Developing Black Belts, via a Community of Practice for Blended Science and Engineering Learning and Teaching at UniSA

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This paper outlines a pilot project to encourage Blending and Flipping of classes at UniSA by the implementation of a formal Community of Practice (COP) of scholars and peers in Science and Engineering. The project COP staff worked with academic staff to assist teachers to use online resources and active learning strategies to engage students and promote deep learning, engagement and problem solving whilst making greater use of all facets of learning technology.

Keywords: blended learning, flipped classes, professional practice, online, flexible, engagement

Introduction

The development by the University of South Australia (UniSA) of more than 25 online Engineering Associate Degree units (courses) for external study over the last three years, in conjunction with Open Universities Australia (OUA), has allowed the production of a comprehensive array of online learning resources (Jackson et al., 2013), plus a sophisticated introduction to the training and delivery of these for UniSA staff (James et al., 2011). The Blending Engineering/Environmental Learning and Teaching (BELT) project within UniSA's School of Natural and Built Environments (NBE) aims to blend the online OUA materials into the face-to-face courses. Integral to the BELT project was the development of a Community of Practice (COP) that involved a number of staff from within NBE's Engineering and Environmental/Geospatial disciplines which were assigned coloured 'Belt' status (Engineering became 'Brown Belts' and the Environmental/Geospatial Sciences were deemed 'Green Belts'), with the obvious aspirations to master Black Belt status! Specifically, 9 Civil Engineering courses and 8 Environmental/Geospatial Sciences courses were targeted to blend the resources and teaching approaches from the online courses with the on-campus practices. This paper details the journey undertaken by academic staff involved in this COP and begins with the background to COP and Learning Approaches (with a focus on Blended and Flipped learning), then progresses onto detailing the COP, a case study unit (course) and concludes with discussion and future directions.

Communities of Practice (COP)

The BELT COP aimed to support the academics in blending the learning in their courses, enhancing their teaching strategies and furthermore, provided a forum for the discussion and exploration of the implications of this approach. COPs were initiated by Wenger (1998) and are based on social learning theory which proposes that humans are social animals and as such, like to learn together. What Lave and Wenger (1991) termed 'situated learning', Atherton (2013a) developed into communities of practice comprised of people coming together as a community to explore an area of interest (domain) and share their practice in terms of research into the area and its application. COPs provide a context for members to engage in sustained conversations around teaching and learning, situated in the focus of an area of study. COPs are effective as places of negotiation, learning, meaning and identity which are modes of a social learning system (Wenger, 1998). Traditionally, learning and collaboration have been seen as independent constructs (Lin & Beyermein, 2006), but COPs promote a new approach as the two join together, a manner that endorses the viewpoint of Brown and Duguid (1991) that "collaborative learning and individual learning as inseparable when a group of people works together". The ongoing, social and interactive processes of the BELT COP support the dynamic element of 'practice', i.e. how people do things, the first of the five critical elements in Wenger's COPs (1998) and in context, through teaching and supporting student learning. The COP is therefore a dynamic and responsive form of professional development and with respect to the BELT members would mean sharing a sense of joint enterprise to support an interactive, experiential and constructivist approach to teaching and learning in their courses, thus supporting Wenger's views on situated learning. Through individual and collaborative efforts,

reflection and experiences, the group aimed to develop a shared repertoire of resources as including theories, language and teaching strategies. In doing so, the BELT COP have been mindful of the need to build on COPs issues raised by Hodkinson and Hodkinson (2004) and in particular, have addressed the shortcoming of Lave and Wenger's original model with its emphasis on 'legitimate peripheral participation', i.e. newcomers, as the majority of the BELT COP members are experienced educators. This experience has supported those who are newer to teaching in the academe and has the risk of introducing elements of social and cultural capital that Bourdieu raised from the work of Lave and Wenger, in terms of who has the knowledge and power within the COP.

