Reimagining the dissemination of Engineering education practices through a global learning partnership

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Structured abstract

BACKGROUND
Emerging amongst the many calls to transform engineering education is a push to replace the traditional lecture with online video 'content' and couple this with collaborative active learning on campus. The interest in this Flipped Classroom approach is mirrored by the global MOOC (Massive Open Online Course) phenomenon. Both point to the need to reimagine the online and on-campus environments to ensure successful recruitment and retention of students, whilst maintaining the focus on learning outcomes. One large-scale (1000 students) Flipped Classroom implementation was demonstrated at The University of Queensland in 2012 and has generated significant attention both nationally and internationally due to its unique pedagogical design, leading to an international research collaboration with the aim of exploring opportunities and connections towards reimagining the future of online and on-campus learning environments. The first event in this collaboration was a workshop held at Stanford in May 2013 which forms the focus of this paper.

PURPOSE
This work builds on new forms of open scholarly communication with the goal of accelerating systemic change in engineering education. That is, we are attempting to organise ourselves utilising the principles of Baxter Magolda's "Learning Partnership" (2012) to transfer practice and disseminate for impact faster than would be expected in the traditional manner. This paper is the beginning of an answer to the question of how a learning partnership can be made to work across national and disciplinary boundaries and how such a partnership may impact on the forms and dissemination of flipped classrooms.

APPROACH
The Stanford workshop was constructed around planning a research project focussing on the integrated use of Flipped Classrooms and MOOCs at the participant institutions. Program Logic was used as a framework for the two-day event and throughout the workshop Learning Partnership techniques were employed. This was effected through the use of the SAID approach (Situation, Affect, Interpretation, Decision) for structured journal writing and extended into participant sharing. The workshop made innovative use of artefacts as a prompt to collaborative planning and events and outcomes were summarised in visual form. Here we consider how this open communication and mutual construction of understandings about the project have helped to develop our Learning Partnership and influenced our thinking on what such a partnership is and what it can accomplish.

ACTUAL OR ANTICIPATED OUTCOMES
Participants found the open nature of the conversations to be stimulating and challenging. The approach described here meant that discussions included a depth of insight that is not found when participants are working in a more formal setting. As a result we have been able to develop a common understanding of what Flipped Classrooms are and how this project needs to study them that would have been hard to articulate using normal academic modes of communication and collaboration.

CONCLUSIONS
The time pressures experienced by the academic often do not allow for creating, implementing and operating, as well as disseminating through the traditional means of publication. The Learning Partnership approach offers a new way to collaborate and provide broad dissemination, although its implementation is not straight-forward.

KEYWORDS

Introduction

Engineering education has long been living with demands for change and improvement (Institution of Engineers 1996, National Academy of Engineering 2005, Reidsema et. al. 2011). In the mid-1990s the demands were for improved training in the so-called 'soft skills' such as teamwork in the cause of turning out more fully-rounded, sophisticated professional practitioners who could apply knowledge in complex global contexts. This has required some re-examination of fundamental assumptions about the nature of learning and teaching and a proliferation of 'alternative' teaching methodologies such as active learning and Problem Based Learning. While doubt lingers in some quarters about the efficacy of such methods, they have been found to work where they are well understood and well applied (Prince 2004). Emerging amongst the many calls to transform engineering education is a push to replace the traditional lecture with online video 'content' and couple this with collaborative active learning on campus. The interest in this Flipped Classroom approach is mirrored by the global MOOC (Massive Open Online Course) phenomenon. Both point to the need to reimagine the online and on-campus environments to ensure successful recruitment and retention of students, whilst maintaining the focus on learning outcomes. One large-scale (1000 students) Flipped Classroom implementation was demonstrated at The University of Queensland in 2012 and has generated significant attention both nationally and internationally due to its unique pedagogical design, leading to an international research collaboration with the aim of exploring opportunities and connections towards reimagining the future of online and on-campus learning environments. While exploring the varieties of Flipped Classroom approach that may be possible and efficacious, we are also interested in how to embed this kind of change in curriculum, where so many other innovations have languished. We are drawing on the philosophy of a Learning Partnership to overcome some of the difficulties of sustaining and embedding curriculum change.

The Context of Flipped Classrooms

First year engineering courses pose significant challenges with cohorts of hundreds (often thousands) of students. Their sheer size and importance in grounding students in requisite fundamental theoretical knowledge makes it extremely difficult to include teaching of engineering ability and professional behaviour learning outcomes. Research and teaching academics view lectures as time-efficient and a safe option against performance reviews largely based on research outputs. First year student expectations align with 'being taught' and having what they need to know clearly stated with resources that are familiar to them laid out and well structured (Entwistle and Peterson, 2004). Upsetting this balanced equation poses significant risks to both academics and students and stymies efforts to reconceptualise more coherent and productive learning pathways. Exacerbating this situation is a 72% growth in student enrolments in Australia from 2000 to 2010 (Larkins, 2012).

