	Ownership of Learning	Most thought provoking: How to develop student ownership of learning. Prelearning - will students do the work? Not enough concrete examples of how you get students to bury into 'pre class' work. What to do if pre-activities aren't done Putting myself in the student's perspective….why are they not doing their prereading and does it matter?
	Specific Needs	Suggestions for improvements: How to design for an off-campus student. The idea that a flipped classroom can be used to add more interactivity to my online class Suggestions for improvements: Perhaps special focus on cross-cultured issues for international students in flipped classrooms - mentioned at the end of session.
Other staff		Do it again so my tutors can participate. Best: nice to meet others, still need to have local support. The need to collaborate in this form of curriculum.
Workload		Other: Tell us how long it actually takes to flip a lecture - you need to address black hat concerns to convince us to put in so much time. Most thought provoking: How long it may take to plan activities well and then implement
Institution	Change Management	Organising a flipped classroom, challenges Logistics of achieving change with large classes
	Real Support	Most thought provoking: How to address resource acquisitions for building flipped classroom - lots of good ideas shared. Suggestions for improvements: More insight re alternative structures, associated budget models.
Spaces		Most thought provoking: Seeing the physical parameters of a non-lecture-theatre-style learning space. How can I use a lecture theatre effectively. Most thought provoking: I liked seeing the spaces available at other universities.
Technology	General Analytics Tools	Better tech integration during the face-to-face day (particularly during wrap-up) Ensure technology works on personal device before session starts. Other: Not enough time to talk about anxieties, technologies. I would have liked to hear more on how to integrate technology Most thought provoking: use of tools and analytics. ..a lot of tech tools available - padlet, TexTT, f2f, showme etc. Worst: Podcasty - no info. Improvements: Need to guide folks more .. Most thought provoking: Continuous (anonymous) input via wordle cloud.

Appendix P: The Flipped Classroom Continuum

Already flipping who were helped by the workshop to develop their skills and motivation

- **ANU**: … had flipped our classes prior to the workshop, but for me the workshop provided some extra motivation (and validation of our thinking) to continue on the path.
  I use a model where the tutorials are flipped, and we support students to take turns co-facilitating a topic in the course. My 'lectures' are now 'workshops' where I work with next week facilitators to develop their plans around their facilitations, building on Prof. Richard Baker's supertute method in geography (a quick video I use to explain it to students is here: https://www.youtube.com/watch?v=o4CRUehJYf4)

- **RMIT University**: We implemented FC in our second year mass and energy balance course in 2011 in response to some work done at RMIT rather than the UQ project. It's in its 4th year. Going well. Course evaluation survey results from students increased in the first year from 45 to 70% and apart from one year are still sitting at 70%. The one year it dipped I got some good ideas in your session in UQ - so we were encouraged us to continue and tried a few new things. I visited the class recently and was very impressed with the buzz of activity in the two hour tutorial with around 80% attendance and students working non-stop on problems. Publication: Parthasarathy R, Jollands M. Interteaching in a second year chemical engineering undergraduate project-based course. Proceedings of the 23rd Annual International Conference AAEE2012, 2012 Dec 3-5; Melbourne, Australia.

- **U Sydney**: As context: Sydney Medical School bases most of its teaching in the first 2 years around problem based learning. I have coordinated the compilation of teaching in the Flipped format however almost all of our teaching is done by clinicians experts and not professional academic teaching staff. In 2014 we piloted a single problem (ie. 1 week) in the flipped classroom format which we expanded to 4 problems in 2015. From 2014 to 2015 we not only expanded to volume of the teaching materials but switched the software used to deliver the pre-recorded learning materials from powerpoint with audio to Articulate modules. In 2016 we are proceeding with the same 4 weeks but are hoping to put our teaching staff though some training to improve the quality of the face-to-face sessions in particular. We have found this to be most challenging.

- **UQ**: …I have been using a flipped learning model for some time prior to the workshop. Your workshop had consolidated my own beliefs and ideas about the benefits of this approach and I was also able to gain a better appreciation of the face to face component of the flip.

- **UniSA**: …in the School of Engineering, we are progressively moving to Flipped Classroom for mechanical engineering (about 2/3 of program done) and then moving onto electrical engineering (about 1/3 done).
  We have not seen any significant change at a program level in student evaluations, but there is a variation in courses with some doing it poorly at first and then improving with the next delivery. We are doing this for many reasons. One is to cater for external (onshore and offshore) students and to also allow delivery on multiple campuses. We are using lecture recordings and face-to-face learning activities.

- **U Adelaide:** The flipped classroom workshop run by Lydia and Carl, started the ball rolling for us as we had just embarked on our [OLT] project, so it was good to benchmark practices. The biggest benefit for the team was the Learning Pathways collaboration which has been piloted in a few first year courses at Adel Uni. We are running an evaluation on this at the moment … It is a brilliant framework to use for managing flipped classroom resources….. We will be contacting Carl early in the year to get him to review some of our resources as he has been identified as one

of our reference group members because of the fact that he lead the engineering flipped classroom OLT project.

Massey, NZ: During January 2014 the 1st Year programme was reviewed. This resulted in creating a "Learning for Success" first year engagement and transition to University initiative. This encompasses activities such as: active learning pedagogy; modular assessment; and a holistic approach to learning support:

Active Learning
Students have two types of staff engagement where they have direct contact with the teaching team. These are called Guided Instruction and Subject Workshop sessions. These 'contact' sessions take up 4 hours of a student's time per week. The rest of their time, that is dedicated to a particular paper/course (i.e. 6 hours per week), is spent reading, preparing for assessments, practicing exercises, etc. which is supported by utilising Massey's Learning Management System, i.e. STREAM:

Guided Instruction
Rather than lecturing in large groups, where learning can be quite passive (i.e. the teacher mainly talks), we've developed these sessions where staff actively engage with students to get them to think and discuss key concepts.

Subject Workshops
These are compulsory for students and are monitored for attendance. Each Workshop has a maximum of 25 students per tutor. Students work in groups of four solely focused on solving problems.

- **Christchurch Polytechnic Institute of Technology, Auckland:** I am teaching Mechanical engineering to Diploma and degree students and using flip class for all my courses. I was using flip from the start of 2013 (before the workshop). Although the students really like the flip, there is no clear evidence that the average grade in the classes has improved. However, students want more courses done this way and they feel that it is improving their learning. One of the main problems is getting the students to engage with the pre class videos. For this, I have started using pre class Moodle based multi choice quizzes which have only really made a small improvement. However the quiz is being done even by those who have not watched the videos, so that at least the main topic point are being looked at before the class. It is interesting that I have 10 quiz's each with 3 questions and the whole lot are worth 2%, and they still do them.
  I am currently looking at the timing of the information being presented. Looking at doing an intro at the end of one week, leaving them to watch the detailed content over the weekend, then problem based class time. Currently using the videos for both intro and details, but too many students forget to watch the videos.

Had started to think about it and then began to flip fully

- **Griffith:** I first heard about the flipped classroom approach from an education designer who was helping me develop the online contents of my course. I was sceptical and unsure at first as to how the approach would at all help improve my teaching. That was around the time when UQ advertised its OLT-funded flipped classroom workshop. I immediately signed up as I was keen to learn what this approach exactly was. The workshop was quite interactive and it helped me put things in perspective. With knowledge gained from the workshop, I immediately experimented the approach with my postgraduate class and it was extremely well received. I now flip my classes on a regular basis. Some of my colleagues have now started to follow suit upon seeing the benefits of this approach.

- **USC:** I have implemented the FC approach to an undergraduate course (approx 700 students) and a postgraduate course (approx 40 students)

- **USC:** Implemented a FC in an U/G pharmacology course in nursing. It is going well and improvements are made from the research data collected (HREC approved). Publication: Article

title: Surveying The Experiences And Perceptions Of Undergraduate Nursing Students Of A Flipped Classroom Approach To Increase Understanding Of Drug Science And Its Application To Clinical Practice *Nurse Education in Practice,* 2015.

Had started to think about it and then began to flip partially

- **CQU:** I was predominantly there to get some ideas on how to flip my classrooms. I have done a small partial flip, but this is extremely difficult with 80%+ external students. We are implementing better broadcasting technologies so I'm hoping to do more in the future.

- **UQ:** In EDUC6720, Curriculum Foundations, Languages, in the Grad. Dip. Ed. Course, in virtually every lecture I now have pre-reading to be done before the lecture. A growing amount of that is material I used to cover in the lectures [I have a 3 hr slot that works as a lecture/tute/workshop with 38 students]. This has freed up some time for more discussion, and also allowed more material to be covered. There are students who are doing the readings, and also, very obviously, students who are not. It shows up in their questions and assignments.

- **UQ:** i haven't implemented a flipped classroom for my class PSYC3062. Still have traditional lectures, punctuated by some major site visits. However I have semi-flipped the activities in the Practical sessions -- students do a quiz first based on the previous lecture, and then apply the lecture material in the Practical activity. Unfortunately I found the workshop a bit "packaged", too noisy, and ended up leaving early. However I appreciated the opportunity to learn about flipped classroom possibilities.

- **UQ:** I've tilted rather than flipped a number of classrooms. ENGL1500 Reading and Writing Contemporary Literature, around 200 students. I use feedback-rich online quizzes quizzes that are rewarded with marks to encourage students to prioriitise reading before class. it is very successful. i've also incorporated it into advanced u/g literature classes. I trialled it with a gateway course, and the improvement was fantastic, but sadly I no longer convene that course, and the new convenor has chosen not to use quizzes. So not entirely successful!