Learning Approaches

The BELT project was grounded upon the belief in the importance of brain-based learning & teaching and the two key learning theories of constructivism and collaborative learning.

Brain-based learning & teaching

Neuroscience, cognitive science and psychology have provided insights into how the brain works and educationalists have used this to inform their practice and created a field known as brain-based learning (Jensen 1998; Hendel-Giller et al. 2010). Brain-based learning principles and strategies provide educators with the knowledge and skills to engage and motivate students and assist in their learning and retention. The impact of environmental factors, the 'social brain', emotions, and how the brain organizes information, are all considered in the BELT project as factors that assist learning.

Constructivism

The central thesis of a constructivist learning theory is that the learner is active in constructing their own learning/knowledge of the new ideas or concepts based upon their current and past understandings, beliefs, and attitudes (Kelly, 2012; SACSA, 2001). Learning is student-centred and is not linear, rather, it involves learners extending, elaborating, reorganising, reformulating and reflecting upon their own frameworks of knowledge. Students therefore need learning activities that ask them to apply the theory/ concepts/knowledge and that encourage problem solving, exploration, the use of higher order thinking skills, as well as structures/ opportunities to develop reflection/ awareness of their own learning/progress (Atherton, 2013b). Having a starting point of a question or enquiry is a useful approach to implementing a constructivist approach to teaching and learning.

Collaborative Learning Theory

Collaborative learning refers to methodologies and learning environments where students attempt to learn something together, drawing on each other's resources and skills to solve problems, form study groups, undertake group projects or create a product of their learning. Collaborative learning is grounded in Vygotsky's (1978) belief about the inherent social nature of learning and includes the teacher being part of this learning community. This theory binds well with a constructivist approach to teaching as it acknowledges that learners are not social islands and are more likely to engage in constructing their own understanding in a supportive social environment. Therefore, opportunities to work collaboratively will enhance their learning and lead to a deeper understanding of the content as students are able to communicate their questions, intuitions, conjectures, reasons, explanations, judgements and ideas. Learning situations and activities/assessment that are relevant, realistic and authentic and give a sense of the 'real world' are valued by students and assist their learning. This learning theory is compatible with the 5-Stage Model of E-Learning (Salmon, 2000) using a Community of Inquiry approach to online learning proposed by Garrison (2003) which was used by the UniSA OUA Course Developers to design and develop the websites for the online Engineering Associate Degree units/courses and consequently formed the basis for the BELT lecturers' face-to-face teaching that aimed to blend the online materials, from the OUA courses and other sources.

Blended and flipped learning

The availability of new learning technologies has meant that the allure of 'traditional' content driven lectures, typically using Powerpoint slides, has become much less attractive and relevant to students. UniSA lectures are approximately two hours long with a 10 minute break and tend to be didactic, content rich (heavy) and teacher-centered, with minimal student interaction or feedback. Not surprisingly, attendance has thus dropped off dramatically and this has led to a growth in the research into and application of, alternative class interaction

techniques. These strategies are commonly known as 'blended learning' and 'flipped' lectures. The term 'blended' encompasses a broad continuum and can include any integration of face-to-face and online instructional content and information communication technologies. Blended learning is not just about using technology because it is available, nor is it an 'additive approach' (Simpson, 2008). Rather, the goal of a blended approach is to transform the learning experience by changing traditional face-to-face teaching practices by joining them with those of online instruction. At UniSA, these were mainly derived from the OUA courses. While not a new concept or practice, 'flipping' the lecture has gained momentum recently as an effective and relevant strategy to assist contemporary students in their learning outcomes and is, in fact, part of a 'blended learning' approach (Brame, 2014) where the teacher is there to serve as facilitator (Jensen, 1998). It also builds technical skills (knowledge, practical skills) and soft skills (communication skills, decision making skills, group skills), that Male et al. (2010) identified as deficiencies of graduate engineers i.e. practical engineering, engineering business competencies, communication skills, self-management and appropriate attitude, problem solving and teamwork. Furthermore, Newberry et al. (2011) found that these graduates needed complex skills and attributes because they 'increasingly study, communicate, travel, and work across national and cultural boundaries'.