The **Flipped Classroom** provides a potentially effective pedagogical model for transforming these traditional core-engineering courses by making use of students' ubiquitous access to technology. However one defines Flipped Classroom pedagogy (see for instance www.flippedlearning.org) it entails finding ways to deliver information outside of class and encouraging students to work actively at making sense of the information in class with peers. The increasing capabilities of online learning tools, and the ease with which short, high quality "content-oriented" learning videos can be created and delivered, provides the opportunity to replace passive learning activities (lectures) with empirically determined online learning design patterns that are integrated to authentic practice-based activities such as laboratory experimentation, building/modelling, and testing and design tasks. Integrating theory with practice in this way has been shown to drive deeper conceptual understanding of engineering fundamentals (Dori & Belcher, 2005; Prince, 2004). Utilising indirect learning time (off-campus) allows for an increasing focus on delivering authentic learning activities that address industry and community expectations of graduates having both professional and technical/theoretical competencies.

Emerging online platforms (e.g. MOOCs) potentially enable institutions to rapidly scale up course delivery to meet demand by offering low cost education to massive numbers of students both internally and externally (Akyol, 2011). However, their integration with on-campus learning has not yet been adequately explored.

The difficulty we face, however, is that *transformational change is unfamiliar to most higher education institutions* (Kezar & Eckel 2002). Such change: *(a) alters the culture of the institution by changing select underlying assumptions and institutional behaviours, processes, and products; (b) is deep and pervasive, affecting the whole institution; (c) is intentional; and (d) occurs over time* (ibid). There is positive evidence (Reidsema et. al. 2011) that a strategy for change that engages more directly with the operational level would be welcomed by academics.

Flipped Classrooms and learning partnerships

The combination of collaborative learning (students learning together with no fixed roles) and targeted teaching that the Flipped Classroom approach embodies is claimed to deliver deeper, more engaged learning and more effective, intellectually and socially developed graduates (Boud et al. 2001; Brown 2012). Flipping the classroom achieves this by prompting independent work out of class through use of podcasts, MOOCs and other resources, and independent work in class time requiring self-organisation on the part of the learner and facilitation on the part of the academic. But this is an unfamiliar way of working and requires that students take responsibility for their own learning, and encouraging them to do so is no small task. While strategic allocation of marks for preparatory activities and other similar policing of activities may be necessary, what we are really after is a transformative change in thinking. In order to understand what is necessary for this to happen, we have been exploring Baxter Magolda's Learning Partnership (LP) philosophy (2012), which seems to us to have similar aims and assumptions.

Baxter Magolda (2012) suggests we need to change our understanding of learning and our approach to teaching if we are to encourage transformational learning rather than informational learning which focusses on the acquisition of gobbets of facts and de-contextualised skills. The approach is based on both 'Challenge' and 'Support' as shown in Figure 1.

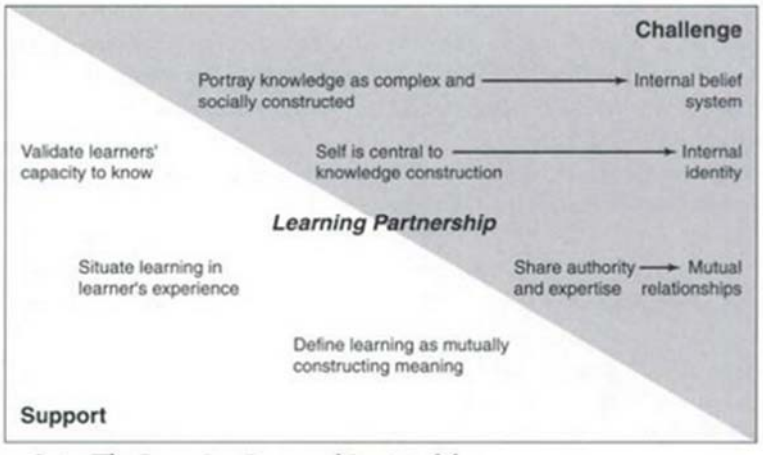

Figure 1. Baxter Magolda's model from Baxter Magolda and King (2004, p. 41).