- **UQ:** implemented the use of social media in all aspects (lectures, tutorials, assessment, asynchronous communication, student contributions and reflections) across my course EDUC1029 Introduction to Education in the UQ School of Education. Many of these uses are FC in nature.

Motivated by the workshop and made small changes

- **UNE:** No, we still haven't done anything much with the FC idea. We are still playing on the edges with the flipped classroom. But the improvement we have made with interactivity with the students in first year have led to improved student evaluations this year. From the flipped classroom Lydia did a skype session with staff at UNE in the sciences and that went down really well, and staff did make small changes, but not whole of unit. It made staff reflect on their practices and that worked really well in terms of assessing their current teaching style.

Motivated by the workshop but nothing has happened since

- **CQU:** Sadly, our administrators seem unable to include a change to the curriculum. It would appear that their current workload prohibits any additional improvements. They loved the idea and they were excited about the potential, but it hasn't moved a muscle. Sad, but true.

- **USQ:** While the workshop was interesting, we still have not done anything in regards to FC – too many other things have been happening

- **UWS:** No, we still haven't done anything much with the FC idea. We do recommend it as learning designers at the College/University.

Flipping has been useful for accreditation

- **ANU:** One final anecdotal insight (and probably very biased) is that we just completed EA accreditation, and (initial feedback only) our Systems core was the main commendation of our program (has never been recognised as such), and this is where the vast majority of our creative teaching practice lives.

Have begun / developed further projects and ventures since the workshop

- **USC:** Joined an International Collaborative Writing Group (ICWG) and attended the ISSOTL conference in Melbourne 2015 in order to write a paper about Flipped Learning
  Member of a research team at USC - OLT grant - to map the use of flipped classrooms across disciplines

- **USC:** I am part of a research team that has secured an internal grant to collect data and publish results. All going well so far.

- **ANU:** I won a Australian Award for University Teaching in an application predominantly outlining this flipped mode implementation (http://www.olt.gov.au/system/files/2014_AAUT.pdf)
  This year, I had a number of Honours projects that created activities for these tutorials using a local Teaching Enhancement Grant. I've attached an internal update that I gave on the project (specifically p3-4 describe how former students are co-creating awesome L&T activities). I've started talking about this a bit more widely (now that I can see the light at the end of the tunnel on my PhD) with Abstracts at ISSoTL (International Society for the Scholarship of Teaching and Learning) and CAUSTL (China-Australia University Summit on Teaching and Learning), and an upcoming paper at AAEE (Using Distributed Constructionism in Engineering Tutorials: Requirements Engineering).
  I'm also working with Mick Healey and Kelly Matthews ISSoTL collaborative writing group on the topic of Flipped Classrooms, and we plan to have a paper in a special issue of Teaching & Learning Inquiry next year providing a framework for describing different versions of flipped classrooms.

- **Charles Darwin University:** It would be quicker to talk - As AD L&T, i used this [OLT workshop at UQ] workshop as a motivator for a STEM faculty PD program called iScholar which now involves about 35 academic staff in various disciplines including Psych, Nursing, IT, Engineering Sports Science to name a few. Focus is around the iScholar program, with about 30 academics and another 5-6 librarians and technicians involved. The interdisciplinary sharing has been a key success.
  The FC seemed to be the idea that galvanised most interest, with the challenge being that it had to apply to both on-campus and off-campus students.Currently working with a writing group to review the FC literature.
  Investigating a range of new ways to get students to engage in the between class activities, including gamification.
  Also trialling a range of ideas for engaging students in the in-class activities, e.g. speed dating.
  In summary, great outcomes from the workshop for the team of 9 who attended.

- **U Adelaide:** Our OLT grant *Translating concept into practice: enabling first-year health sciences teachers to blueprint effective flipped learning approaches* Focussing on health sciences ; building teacher capacity to flip effectively; resources being built based on the feedback we have received from the workshops we have run. This website was set up in 2013 funded by an internal university grant and our application with the OLT, was based on the results we collected from this small project.

- **UniSA:** We are also developing residential weeks (1 per study period) whereby external students come on campus to do a range of activities at both a program and course level. We will have a common week twice a year (during study breaks) that all year levels will attend. They will break into some course specific activities but also do program specific site visits and other activities.

- **UQ:** I've presented my findings at two conferences this year and I'll write up my findings in the next couple of months. The quizzes are now being used at USQ and at Oxford Brookes in the UK.

- **UQ:** The course is part of the Strengthening the First Year Gateways initiative in the HASS faculty, and I have just won a HASS Faculty Teaching Award for it. So, good outcomes all around! Publications are planned.

- **UQ:** With regard to feedback on Flipped Classroom implementation since the workshop in December 2013 I have been involved in a number of projects and presented at various national and international conferences…Since your workshop I have completed the following:..

  Presentations
  Delivered a 3 hour workshop on blended learning at AMEE Milan 2014 (this is the International Medical Education Conference); Presented 2 flipped classroom presentations at the ANZMET Conference in NSW (National Prevocational Medical Education Conference); Presented the flipped learning intern readiness program AMEE Glasgow 2015.

  Programs developed and implemented using this model
  Flipped clinical simulation program for 4th Year medical students at the Rural Clinical School, Toowoomba - 2014 and 2015 programs; Flipped intern readiness program at the Rural Clinical School, 4th Year medical students , Toowoomba - 2014 and 2015 programs; Currently working on flipped PBL program for 3rd year Medical Students - anticipated for the 2016 program; International collaboration with Manchester University Medical School (September to November 2015); Utilising flipped learning model to restructure their 3rd Year PBL program. I have created the elearning component for their pilot project.

  Papers
  Currently writing a paper on flipped learning for the intern readiness program - utilising my own version of the flipped learning model.

Appendix Q: Learning Partnership Requests and Analysis

Table Q.1: Institutions requesting information about the Learning Partnership

Institution	State	Requests
University of Southern Queensland	Qld	3
The University of Queensland		9
James Cook University		3
University of the Sunshine Coast		6
CQUniversity		6
Griffith University		7
Queensland University of Technology		2
Charles Darwin University		6
University of New South Wales	NSW	5
The University of Sydney		3
University of Canberra		1
University of New England		2
Australian National University		3
University of Technology Sydney		3
Australian Catholic University		1
Western Sydney University		1
The University of Adelaide	SA	2
University of South Australia		5
RMIT University	VIC	2
Monash University		3
Swinburne University		1
Curtin University	WA	2
Australian Maritime College	TAS	1
Leicester University	UK	1
Waikato Institute of Technology	NZ	1
Unitec Institute of Technology		2
Total Number of Requests		**80**

Appendix R: Web Traffic to OLT Project Site

The UQ's flipped classroom website www.uq.edu.au/teach/flipped-classroom/index.html receives visitors from across the world. The maps showing sources of visitors as at July 2014 (Figure R.1) and July 2015 (Figure R.2) indicate that interest in the flipped classroom has not diminished.

Separate statistics for the OLT Project landing page (www.uq.edu.au/teach/flipped-classroom/olt-transforming/) were not able to be tracked until July 2014, when ITaLI was formed and the web pages for the Institute upgraded.

Figure R.3 shows the page views per week for the landing page for the OLT Project. Of these page views, the majority were from Australia (57.7 per cent), followed by the United States of America (6.6 per cent), United Kingdom (3.7 per cent), China (2.3 per cent) and Singapore (2.0 per cent).