The Blended Engineering/Environmental Learning and Teaching (BELT) COP in action

The BELT COP consisted of participating course lecturers, the Associate Head of the NBE School and was facilitated by educational experts. The lecturers were from a variety of disciplines such as Biology, Geology, Surveying, Mathematics, Engineering and Resource Management, varied in ages from early 30s to late 50s and had differing exposures to technological use in the classroom, and involvement with online courses and teaching. Each COP meeting was structured to allow social interaction and relationship building, while also providing an opportunity to build domain knowledge on the topic of the meeting, followed by shared practice discussion by participants and problem analysis. COP members shared updates on their practice and identified areas to explore together, including 'teaching', 'assessment of group work' (including mapping group work across the courses) and 'helping the students understand the new approaches to teaching and learning', as their 2014 foci to shape the future work. Further exploratory meetings were convened with staff, both individually and as a group, to discuss the forthcoming semester teaching and to plan the operational progress of the COP throughout the semester. Lecturers agreed to attend at least one lecture of each other's to appreciate different delivery styles, witness how the different types of blending and flipping were incorporated into their peer's teaching and also student reactions. The education experts and COP members also recognised the importance of reflection in the learning process and the experiential model of the adult learning process advocated by Atherton (2013c). Further, the capacity to reflect on action and to engage in a process of continuous learning is one of the defining characteristics of professional practice (Schon, 1983). This reflection occurred through both pre-lecture planning and post-lecture discussions that the two education experts conducted with each of the participating academics. Changes in practice wrought through individual reflection and choice have a greater chance of being sustained. Changes evident among individuals within the BELT program included, improvement in slides via reduced amount of text, enlarged font and the addition of visual data, the use of student/peer-discussion during the lecture on information presented to foster students processing of the content, increased use of technological learning tools and increased confidence in question-asking. Examples of changed practice in lecture sessions presented by the other BELT COP lecturers include:

- using Polleverywhere for student feedback in Geoscience & Engineering Structures;
- student debates, surveys and 'World Café' in Environmental studies;
- group problem solving and demonstrations in Structural Engineering;
- use of web resources and Google Earth/ 360 degree visualizations/virtual field trips in Geoscience; and
- use of web resources – print, visual, 3D in several of these courses.

Staff were encouraged to plan their sessions around the core knowledge or skills they wanted their students to gain that week and to then frame that around a question or questions to help the students explore the learning as part of their own knowledge creation This inquiry-based exploratory learning, or student-centred learning, has traditionally been the approach used in tutorials, workshops, laboratory practicals or field excursions. In recognizing the value of this learning approach, the COP engaged in a strategic process to encourage all of the BELT lecturers to radically revise their class interaction in their 2 hour learning sessions (the term 'lectures' was deliberately not used) through the blending and flipping of their course materials and teaching activities, in two main ways. Firstly, lecturers have provided pre-session materials, many of which are now enhanced by the inclusion of multi-media and other learning technology resources from the lecturers on-line courses or other

sources when there is no OUA course equivalent. Students are expected to read/view/listen to these materials in their own time prior to the session, as they provide the key content and concepts to be covered in the session. Secondly, by introducing collaborative learning activities during the learning session, more class time is spent on applying the concepts students have learned.