The LP model is based on three assumptions about learning which are necessary if we are to help learners cope with complexity. These assumptions are: a) knowledge is complex and socially constructed, b) self is central to knowledge creation, and c) authority and expertise are shared in the mutual construction of knowledge among peers. The first concept of the social construction of knowledge is well-known in the social sciences and is taken for granted in much writing on education, but its implications for engineering education are profound. If

we accept this principle we have to make sure our strategies for allowing this to happen actively support the process and don't just expect it to happen 'naturally'. Flipped Classrooms' emphases on fostering self-directed, peer-to-peer collaboration provide a good starting point and the rest of the model gives us guidance in how to bring it about. The second assumption that the self is central to knowledge creation follows from the first assumption, since the social construction of knowledge relies on the work performed by multiple selves such as groups or teams, and will be shaped by those selves. This can be a difficult issue to take seriously from the positivist standpoint of engineering and the result is sometimes that we do not pay enough attention to it. Members of a LP need to have some self-awareness to get the most out of learning experiences. Flipped Classroom approaches have the potential to address the intellectual maturation of learners and the growth of self-awareness and self-confidence. Finally, the last assumption will be familiar to some of us from demands that we need to replace the "sage on the stage" with the "guide on the side". Unfortunately, without some serious scrutiny of the role of the 'expert' in the social construction of knowledge, it can be hard to tell the difference between the Sage and the Guide. Our students often tell us when they feel something we are delivering is irrelevant but they are also quick to tell us when they feel that there are not enough 'grey hairs' on the heads of their Guides.

Naturally, making assumptions is not enough. We need ways of putting those assumptions into practice and Baxter Magolda's model provides three principles to guide this process. They are a) validating learners' capacity to know, b) situating learning in the learners' experience, and c) mutually constructing meaning. In describing the first principle, Baxter Magolda uses language such as "solicit learner perspectives', 'trust their judgement' and 'respect their beliefs' which may cause discomfort and be misleading, or at the very least not easily translated to the engineering context. However, in some ways we already do this: many project-based courses require students to refine their understanding of a problem and its solutions using such techniques. The difference in the Flipped Classroom is that it happens continually at every level of activity, in every session. The second principle is not only a reference to the well-established principle that in learning new knowledge needs to be connected meaningfully to old knowledge, but a call for 'experiential learning'. Flipped Classrooms do not allow for 'passive learning' or for 'passive teaching' either. The final principle that meaning is mutually constructed, embodies the insight that the "guide on the side' has an important role to play in making learning meaningful and for developing the kind of mature professional demanded by all the reports mentioned earlier. That role is not the old one of the bestower of information – the Internet has assumed that role. Instead it requires the Guide to enter into the learning process with the learners, help them to discover meaning and perhaps reorganise their own thinking as well. This abdication of intellectual authority may be difficult for some teachers, although it is a role they might be more familiar with in their research activities, and it will also clash with the expectations of many students. In actuality, the Flipped Classroom may have several sources of authority including a MOOC component, external information sources, teaching staff and unfortunately, an unreasoning acceptance of the familiar. To return to the mutual construction of meaning, flipped classroom designers must push beyond this and support the learners to discover the most that they can with all of the resources available.

However, building LPs into Flipped Classrooms requires attention to change by the instructors in order to bring about change in the students – we need to model what we want to promote (Baxter Magolda and King 2004, p. 43). At present the research team are using the LP model to scrutinise our own practises and understandings, in the expectation that this will enable us to readily identify and deal with obstacles in the improvement and dissemination of Flipped Classrooms. In the rest of this paper we use the first collaborative meeting of the team in May of this year to illustrate what it means to work in a LP.

The Workshop

Our project began with a workshop at Stanford's Center for Design Research Lab for all of the team members, who come from three American and three Australian universities. The workshop had been designed to provide structured activities which would help to raise issues, introduce participants and their points of view, and lead eventually to more open and creative activities. Program Logic was used as a framework for the two-day event and throughout the workshop LP techniques were employed. This was effected through the use of the **SAID** approach (Situation, Affect, Interpretation, Decision) for structured analysis of critical moments (Hogan 1995) and extended into participant sharing. The workshop made innovative use of artefacts as a prompt to collaborative planning, and events and outcomes were summarised in visual form (eg Figure 2).