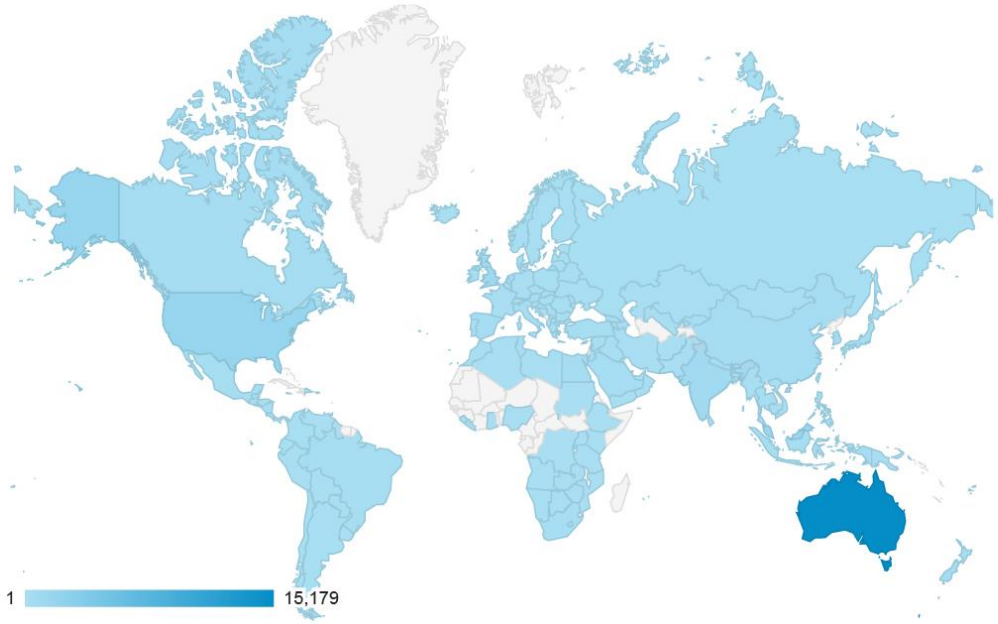


Figure R.1: Visitors to UQ Flipped Classroom website at July 2014

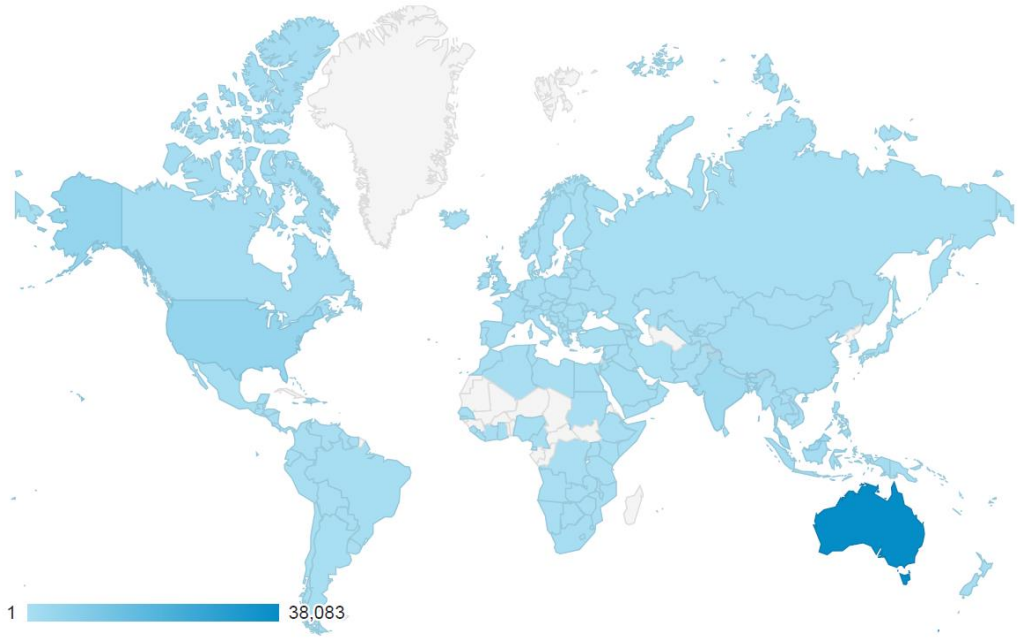


Figure R.2: Visitors to UQ Flipped Classroom website at July 2015

Visits to the web page that workshop attendees were required to use to complete pre-learning for workshops (www.uq.edu.au/teach/flipped-classroom/olt-transforming/pre-work.html) were able to be tracked from the establishment of the website for the OLT project in November 2013.

The page views per week are presented in Figure R.4. The traffic related to the first and largest workshop held on 7 December 2013 is clear, and activity related to workshops conducted throughout 2014 is evident. Workshop activity decreased in 2015.