BELT case study: Geospatial Science for Engineers (GSE) course

GSE focuses on the use of mapping within Civil Engineering and is a 2nd year course with a cohort of approximately 60 students and is held in a fixed seating and tiered lecture theatre for 2x 50 minute 'lecture' sessions per week for 13 weeks. An OUA unit was developed for this course during 2012 and so a variety of online resources were available for use. The education experts met with the lecturer to discuss and plan the new approaches to the learning sessions each week and attended the classes to assist, team-teach, help with equipment, record, evaluate and then provided feedback for consideration, discussion and future planning. Each learning session worked to engender a sense of enthusiasm, engagement and commitment by students to the studies being presented discussed and synthesized. A 'planning chart' was developed for the lecturer to use which supported an inquiry-based approach to teaching and which built on the students reading of, and listening to, the pre-session material. Paramount in that chart was the overall aim for the session (e.g. Session 1 - To make the student 'love maps'), the *key* questions to be covered (What is a GPS? What is GIS? and how can these be used in engineering?) to enable the *key* concepts (Course, Maps and GIS) to be reinforced during the session through the activities and content. Each session was designed to contain a blend of learning technologies e.g. Poll Everywhere software was used to pose questions and allow immediate anonymous replies from students e.g. 'Where can maps be used within your own discipline? Further tools used included headset microphones and multiple microphones for use in the classes, student submission of images (via Instagram), video and Google/ Google Earth. Butchers paper, felt pens, blue-tack, post-it notes were provided for student group use when undertaking the collaborative and interactive learning activities. Specific sessions in the different courses used different items depending on the learning activity and included string, chocolate, floor satellite maps, inflatable models, protractors, measuring tapes, surveying equipment and cards. These were consistent with the brain-based learning approaches discussed previously and incorporated the use of music and the element of surprise in terms of seating/ choice of participants.

Discussion and conclusion

Academic life can be isolating and BELT COP members came together as a group of academics across different disciplines, united by a focus on teaching and learning within a research orientated university world. A culture of collegiate openness and professional discussion on teaching and learning, based on the learning theories informing the BELT project, as opposed to 'content delivery', has been established. Resources, stories and ways of addressing recurring problems have also been shared. Transparency and support from university and school management have enabled trust to be established. Members have visited each other's sessions which has resulted in professional discussions both within and outside of COP meetings. A COP is 'dynamic and involves learning on the part of everyone' (Wenger, 2006) which means both participants and facilitators. Utilising these strategies (see Case Study) the first 2014 semester iteration has assisted participating lecturers to effectively flip their teaching in some form or other, but it is important to acknowledge that this does occur along a continuum depending upon the lecturers' comfort/confidence with the approach and the nature of the course being taught. The Brown and Green BELT academics have enthusiastically accepted their flipped and blended practices. Indeed, their own feedback has identified that the COP provided a supportive forum where they could discuss teaching approaches to provide a consistent approach across the student degree cohort. This made it easier to introduce new ideas and approaches knowing that the students will be more comfortable, confident and familiar with them. They also noted that the COP enabled them to collect feedback from peers as well as experts in education on what works well and what doesn't, and also comments from students that came about indirectly via other staff members in forums such as the FGDs – thus giving a different perspective that is otherwise unavailable. Having an opportunity to observe the teaching approaches and performances of others, gain new techniques and ideas by sharing experiences and appreciating the encouragement to include more interactive activities in class was all deemed valuable outcomes by the academics. Furthermore, the COP was viewed as a useful mechanism to enable strategic decisions to be made about teaching goals and how the curriculum supports these, not just within one subject but across an entire year level or degree. To plan for the future, a series of Focus Group Discussions (FGDs) were conducted with samples of students from all but one of the BELT courses. The findings and recommendations of the FGD participants have been illuminating and the qualitative data will be used to assist revision of first semester 2014 courses for 2015 delivery and the planning for BELT-affected courses in the second semester of 2014. This data will be used to triangulate data from the course and student evaluations which are a regular part of the monitoring and evaluation procedures of UniSA.

The data may be part of student evaluation discussions at faculty level. This 'pilot', will in turn, shape the COP that will be extended to include other staff in 2015-16. The BELT academics have enthusiastically accepted their flipped and blended practices and it is envisaged Black belt status will be 'achieved' for many of them and their colleagues during the extension of this professional practice project in future.

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