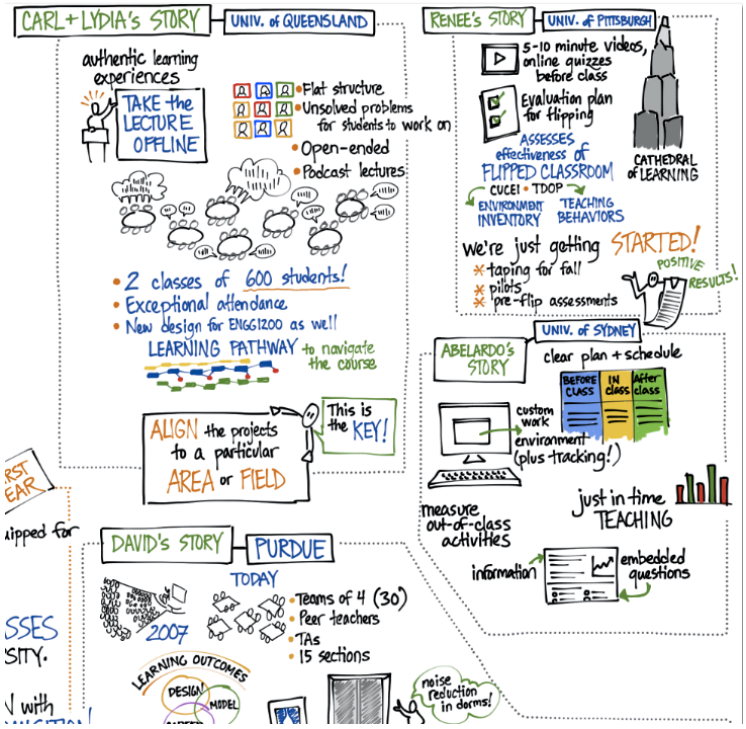

Figure 2: Sharing information in visual form.

For instance, an early activity was for each partner to tell their story about Flipped Classrooms (Figure 2), including sharing the difficulties and 'ah-ha' moments. This was followed up with a SAID analysis of critical moments in each story, with results displayed for the whole group. Everyone then added a sticky-note comment to the analysis detailing what they thought was most important or difficult about Flipped Classrooms. Out of those sticky notes a concept map (Figure 3) was constructed, which we believe sets out what the collective understanding of the project is.

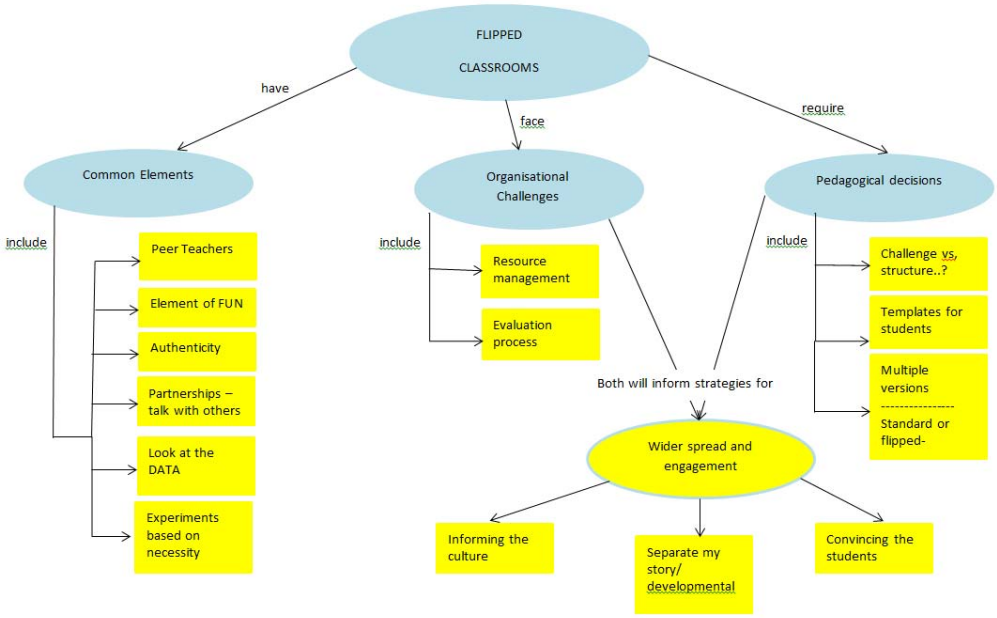

Figure 3: What this learning partnership is about. (Yellow nodes direct from sticky notes)

Over two days of such activities communication became ever more open, although not without some stumbling blocks. When dearly-held positions were challenged it sometimes required a drastic re-organisation of planned activities to move on and create mutual agreement. This is exactly the kind of situation that Flipped Classrooms will need to be able to negotiate too. In the end, participants found the open nature of the conversations to be stimulating and challenging. The approach described here meant that discussions included a depth of insight that is not found when participants are working in a more formal setting. The team is currently exploring ways to facilitate Radically Transparent Research techniques (Baltzersen 2010) and public sharing of information and ideas to further the principles of LPs.