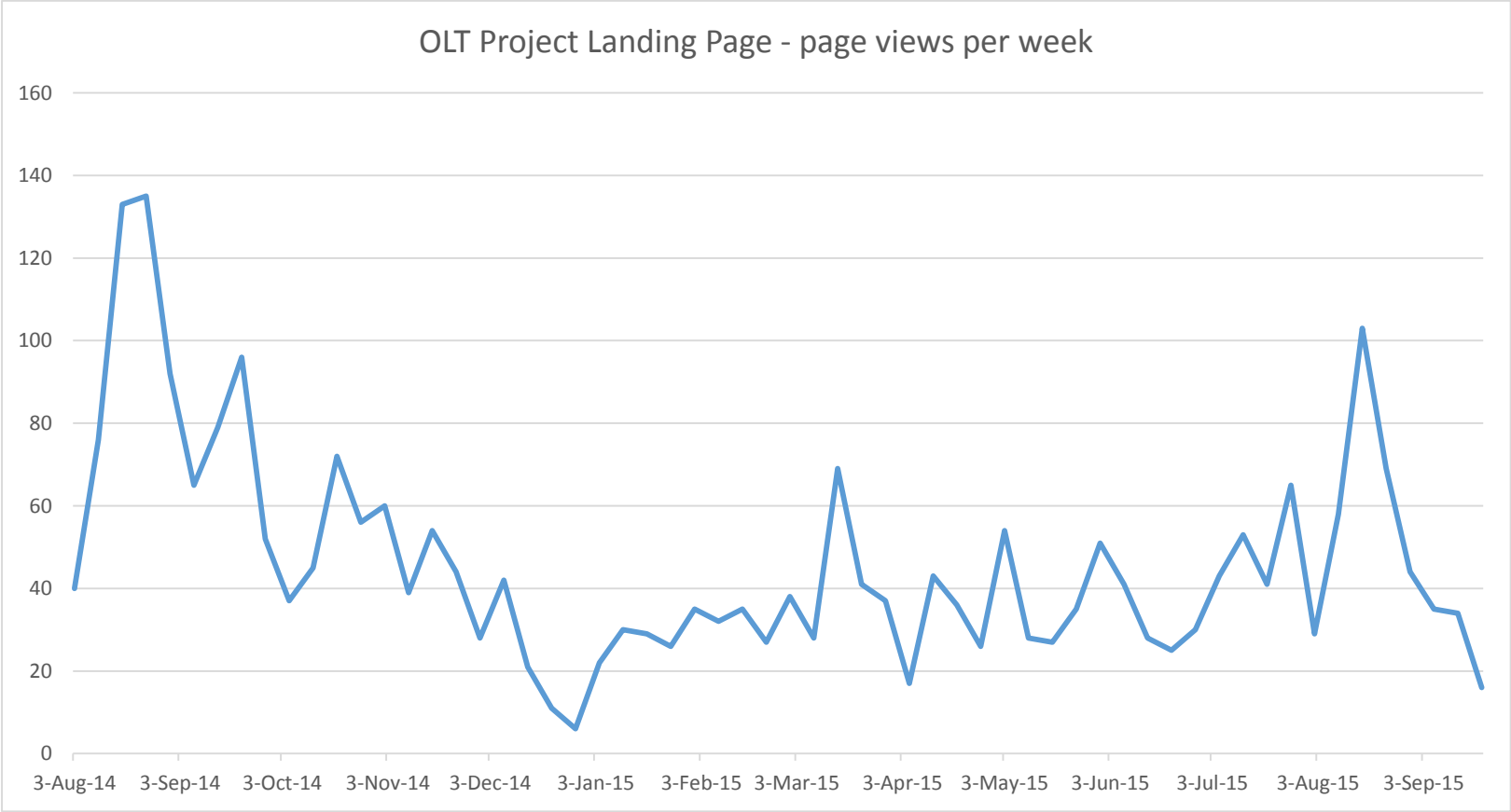


Figure R.3: OLT Project landing page – page views per week

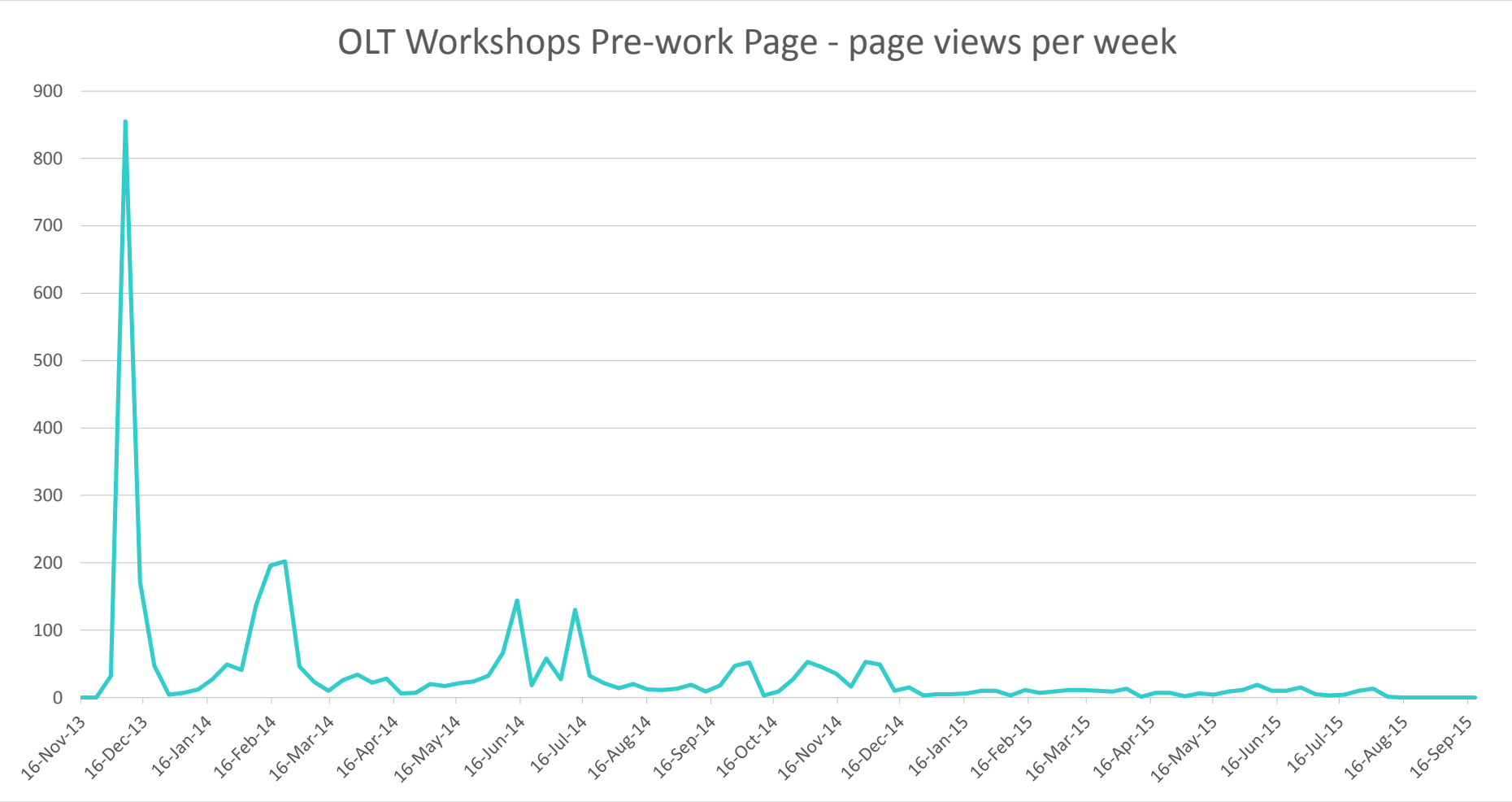


Figure R.4: OLT Project pre-work page – page views per week

Appendix S: Project Publications

Conference Papers

1. Kavanagh, L. & Reidsema, C.A. (2014). The importance of narrative: helping students make sense of what they're learning. *Proceedings of the 25th AAEE Conference, Wellington, December 8-10, 2014*
2. Kavanagh, L., Reidsema, C.A. & Chen, S. (2014). Peer Assessment barriers faced by international students engaging in project-based courses. *Proceedings of the 25th AAEE Conference, Wellington, December 8-10, 2014*
3. Quental, D., Reidsema, C.A. & Kavanagh, L. (2014). Fostering Ownership of Learning in Engineering Education. *Proceedings of the 25th AAEE Conference, Wellington, December 8-10, 2014*
4. Reidsema, C.A., Kavanagh, L. & Jolly, L. (2014). Flipping the Classroom at Scale to Achieve Integration of Theory and Practice in a First Year Engineering Design and Build Course. *Proceedings of the 121st ASEE Annual Conference and Exposition, Indianapolis*, *June 15-18, 2014*.
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Appendix T: Book Chapter Synopses

The Flipped classroom: practice and practices

Chapter 1: Introduction to the Flipped Classroom

Carl A. Reidsema (UQ) and Roger Hadgraft (UTS)

What's the fuss about the Flipped Classroom? In a sense, this is a new name for an old concept, where students seek out information outside the classroom, rather than expecting the teacher to dictate it to them via lectures. Certainly Problem Based Learning is one example of the same rationale, using a structured problem solving process to get students to investigate the underlying phenomena of interest (Norman & Schmidt, 2001). The Flipped Classroom (FC) approach seems to be more widely attractive to teachers (than PBL for instance), perhaps because it seems to be more widely applicable, without the need to restructure the curriculum into an investigative model (Bergmann & Sams, 2012). Nevertheless, some restructure seems inevitable because the focus of activity shifts from listening to lectures to doing activities (for which online mini-lectures may have been provided) (Brown, 2012; McLaughlin et al., 2014; Prince, 2004; Reidsema et al., 2014; Seely Brown et al., 1989; Sullivan, 2009).

It is easy to see that a teacher could get started without a huge amount of effort, perhaps recording the online lectures as the first activity. Sometimes, these might even be available from last year's automatic recording using software (such as Echo 360 for instance). The next step is to wonder what class time will be spent doing. Perhaps mini-projects are introduced. These could run from one week to a few weeks. In first year, students will need a fair amount of scaffolding in order to help them unpack the problem, apply the theoretical ideas of the course, and then assemble a solution, perhaps through some mathematical modelling and/or some physical modelling in a laboratory. In the process they are also learning team skills and writing and presenting skills as well as time management (Kavanagh et al., 2011). They are becoming student professionals (Stevens et al., 2008). With these new FC approaches has come the need for teaching academics to develop a deeper understanding of what is entailed in both the teacher's and learner's role and what expectations are required in order to successfully teach a FC approach. Yet presently while there is plenty of literature on theoretical concepts and ideas around FC and some practical teaching experiences, albeit limited to a mono institution, there is little on how both could be utilized across diverse cultural, institutional, epistemological and pedagogical constructs.

It is our aim that this book addresses this void by developing a much deeper understanding into the complex phenomenon of flipped classroom approaches within higher education as well as serve as a practical guide to implementing them in teaching academic practice across

these diverse constructs. The present evidence trend of learning analytics is prevalent throughout this book (Dawson, 2014).

Part 1 of this book describes the theoretical considerations to be undertaken when changing to a flipped classroom approach with the intent of engaging students in student centred learning activities. The purpose of this is to immediately involve the reader in the excitement of this new development and to highlight some of the challenges to be faced within the transformation of providing innovative teaching and learning within higher education (Beanland & Hadgraft, 2013). There is also a review on the educational concepts on which the flipped classroom depends, including some history of similar innovations in the past (Fulton, 2014; Scheg, 2014). The final sections of Part 1 explore the tools needed for flipping, such as video capture of short lecture segments and online navigational interfaces for virtual interaction as well as evaluative strategies for measuring a FC approach.

Part 2 of the book provides a range of case studies from higher educational institutions in different countries to further demonstrate the many shapes and sizes of flipped classroom courses. Classes can be flipped in many ways. However, some of the challenges to be faced are common, such as engaging students in their own learning and shifting them from spectators in the learning process to active participants.

As students continually progress through their university program, we would hope that they will become not just active participants but also active investigators in a broader sense, shaping the structure of their learning not just satisfying the teachers' needs. They will emerge from the university as proto-professionals, having developed the full range of tools required for successful practice. Our proposed book serves as a practical guide for teaching academics interested in facilitating this student development through a FC approach.

Chapter 2: Design Considerations

Lydia Kavanagh (UQ), Carl A. Reidsema (UQ), Neville Smith (UQ) and Julie E. McCredden (UQ)

The quality of student learning depends largely on how well we design our curriculum and the pedagogies we use within this curriculum. A successful Flipped Classroom (FC) is no exception: to engage students and ensure learning requires carefully considered design and implementation. This chapter teases out, and more closely examines, the key critical success factors from the perspective of the changes that are required in both student and facilitator expectations and roles. In addition, a model for designing a FC provides a structured approach that emphasises a "context-first" strategy.

Chapter 3: Technology in the flipped classroom

Phillip Long (U Texas, Austin), Gráinne Conole (Bath Spa U), Carl A. Reidsema (UQ), Anthea Leggett (UQ), Dominic McGrath (UQ) and Esther Fink (UQ)

The flipped classroom is more than putting lectures online and homework in class. Alongside contemporary theories of the way people learn, the explosion of capabilities with information and communication technologies provides a myriad of possibilities to design unique and interesting learning experiences that bring learning to life and bridge the divide between abstraction and authenticity. The flipped classroom represents a shift in emphasis from didactic teaching skills to design skills focusing on activities that can inspire critical and creative problem-solvers. Once the design makes sense in its clear link to outcomes, technology can serve to enhance or even enable the design, engage learners and play a key role to support and sustain significant learning.

Chapter 4: Assessing Flipped Classrooms

Renee M. Clark (U Pittsburgh) and Mary Besterfield-Sacre (U Pittsburgh)

We discuss a mixed methods approach for assessing the flipped classroom, which we applied to a school-wide initiative starting in the fall of 2013. Assessment of a flipped classroom is, in many ways, no different than rigorous assessment of any good pedagogy. Assessment planning must first consider the objectives of the pedagogical initiative. The critical question we asked was, "What educational gains or advantages should students experience as a result of course flipping?" We then focused on the selection of instruments and protocols for measurement. To study student learning and achievement, we analysed pre-flip versus flip exam and homework results and formally interviewed instructors. To investigate in-class engagement and active learning, we conducted classroom observation using a validated protocol. Using web analytics video access data, we investigated preparation with the flipped classroom and its relationship to achievement. Finally, to assess student perceptions, we used an evaluation survey tailored to the flipped classroom and a research-based classroom environment instrument. A comprehensive and thorough assessment plan provides the advantage of both formative and summative data for an initiative and can guide future directions with it.

Chapter 5: Learning Partnerships: Building a bridge between what is expected and what can be done to facilitate self-authorship in a Flipped Classroom

Roger Hadgraft (UTS), Carl A. Reidsema (UQ) and Neville Smith (UQ)

As graduate students enter the 21st century workforce, the ability to deal with complex and often ambiguous information will be more important than simply knowing facts (Frand, 2000). Having a generic set of transferable skills and the strategic awareness for dealing with real world complex interdisciplinary problems will be a far greater asset valued by

industry in the 21st century (Helyer, 2014). The idea of self-authorship (as the underlying platform for these skills to be developed) is viewed as the necessary component required which entails a fundamental shift in mind-set of how we imagine and structure the preparatory learning environment for the undergraduate student (Hodge et al., 2009). Yet acquisition of self-authorship attributes is not something all students may bring to the higher educational environment even though academic expectations often are that they should be able to demonstrate and perform within that paradigm leading to a distinct gap between instructor and student (Baxter Magolda,1999; 2012).

