2008

Activity Systems Within Blended Problem-Based Learning in Academic Professional Development

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Recommended Citation

Donnelly, R. (2008). Activity Systems Within Blended Problem-Based Learning in Academic Professional Development. *International Journal of Applied Educational Studies*, 3, 1, pp.38-59.

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Abstract

Blending face-to-face and online problem-based learning environments presents opportunities for both learners and lecturers to take part in collaborative knowledge construction. Activity theory is a suitable framework to investigate such environments and the learning processes that both sets of participants experience when engaging in these complementary environments. This paper attempts to map out the potential for activity systems using a blended problem-based learning approach through the exploration of an accredited academic staff development programme in Ireland. Firstly, an analysis of tool use and the discourse that participants and tutors engage in is presented. Secondly, tutor reflections about the evolution of the group's collaborative practices is explored, including issues such as the locus of control (changing role of tutor and students) within blended PBL tutorials, alongside the matter of whether ultimately combining new innovative technologies with pedagogies such as problem-based learning can be used to engage students' curiosity and initiate learning the subject matter. It is argued that designers and tutors should direct its focus away from organisation of content and towards design of activities, and facilitation should acknowledge the cultural, historical and technological influences that shape complex human activity in blended problem-based learning.

Introduction

This paper outlines the background and rationale for a qualitative study on blended problem-based learning within the context of academic development in higher education. The case study research is grounded in an activity learning theoretical approach, and it is argued that it is necessary to make a reflection of technology in relation to activities, learning principles, and a learning theory in order to qualitatively develop the field of academic development. The terms staff development, educational or academic development and faculty development are all used in different higher education systems across the world and although they carry slightly different meanings, they share a common core in referring to the work of developers in studying and enhancing the professional work of university academics. For this study, the term *academic development* has been used as it is more frequently recognized and utilized within a UK and I would similarly argue, an Irish higher education context (Macdonald, 2003).

Similarly, there are many definitions currently existing for blended learning and the definitional debates seem to converge around the idea of synthesizing eLearning with the more traditional forms of teaching and learning, drawing together the 'e' with the classroom, the laboratory, the seminar and the tutorial setting. Problem-based learning (PBL) is an educational strategy that involves the presentation of significant, complex and "real-world" problems to students that are structured in such a way that there is not one specific correct answer or predetermined outcome (Boud & Feletti, 1997; Duch *et al*., 2001).

Problem-based learning (PBL) and the social constructivist side of eLearning are both inherently collaborative. The essence of PBL can be challenging to move to a virtual

environment, where students work in small groups with the guidance of a tutor, learning through solving real-life complex problems and reflecting on their experience. However, benefits of online PBL can be the provision of scaffolding to further support collaborative knowledge construction in a social environment (Sage, 2000; Ronteltap & Eurelings, 2002; Björck, 2002; Lehtinen, 2002; Orrill, 2002; McConnell, 2002; Wertsch, 2002). Tools and discourse necessarily play a vital role in mediating learning in such environs (Scardamalia & Bereiter, 1994). Blended PBL is a complex activity, related not only to pedagogic and subject expertise, technological resource and time availability, but also sensitive to the cultural contexts and traditions in which it is embedded. There are two goals of this paper; as well as focusing on the potential for activity systems using a blended problem-based learning approach, activity theory is used in this paper to serve as a lens for describing and understanding how learning occurs in a complex blending of PBL and eLearning in academic development in higher education. Activity theory theorizes that when individuals engage and interact with their environment, production of tools are resulted. These tools are "exteriorized" forms of mental processes, and as these mental processes are manifested in tools, they become more readily accessible and communicable to other people, thereafter becoming useful for social interaction (Fjeld *et al*., 2002).

Following discussion of the context of the study and the issues of embedding a blended PBL approach, the paper then provides an analysis of the problems used in the PBL blended tutorial, how the participants approached the task, and the data analysed using the activity model.