A First-pass attempt at learning partnership

The Stanford workshop was valuable to us as an exercise in team building, but also as an experience that helps us understand what Baxter Magolda means when she describes the assumptions and principles of LPs and what it takes to put them into practice – and what our students are likely to be experiencing in a Flipped Classroom. Baxter Magolda (2012, p. 34) includes the following points in her description of how to build a Partnership, to which we have added our experiences:

Negotiating respect

We were a bunch of enthusiasts for a common topic, but it turned out that on some points we started from quite divergent positions. Negotiating respect meant acknowledging that others had different views, accepting that different contexts necessitated different approaches, and allowing ourselves to accept that our views were not necessarily the only or better way. In addition, we had to grapple with what the differences of opinion meant for our group practice and we had to forge new positions for everyone out of this collaborative work. In teaching situations one often hears the mantra about respecting others but there is not much discussion of just how that affects action. What is certain is that while negotiating respect does not happen without conscious effort, it does however appear to be a skill that can be developed and learnt; this is something that we can impart to our students.

Mutual collaboration to identify and work on problems

Whatever we each thought individually before the workshop, working together in the way we did altered the vision we had of what the possibilities were for this project. Throughout the workshop we allowed the scope and outcomes to be redefined and made this process

explicit. This illustrates the way in which knowledge is socially constructed. By not insisting on one version of what could be and allowing all voices to be heard and valued, we came up with a richer version which opens up wider possibilities such as open-source sharing of information and diverse understandings of what Flipped Classrooms are.

Discouraging simplistic solutions

At times our interaction was both intellectually and emotionally challenging and the temptation in such situations in classrooms is to give in to the loudest voice or the least contentious solution. Our deliberations were enriched by taking on the complexity of using so many disparate positions head-on and acknowledging that we were doing so. This is an explicit process that is likely to last throughout the project and is necessary to our determination to enact transformative learning procedures.

Growing authority

In the classroom, authority is granted to the person who stands in front of the class, and this is built into institutional structures and assumptions about teaching and learning. In our interaction, we had to learn to overcome some of these inherited authority positions. For instance, it can be hard to shake off behaviours derived from the academic hierarchy of 'Dr', 'Associate Professor', and 'Professor, and instead we had to learn where relevant authority lay in the group – who had what skills, background and resources. Obviously this is relevant to our students' experiences also.

Encouraging sharing

We found that the strategy of moving from quite structured activities to more open and unstructured ones was a significant factor in allowing people to share their insights and their insecurities. As academics and engineers, we are used to being in control of the facts and this makes a public discovery process difficult. By starting with activities such a Program Logic analysis or a SAID reflection, people were given a structured way to present their thoughts and questions that catered to their need for security, while allowing identification of common viewpoints and common problems which were then able to be discussed in a much more open and robust way. There is no reason to think that such an approach might not be helpful for student groups also.

These five principles need to be explicitly embedded in both our project LP and any LP which we develop with students in flipping the classroom. They are challenging to achieve but are fundamental to the success of an LP and therefore need to be prioritised. One way to do this could be to include them along with the learning objectives that we specify for any course.

Where to from here?

The advent and uptake of approaches like the Flipped Classroom, with its emphasis on collaborative self-directed, active learning, signals that engineering education has reached a maturity where transformational change is possible, the kind of change that is needed to meet the demands being made of the profession. We need to transform our classrooms into places where intellectual development takes place, rather than just the exchange of information. But in order to transform the classroom we need to transform our academic practices, including research into educational innovation and the dissemination of research findings. In the past, educational reforms have come and gone and found it hard to find a foothold in our universities (Graham 2012). The LP approach provides one framework within which alternative practices can be explored openly and in good time, and here we have begun to sketch our growing understanding of what might that imply for us as researchers and teachers. As our project progresses we will be seeking further opportunities to share understandings of and strategies for Flipped Classrooms and for the kind of collaborations amongst academics that can disseminate those understandings. But we will need to think also of the structural context of the universities in which we work and how they might impact on such transformational change.

In describing the shift to a LP philosophy at Virginia Tech, Wildman (2004) describes how institutional readiness for change needs to be enhanced by well-targeted activities which

address changing roles, the validation of change activities and the creation of contexts for learning that don't just draw on old educational designs. As Baxter Magolda frequently points out, we need to be the change we want see in our institutions and our students. The apparent duality we have observed in both the changes we are asking of our students and the changes that we must face through the development of the LP will provide important and valuable insight in directing and validating our proposed transformational change agenda.

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