Compounding this misalignment is the Flipped Classroom learning environment which entails the shift as Barr and Tagg (1995) have termed as from an "instructional" paradigm, which emphasizes instructors telling students what they need to know, to a "learning" paradigm, which emphasizes the design of active learning environments that encourage students to construct their own ideas. By the incorporation of moving content to online with better quality technology there is also an academic expectation that students will naturally access the content and manage their learning with self-directed strategies. But what literature has identified (Reidsema, et al., 2014) is that students may not be ready to make the transformational shift of completely applying self-directed learning (as part of a self-authorship approach) because they were not sure how to do that due to the familiarity of a teacher controlled learning environment in their previous schooling experiences. The principles of Baxter Magolda's (2012) "Learning Partnership" (LP) is a potential solution to bridging this transitional change to enable earlier and greater student graduate development of self-authorship skills within the Flipped Classroom learning environment.

It is important then that educators who take up the challenge of helping students become self-authoring must have gone through this LP process themselves. They must be able to envision the growth required for success in adult life; articulate it in the form of learning goals; develop educational practices that effectively support and challenge students to make the necessary mental shifts; and act on this vision despite students', parents', or administrators' resistance to it. This chapter will focus on the growth required of educators to promote the kind of development that will enable graduates to navigate life's challenges through the Flipped Classroom (FC) approach as the ideal learning environment. Additionally, reflections of our own LP experience derived from the OLT project (this book is an outcome of) will be presented as an example in practice of how to get started with a LP approach. Before this, it is crucial to lay out the platform of what the learning expectations entail within the higher educational setting in preparing graduates to be employable ready for the 21st century workforce.

Chapter 6: Reflective and reflexive practice in the Flipped Classroom

Geoff Greenfield (UQ) and Paul Hibbert (U St Andrews)

This chapter is concerned with exploring two particular aspects of what we are asking students to do in flipped classroom contexts in the 21st century learning environment. The first aspect is that we are asking students to independently (but with facilitation) engage with practical and theoretical problems in order to develop their own discipline-focussed understanding. The second aspect is that, through engaging in this independent learning process, we are asking students to understand *themselves* differently. That is, to see themselves as adult learners (Knowles, Holton & Swanson, 2011) capable of developing their knowledge further through individual *self-directed* learning, and through engaging with other adult learners in team processes. These things that we thereby ask of students – to learn in a more independent mode and to understand themselves differently – are two distinct yet overlapping challenges. Addressing these challenges also requires the development of two distinct yet overlapping kinds of practices – namely *reflective* (problem-oriented) and *reflexive* (self-oriented) practice (Hibbert, 2013; Cunliffe, 2004; 2009a).

In this chapter both kinds of practice are outlined and the issues that may arise are considered. To provide a structure for this engagement, the remainder of the text proceeds in three parts. First, reflective and reflexive practice are briefly defined and contrasted. Second, using Knowles, Holton and Swanson's (2011) six adult learner principles as an organising framework, example approaches to support student engagement in these practices are described. Finally, issues related to variations in learner engagement and developmental trajectories are considered in order to stimulate further generative reflection for educators.

Chapter 7: Flipping the classroom: Enabling change to happen through a collaborative approach

Carl A. Reidsema (UQ), Mary Besterfield-Sacre (U Pittsburgh), Ruth Graham (Independent Consultant in Engineering Education and Entrepreneurship) and Neville Smith (UQ)

Implementing and sustaining successful change practices in teaching within higher education requires a collaborative team effort. The change in transforming and sustaining Flipped Classroom (FC) practices while initially may be started by an individual or several academics within a singular or several courses, successfully embedding its practice requires a longer and more considered collaborative approach. This chapter outlines and examines the main features of this collaborative approach such as leadership which can ignite and implement the change to Flipped Classroom (FC) practices, well considered planning and preparation to provide context and structure for the change to occur, collaborative practice development to enable the change processes to be accomplished and evaluation for monitoring these processes against school and faculty strategic plans. Crucially, the

consideration of major barriers to changed teaching practices academics face is explored with the solution of a collaborative approach put forward as a possible strategy to overcoming these in direct reference to establishing and embedding Flipped Classroom (FC) approaches. But first it is poignant to explain what change means within any organisational setting. More importantly, to unpack how change can be managed and sustained within a higher educational setting.

Chapter 8: Part 2 Case study framework

Lydia Kavanagh (UQ), Roger Hadgraft (UTS), Carl A. Reidsema (UQ), Neville Smith (UQ) and Dominic McGrath (UQ)

This chapter provides the framework to the case studies included in Part 2 of the book. The series of case studies each represent a different authentic context and highlights the diversity of Flipped Classroom (FC) approaches in practice. The purpose of including these case studies is because of their usefulness to learn about the processes of these diverse FC approaches within a broad range of higher educational disciplinary teaching and learning contexts. These case studies are examples which can be analysed from both theoretical and practical perspectives as well as a structure that the reader can use to develop their own FC teaching practice within similar contexts.

The structure of the cases followed a framework designed and provided for the contributors so they could provide their experiences in a way where an overarching paradigm could be derived on the basis of their successes or difficulties with implementing FC approaches in practice. These cases not only serve as a source of encouragement but also foreground the challenges which academic teachers and their respective institutions have faced with these implementations. The problems identified by each contributor that they faced were tackled from a FC approach but with different pedagogical issues in milieu to their response to the different student learner requirements. While some of the contributors' chapters follow different presentation styles we have accepted these in order to give scope to different ways of presenting these cases as far as possible. We also have intended to retain the original style for the chapters with just the required editing.

What is also presented in this chapter are the big ideas or key considerations previously discussed in Part 1 which enabled a deeper exploration of the major issues to consider within a FC approach. We then take these big ideas and move forward to Part 2 of the book through the thread of the common rationale framework developed through the sharing of the key considerations and our case studies. It is our intention that for Part 2 of the book the reader can start to identify potential patterns of the challenges, opportunities and pitfalls around FC practices that were addressed in Part 1 of the book.

Chapter 9: Using a flipped classroom framework to design an authentic, active learning environment for developing first year student engineers (The University of Queensland)

Julie E. McCredden , Carl A. Reidsema and Lydia Kavanagh

This case study presents the flipped classroom (FC) as a framework for transforming a large first year traditional engineering course (ENGG1200) so as to immerse student engineers into real world practices, including knowledge of materials engineering, design, problem solving, modelling, and professional skills. Using a design approach and drawing on relevant research, a learning environment was constructed whose architecture comprised an integrated set of learning components that would develop within our students the internal learning mechanisms required for attaining these skills. A central component of the learning environment was an authentic open-ended design project, which was completed by multidisciplinary teams. Implementation of the course using a FC framework allowed the contact time with students to be used for hands-on workshops that developed and scaffolded many of the skills necessary for the main project. Out of class hours were used by students for acquiring the necessary background knowledge and skills required for the projects, and for further team development of the project artefact and report. The learning environment included online modules and quizzes, an online organisational tool (the Learning Pathway), online reflections, and extensive extra online resources.

The design process, the design solution, and the evaluation of the course architecture are described in this chapter, along with the characteristics that enabled the learning goals to be achieved. Evaluation of marks suggests that the learning mechanisms were able to facilitate the desired internal mechanisms within students in the way in which they were intended. Furthermore, evaluation of student reflections indicate that students did indeed develop knowledge and skills in engineering materials, modelling, problem solving, self-management, teamwork, communication, and linking concepts with practice. Many aspects of the design process described are transferrable to other disciplines aiming to facilitate authentic learning activities using FC approaches.

Chapter 10: Experiences with “Flipping” an Introductory Mechanical Design Course (University of Pittsburgh)

Renee M. Clark, William W. Clark, and Mary Besterfield-Sacre

We formally incorporated the “flipped classroom” into our undergraduate mechanical engineering curriculum during the fall of 2013. In addition to a second-year course in mechanics and statics, we also flipped the lab portion of a required second-year course in introductory mechanical design taken by over 200 students annually. The CAD modelling portion of the course was delivered in a flipped fashion, in which students applied their SolidWorks knowledge during the weekly two-hour lab session. In the “flipped classroom,”

face-to-face time is used for application of skills versus the conveyance of facts. To enable this approach, students watched video lectures before class. This course was part of a school-wide initiative to drive active learning, engagement, and deeper learning.

We obtained positive results with flipping this course, as perceived by the students, teaching assistants, and instructor. Structured classroom observation revealed many of the ideals of the flipped classroom, including teamwork, peer discussions, active questioning, and problem solving. Using the Teaching Dimensions Observation Protocol (TDOP), we observed that nearly 100% of the observation segments contained problem solving with SolidWorks as the TAs circulated and assisted students. This interactive environment aligned with our finding from the College and University Classroom Environment Inventory (CUCEI), in which students rated the personalization dimension, which assesses student-to-teacher interaction, highest. We benchmarked our CUCEI results against those of STEM classrooms at two other schools.

Despite some challenges and a lack of statistical significance of the homework results, we considered this to be a successful implementation of the flipped classroom given the level of student engagement. Going forward, flipped instruction will be the teaching and learning format that we plan to use with this course as well as others in the mechanical engineering department.

Chapter 11: Inclusive STEM: Closing the learning loop (RMIT University)

Patricia McLaughlin, Cindy O'Malley and Pauline Porcaro

The importance of STEM (Science, Technology, Engineering & Mathematics) disciplines for the future economic and social well-being of all Australians cannot be under-estimated: 75% of the fastest growing global occupations require STEM skills and knowledge (Becker & Park, 2011). Increased participation in STEM-related tertiary education is fundamental to the economic and social well-being of the individual and the nation, yet the number and capacity of STEM graduates Australia produces from tertiary institutions is inadequate (OECD, 2011). Attracting and retaining STEM tertiary students will rely upon approaches to learning and teaching that engage, motivate and inspire more diverse cohorts.

However, like many other universities around the world, RMIT now caters to an increasingly more diverse student cohort. Students from diverse backgrounds (socio-economic status, race, age, location, disability, or gender etc), who traditionally were seen as under-represented in higher education institutions, are now enjoying greater access to university. This is evident in STEM disciplines at RMIT and provides new challenges and problems for both the University and the students. It is particularly problematic where more traditional, didactic, teacher-centred, teaching styles have prevailed. Modern learners come with different degrees of abilities and the capacity to be successful at University requires different levels of support. The RMIT Inclusive Teaching and Assessment Practices Project

was initiated with these students in mind, with the aim of providing a cohesive approach to learning and teaching practices that addressed the needs of all learners across the University irrespective of their background.

Chapter 12: Flipping on a shoestring: A case study of Engineering Mechanics (University of Technology Sydney)

Anne Gardner

University-wide decisions are rarely made from purely pedagogical motivations so it was that the institutional pressure to use a flipped learning environment was driven by the objective of reducing face-to-face teaching time. In response to this pressure I started flipping part of a first year civil engineering subject in Spring semester of 2013. I have subsequently flipped this subject for both semesters in 2014. Since this subject, Engineering Mechanics, traditionally has a high failure rate, I saw it as an appropriate subject to trial a new approach so that I could comment on the institutional initiative from a position informed by personal experience. A flipped learning environment also appeared to align with the collaborative learning framework developed progressively over several years by Dr Keith Willey and myself (see Figure 13.1), and this guided the overall subject design. This chapter is an explanation of how I use the collaborative learning framework to support a flipped learning environment.

Chapter 13: Design, Deployment and Evaluation of a Flipped Learning First Year Engineering Course (The University of Sydney)

Abelardo Pardo and Negin Mirriahi

A combination of factors ranging from new technological developments, the use of social platforms, or the appearance of Massive Open Online Courses (MOOCs) have prompted a strong push to review the pedagogical strategies adopted across the entire educational spectrum. This disruption is affecting the way we consider assessment, activities, student engagement, and learning modalities. Although far from reaching a clear vision, the topic of student engagement or the active participation of students in the learning process is emerging as one of the most important. There seems to be a consensus that engaging students actively in learning activities improves the overall learning experience (Prunuske, Batzli, Howell, & Miller, 2012; Roach, 2014). The conventional learning setting where teachers lecture concepts to students in-class followed by students engaging in homework activities or assessments outside of class is no longer the only possibility. Flipping the 'homework vs lecture equation' provides an opportunity for students to engage in socio-constructivist activities in-class by becoming familiar with the course content prior to the class time (Houston & Lin, 2012). In engineering education, the context in which the case study reported in this chapter is situated, the need for active learning techniques is even more pronounced (Freeman et al., 2014; Wieman, 2014).

Flipped learning, also known as the flipped classroom or inverted classroom approach, is one of the active learning mechanisms that is increasingly used in the area of engineering education (He, Gajski, Farkas, & Warschauer, 2015). The notion of students engaging with preparation activities before a face-to-face session is by no means a new one. In fact, the value of student preparation has been recognized for years. However, the widespread use of technology and the variety of resources and online tools available for pre-class activities has prompted a review of how students' engage with them and to reassess their potential. This reassessment can inform course design and teaching practice. Due to the increased availability of online technologies, the interactions students have with course material can now be better spread over a variety of modalities, devices, and temporal options. The affordances provided by online technologies should be considered when designing flipped learning experiences and assessing student engagement.

But embracing flipped learning is rigged with challenges. How can activities be reorganized to make the most of students' time in-class but also engage them with necessary activities outside of class? How should students divide their effort? How could a conventional course be redesigned to better support students' achievement of the intended learning outcomes? This chapter showcases a concrete example of how a large first year engineering course on computer systems has been re-designed as a flipped learning experience overcoming some of the mentioned challenges. A division of activities based on their cognitive load, and their scheduling into *stages* was conceived to promote a gradual exposure of students to concepts in increasing level of difficulty to scaffold their learning. A set of assessment instruments alongside the activities were deployed to provide students with an opportunity to demonstrate their achievement of the learning outcomes and support their sustained engagement with the course material. Hence, formative and summative assessments were interspersed throughout the course to maximise the preparedness of students. The rest of the chapter describes the main aspects of the flipped learning redesign and how it has been evaluated. Section 2 gives a brief description of the background of the problem and current solutions. Section 3 describes the design of the course in detail. An evaluation of the course is included in Section 4. The chapter finishes with a set of conclusions and an outline of next steps.

Chapter 14: Flipped classes: Drivers for change, transition and implementation (Edith Cowan University)

Yassir M. Al-Abdeli

Though not a commonplace teaching and learning model, much interest is being generated in flipped classes. The arguments given for parting ways with the traditional lecture, and moving into flipped classes, are well discussed in the literature and have been derived across a broad range of disciplines. However, transitioning both teaching staff and students into flipped Learning and Teaching (L&T) is an issue which has attracted less attention.

Before implementing flipped classes, it is also necessary to identify the range of merits which students attach to this model as well as the challenges they associate with its implementation. These matters are the focus of two research questions addressed in the present work.

After presenting an overview of the justifications used to introduce flipped L&T into an engineering thermodynamics unit, the processes used to transition students into this model and the particulars of how it was applied are presented. Feedback (qualitative) derived from a questionnaire conducted at the end of the teaching semester is also reported and used to shed light on the student perspective. The chapter adds to the evidence that changing student L&T styles needs to be addressed at the design stage if introducing flipped classes and that a transitional strategy is required to assist students in adapting to the new learning environment.

Chapter 15: A Technology Enabled Flipped Classroom Model (Nanyang Technological University, Singapore)

Paul Gagnon, Redante Mendoza and Jan Carlstedt-Duke

In 2010, Nanyang Technological University (NTU), Singapore and Imperial College, London (ICL) embarked on a collaboration to create Singapore's 3rd medical school, known as the Lee Kong Chain School of Medicine (LKCMedicine). Apart from a mandate to address the primary health care needs of Singapore's aging population, LKMedicine was also challenged to adopt a new educational model which made extensive use of 21st century information technology to enhance the medical education curriculum. Much of the literature with respect to what has been done to date in more recently established schools, both in Singapore and abroad, reflects existing eLearning patterns/norms, i.e., platforms are adopted which are cost effective, scalable, supportive of flexible distribution of content, as well as facilitative of information exchange between students and faculty. In short, Learning Management Systems like Blackboard, Moodle, Sakai etc are adopted which support the delivery of content, collaboration via discussion boards, and rudimentary learning analytics around clicks and access to course materials and communication tools therein.

Accordingly, this chapter demonstrates how LKCMedicine weaves the threads of technology, curriculum and pedagogy to construct its own teaching and learning DNA. Further, we showcase our re-imagining of the *blended learning* or *flipped classroom* narrative. This required managing three main challenges: (1) conceptualizing a learning framework capable of integrating all aspects of learning in both a digital and physical environment; (2) developing an infrastructure capable of supporting the integration of disparate instructional systems deemed essential to the delivery of a highly mobile, paperless Team Based Learning (TBL) curricular experience ; (3) ensuring that all E-Learning innovations are extensible, insofar as possible, to the greater NTU learning community.

Chapter 16: Flipping a Postgraduate Classroom: Experience from Griffith University

Kriengsak Panuwatwanich

In the past decade, technological advancement of the digital age has played an important role in transforming higher education worldwide. Learning materials have been made available to students in various multimedia forms, enabling the students to learn anywhere anytime. As a result, the notion of students physically attending classes to simply listen to and copy down the lectures is widely acknowledged as archaic. Recent development in, and promulgation of, e-learning coupled with the existing distance learning model has further seen the advent of "Massive Open Online Course (MOOC)" where students can study and interact with the professors as well as their classmates without needing to leave their homes. For this reason, one can easily question the value of physically going to a university to study while one can already have access to all the needed education resources anywhere and anytime, at one's fingertips.

Against the backdrop of these two competing modes of learning, a "hybrid" teaching method was developed to capitalise on the advantages of online multimedia course materials while harnessing the benefits of traditional face-to-face learning environment. Such integration of these two different delivery modes was also carried out and proposed with the view to provide a unique learning environment that is conducive for students to be proactive in their learning. Within this environment, students are empowered to take the ownership of their learning and to use the "deep approach" to their learning, which can be developed from "a felt need to engage the task appropriately and meaningfully, so the student tries to use the most appropriate cognitive activities for handling it" (Biggs and Tang, 2007, p.24). In creating such environment, the classroom is "inverted" or "flipped" whereby "the events that have traditionally taken place *inside* the classroom now take place *outside* the classroom and vice versa" (Lage, et. al., 2000, p. 32). In other words, this method of "flipping" the classroom requires the students to study the course materials outside of formal class time (mainly through online multimedia resources) and the teachers to use the formal class time to carry out collaborative and interactive activities relevant to that material (Butt, 2014). In this way, formal class time can be used more effectively for students to carry out higher-order thinking activities (Brame, 2013).

In this chapter, a case study on the use of flipped classroom approach with a postgraduate engineering course at Griffith University in Australia is presented. The aim of this case study is to demonstrate an actual design and implementation of the flipped approach as well as to discuss various issues associated with it. The chapter firstly details the contextual background and motivation of the author for using the flipped classroom approach for this particular course. It then elaborates on the details of the design and implementation, and discusses the main outcomes associated with the use of flipped approach. In particular, it

provides examples of specific activities and pedagogical techniques employed during the classes. The chapter concludes with a reflection on the implementation and highlights key insights into the application of flipped classroom approach within the context of a postgraduate study. Challenges and opportunities are also discussed with the view to improve future implementations of the flipped classroom approach.

Chapter 17: Flipping the learning of subdivision design for Surveying students (RMIT University)

David Mitchell

The discussion in this Chapter will explore aspects of the development, application and evaluation of the *Land Development* course in the RMIT University Surveying program that relates to the flipped classroom. The particular example discussed is the development of an active learning model to support a broadacre land subdivision design project, and the gradual transition to a flipped classroom.

Core learning in RMIT's surveying degree program involves the study of cadastral surveying (defining property boundaries, subdivision, and property law) and land development (design and approval of subdivisions). As many graduates will gain employment in cadastral surveying companies, student knowledge in these areas has a large bearing on their employability and career-readiness. It is also essential for accreditation by the Surveyors Registration Board of Victoria (SRBV) as a licensed surveyor. One of the key roles of graduates of the RMIT Surveying program is the design of land and building subdivision layouts. Another key role for graduates is applying for approval of subdivisions through the land use planning system (ie *land development*).

Feedback from employers across a number of years has emphasised that knowledge of legal and policy frameworks, the ability to solve problems and to be innovative, and a desire for life-long learning are key attributes of employability. Employers often reinforce the importance of Surveying graduates having a strong understanding of the policies, laws and clauses that relate to the design and approval of land development projects. All decisions are ultimately based on planning strategies, supported by statutory clauses in regulations and planning schemes.

Throughout their Surveying program our students are exposed to many practical and technical concepts and tasks, and they are very comfortable working in this sphere. However, some students have more difficulty understanding legal and policy frameworks and how they may be applied. Another area of study that moves some students out of their comfort zone is tasks that require design skills, as this is sometimes at odds with the methodical approach encouraged in much surveying learning.

This Chapter focuses on experiences in addressing these issues in the course *Land Development*. This course is chosen as a case study as it requires students to develop both a

deeper understanding of the policy and legislation related to subdivision approval, and to undertake a design of a broadacre land subdivision. Historical approaches to teaching and learning have included telling the students what they need to know (lectures), students learning this material, practical support (tutorials) and providing a problem where they apply the theory (practical projects).

Chapter 18: Flipping a collaborative classroom to gain deeper understanding of the health system (The University of Queensland)

Allyson Mutch, Charlotte Young, Neville Smith, Kate van Dooren, Cassandra Ranatunga, Cathie Gillan, Katie Brooker, Greg Fowler and Lisa Fitzgerald

How did we get started?

Our teaching team is responsible for PUBH1103: Health Systems and Policy (HSP), a first year core course in the Bachelor of Health Sciences (BHlthSc) program at UQ. The Program provides a pre-clinical and professional pathway for students seeking a career in health. Across the Program students engage with courses covering a range of disciplines including biomedical sciences, public health, health behaviours, research methods, ethics and health policy.

Health Systems and Policy provides a broad introduction and overview of the Australian health system. It examines: the key contributors to health care; the functions, financing and policy processes within the system; use of the system and associated care pathways; and contemporary issues facing health policy makers. The course aims to establish a critical perspective by introducing students to the key stakeholders and decision makers linked to health policy making processes. It also weaves a social determinants of health perspective through the curriculum, to ensure students develop awareness of the impact of health systems and policies on different population groups.

Health Systems and Policy has had to overcome the challenge that many students anticipate a dry and boring course of limited relevance or interest. However, in recent years the health policy environment has been a vibrant space generating much food for thought through national and state elections, system reform agendas and intense political and media debate. The teaching team intentionally works to integrate 'hot' policy issues into the theoretical and historical content of the course. Students frequently comment the course was more engaging than they anticipated.

I thought the teaching team did a really good job at making a course that I expected to be boring, quite interesting. (student, SECaT)

A subject that I thought would be really boring (I'm sorry – it's just policies and government) [was] very enjoyable and one of my favourite subjects. (student, SECaT)

With all this in mind, the old adage 'if it ain't broke don't fix it', could have been used to justify maintaining the course's existing structure and format, but the teaching team became increasingly concerned HSP was becoming stale and not achieving higher level learning outcomes, so we decided to take a different approach.

A core driver for course revision was our commitment to fostering critical thinking and deeper learning (Biggs & Tang, 2011; Ramsden, 2003). Reflecting on existing course materials we were cognisant that our efforts to foster critical thinking were based on the critique of materials in the classroom, largely relying on the transfer of knowledge and skills from the teacher to the student: clearly a limited approach (Dall'Alba, 2005; Whetten, 2007). To redress this, a more integrated approach to delivery that would foster deeper learning was sought through the introduction of collaborative processes that placed students at the centre of class discussions (Biggs & Tagg, 2011). Learning objectives, teaching activities and assessment were realigned; and activities were developed to establish foundational knowledge outside the classroom that would inform and support discussion, reflection, engagement and debate within the classroom (Biggs & Tagg, 2011).

The following chapter maps our teaching team's journey through the redevelopment of HSP. The chapter is divided into four sections. The first describes what we did, the second outlines how we did it and the third reflects on our experiences. Some members of the teaching team maintained regular diaries of the semester, these reflections inform section three. In the final section we briefly discuss some 'next steps'. In reflecting on this journey we have endeavoured to draw on the voices and experiences of students gathered through two brief in-class surveys, and group discussions recorded via Padlet (student response software). The University also conducts a Student Evaluation of Course and Teacher(SECaT) in the final weeks of the semester. The SECaT survey covers eight questions to explore students' perceptions of a range of elements including, feedback processes, learning materials, aims and goals, and assessment. Responses are recorded on a Likert Scale ranging from 5 – outstanding through to 1 - very poor. A measure of overall satisfaction with a course (Q8: 'Overall, how would you rate this course?') provides a basis for monitoring trends across the University. The SECaT evaluation also includes two open-ended questions: what were the best aspects of the course; and what improvements would you suggest? The response rate to the SECaT was 77% (n=100). The data collected across the semester for this chapter was approved by the University's Behavioural Research Ethics Committee.

Chapter 19: Implications for pedagogy: Flipping the classroom to engage pre-service teachers (The University of Queensland)

Linda Willis

As noted by authors in previous chapters of this volume, the idea of flipping the classroom is not new. But the view that flipping the classroom just means students doing work at home

that they once did in classrooms is simplistic, overlooking the imperative of new technologies and how these are revolutionising conventional teaching and learning. I have been a tertiary educator in Australia for almost a decade and began flipping my classroom two years ago to better engage pre-service teachers in learning to teach English and literacy. I first heard about a flipped classroom approach through a university-wide promotion. Subsequently, I joined my university's flipping the classroom community of practice to: learn more about what others were doing in their different settings and contexts; share experiences; gain practical ideas; discuss challenges; explore solutions; receive support; and contribute to ongoing research. In this chapter, I examine and reflect on my experiences of learning so far. In particular, I call on key concepts including community of practice, ethics of responsibility, and habitus as well as frameworks such as gateway, cornerstone, and capstone knowledge that have informed my teaching to highlight the pedagogical implications of the approach as well as the impact on student learning and achievement.

Chapter 20: Flipped Tutorials in Business Courses (The University of Queensland)

April Wright, Geoff Greenfield and Paul Hibbert (U St Andrews)

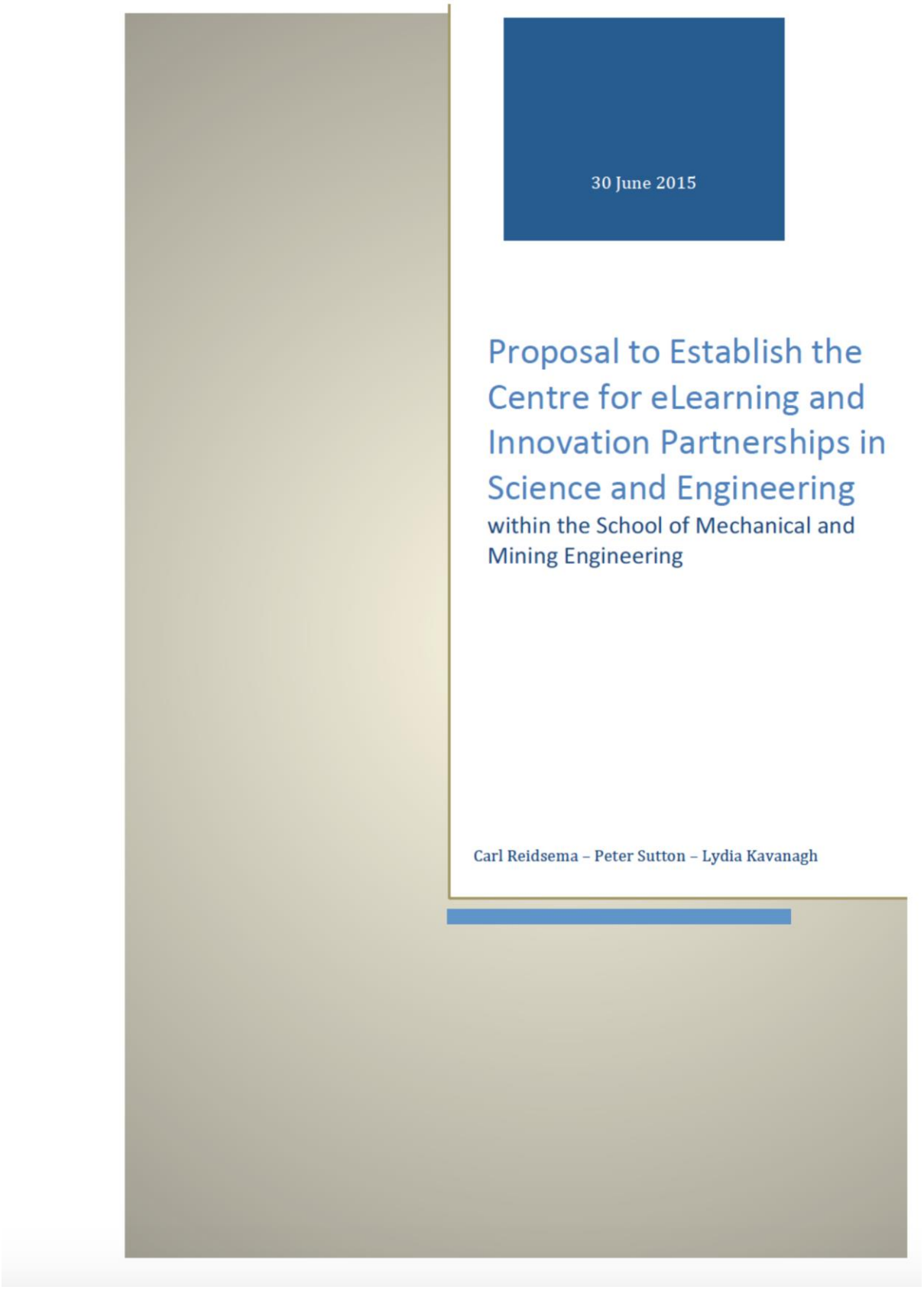
Attention is increasingly being paid to how student learning in the disciplines of Science, Technology, Engineering and Mathematics can be enhanced by flipping or inverting the classroom (Alpay & Gulati, 2010; Deslauriers, Schelew, & Wieman, 2011; Mazur, 2009). Because these disciplines have a tradition of didactic teaching to disseminate content, Berrett (2012) argues they are 'ripe' for flipping in comparison to the humanities and social science disciplines which have historically inverted their classrooms to explore ideas. A dominant flipped classroom tradition in the social sciences, particularly in the law discipline, is the Socratic method because it 'compels students to study the material before class or risk buckling under a barrage of their professor's questions' (Berrett, 2012: 38). The Socratic method is equally well entrenched in business schools, where its application to the teaching of business case studies was pioneered in the 1930s by Harvard Business School (Dewing, 1931; Dooley & Skinner, 1977; Lundberg, Rainsford, Shay, & Young, 2001).

On the surface, traditional Socratic methods of teaching business case studies are consistent with flipped classrooms. Students are expected to prepare in advance of class by reading case study materials and other learning resources, which leaves class time free for a case discussion facilitated by an instructor who (1) raises issues, (2) challenges students to apply theory to resolve the case issues, and (3) prompts "the advancement of discussion … in the service of thinking" (Lundberg & Winn, 2005). Learning is deepened as the instructor encourages students to compete to unravel the managerial dilemma (Berger, 1983), to recognise different concepts in the case and select theories and models appropriate to the situation (Lundberg et al., 2001), and to adopt a mindset of improvisation and multiple interpretations (Aylesworth, 2008; Greenhalgh, 2007).

The traditional Socratic approach to case study teaching works very effectively as a flipped classroom for business courses at the postgraduate and executive education level. Students in these courses are experienced managers with sufficient confidence to engage in vigorous debate and instructors are disciplinary experts skilled at probing and challenging student reasoning (Garvin, 2007). In contrast, Socratic case study teaching works much less effectively as a flipped classroom at the undergraduate level because teaching tends to become instructor-centric (Argyris, 1980; Foster & Carboni, 2009; Siciliano & McAleer, 1997). Large undergraduate courses typically adopt a cost-effective format of mass lectures and tutorials, with case study debates conducted in tutorials. Undergraduate business students, especially first-year students, arrive to the tutorial unprepared and lacking confidence to engage in case discussion. At the same time, tutorial instructors, employed from a casual staff pool of research higher degree students, do not have the expertise and training to facilitate a Socratic case discussion. The outcome is an undergraduate business tutorial which resembles not a flipped classroom but instead a didactic mini-lecture reminiscent of King's (1993) 'sage on the stage'. The inexperienced tutorial instructor adheres rigidly to prepared case notes as students wait passively to receive the answers and a summary of relevant management theories and concepts (Lundberg & Winn, 2005). Student resistance to completing the preparatory work required to 'flip' a classroom has been similarly reported by educators in other disciplines (Herreid & Schiller, 2013).

However, all is not lost for undergraduate business teaching. Advances in thinking about the design of flipped classrooms mean tutorials do not have to regress to a level where, to paraphrase Mazur (2009:51), the case study notes of the tutor are transmitted to the notebooks of undergraduate business students without passing through the brains of either. In this chapter, we show how thoughtful design and implementation of a flipped tutorial class can transform (1) the tutorial instructor from sage-on-the-stage to learning facilitator, and (2) the undergraduate business student from passive knowledge recipient to self-managed learner. The chapter is structured into five sections. First, we describe our teaching context of an introductory management course in the first-year core of an undergraduate business degree. Second, we outline our design of a flipped classroom intervention for teaching case studies and the procedures we adopted for implementing it in tutorials. Third, we elaborate a model of different combinations of tutor and student roles. Fourth, we draw upon our model to explain the role shifts associated with flipped classrooms using illustrative vignettes and quotes sourced from tutors and students in our introductory management course. Finally, we conclude the chapter with a discussion of the broader implications of our experience with flipped classrooms in undergraduate business courses for reflective and reflexive practices of instructors and students more generally.

Appendix U: eLIPSE Centre Proposal - Extract



1. Purpose of the Centre:

The primary purpose of the Centre for eLearning and Innovation Partnerships in Science and Engineering (eLIPSE) is to ensure that eLearning innovation and associated research is well grounded in the curriculum and supported within (although not limited to) the Faculties of EAIT and Science. The eLIPSE Centre will bring together expertise in the field of eLearning and curriculum design that will allow innovations to be quickly and effectively piloted, and research to be developed and disseminated. The Centre will grow in capability and reach by developing and consolidating collaborative partnerships between academics, specialists such as learning designers and software developers, and other stakeholders as required.

The Centre aligns with UQ's Strategic T&L goals for advancing the quality and reputation of education at UQ through improving our understanding of the impacts of eLearning technologies on student learning.

The underpinning mission of eLIPSE is characterised by our ability to:

- improve the overall quality of student learning and experience in Science, Technology, Engineering, and Mathematics (STEM) programs and courses;
- advance our understanding of Technology Enhanced Learning in disciplinary contexts through focused collaborative development of eLearning and Learning Analytics tools, methodologies and infrastructure;
- improve academic teaching practice by enabling collaboration within and across disciplines; and
- improve our research capabilities in the Centres' areas of expertise.

eLIPSE activities will be distinguished from and complementary to ITaLI activities, focusing on supporting discipline experts to lead education and innovation from within and across their faculties and schools.

eLIPSE will work towards a mutually negotiated framework that will support academic ownership of both the benefits and responsibilities required to design, develop, deploy, and evaluate new and innovative eLearning tools within the curriculum. In this way, academics will be able to manage and lead their own projects whilst being supported by locally aligned resources and expertise that can be shared across a wide range of faculty and school projects. The Centre will work towards creating and enabling synergies between projects at the academic level as well as the technical level (integration of systems and reuse of software code), creating improved opportunities for significant outcomes that result from critical mass, and the improved cost and time efficiencies that result from economies of scale. Staff appointments that last for longer than one project will help build the corporate knowledge that contributes to these efficiencies.

eLIPSE will act as a "bridge" between the faculties and relevant supporting organisational units, most importantly ITaLI and ITS. The Centre will achieve this by representation of those two units on an Advisory Panel (Section 8.5), exchange of staff (through secondment or fellowships) as appropriate, and appointment of staff to jointly owned projects.

The Centre will act as a focal point for external and internal funding in eLearning innovation in STEM. Better outcomes for projects will be possible by taking advantage of shared resources and the development expertise within the Centre. The Director, A/Prof Carl Reidsema, has a track record of annual grant income around $350,000 and the establishment of the Centre and a critical mass in this area is expected to lead to an increase in externally funded projects.