Context

As it is important to incorporate capacity development in formal courses on higher education, a postgraduate Postgraduate Diploma in Third Level Learning and Teaching was developed in 2001, and has over 100 graduates today. The 'Designing eLearning' module, which carries ten ECTS (European Credit Transfer and Accumulation System) credits runs over a period of ten weeks. The diploma programme is typical of many in higher education institutions (HEIs) today. In this context, the demand for institutions to put eLearning initiatives and the accompanying academic staff training and development firmly on their agendas has resulted in a number of emergent issues. For example, many academic staff lack the online experience of the Internet generation, and so do not feel as confident in an online environment as they do in a traditional classroom setting. In this context, the problem is a social rather than a pedagogic one and lecturers may need to experience being an online student themselves in order to gain the necessary confidence to move to facilitating an online environment. Putting staff training online can be one response to this problem, but making more efficient use of lecturer time is more often the reason why the online environment is used. Such moves can lead to a negative rather than a positive experience of the online environment, in some cases leading academic staff to believe that buying in to this growing phenomenon means subscribing to their own eventual redundancy. As increasingly it is also becoming important not just to make such training more accessible, but explicitly designed to produce qualitatively improved pedagogy (Ham & Davey 2005, p. 263), it is important to ensure that the lecturer's first experience of an online

environment is positive, one that will allow them to see the pedagogic possibilities at their disposal.

The current and emerging higher education environment in the Institute, as elsewhere, is seeking solutions to problems of changing paradigms of learning and the influx of learning technologies. Skilbeck (2001, p. 10) believes the essential test for such higher education institutions is their readiness to introduce policies and programmes to bring in and provide opportunity for "new blood" as well as for the continuing development of the capabilities of existing staff for amongst others, mastery of the new technologies in both teaching and research. Well-handled, he has concluded, "the opportunities of online education could improve the relationships between staff and students and foster a better quality of learning" (p. 72).

It is suggested here that the need to encourage engagement amongst academic staff with regard to their eLearning and pedagogical professional development opportunities has never been greater (JISC, 2004; McCord, 2007). By so doing, participants would be enabled to experience, discuss and reflect on issues related to teaching and learning in a blended environment. This could thereby enable them to relate their understanding and practice to appropriate educational principles and key institutional policies. This study presents the opportunity to work with eager members of the teaching community in offering a novel approach to their academic development. As all participants on the module are self-selecting and choose to pursue this professional development opportunity themselves, arguably it is a situated reality that participants are motivated and keen to explore the blended PBL approach offered through the module. There are limitations associated with this; when participants self-select, or volunteer for a

study, it is not known how representative such participants are of the population of interest.

The 17 participants on the module in this study are all either lecturers or educational support staff working in higher education. The nature of these academic staff's varied work responsibilities today is complex, with demands on their time (ranging from lesson preparation, student support and research, to staff meetings, curriculum development) pulling them in many directions. As a result of all the pressures academic staff face in today's higher education environment, Donnelly & O'Farrell (2006) have argued that for their own professional development, they need to be provided with streamlined learning experiences which deliver essential topics and learning materials in readily accessible formats. It is believed a central challenge here is to create and sustain quality learning environments of enduring value for teachers.

Challenges Facing Academic Development

The emergence of new learning technologies – multimedia and telecommunications – are presenting new challenges and opportunities to teachers in higher education, and it is a wish of many to make use of them (Chou & Tsai, 2002). Advances in technology during that last decade have brought changes to the ways in which individuals are educated and trained, in particular through online instruction. The teacher may no longer be able to be considered the primary source and organiser of his or her students' learning in the information society of the 21st century. It has been argued by Phelps, Graham & Kerr (2004) that computer technology plays an integral role in our professional lives and the ability to utilize this technology has become the new literacy for this century; teachers are central to the endeavour to enable future generations to

maximize their capability in this regard. However, a competent, confident online teacher is a new and different role for academic staff around the globe today. Teachers need to be made aware that any effective integration of learning technology calling for substantial thinking and rethinking of their curricular and educational practice. All this presents a significant challenge to academic developers, charged with supporting staff in making transitions in their practice (Wilson & Stacey, 2004).

In my experience as an academic developer, over a number of years, there have been a significant number of academic staff who have been inducted and trained to set up the basics of operations in technologically mediated learning environments across the Institute, but few who have been developed further in terms of pedagogical training. Indeed, of those staff who have expressed a wish to engage with eLearning, on average more than half of those who attend an initial day-long introductory session do not proceed immediately to employ it as part of their practice, citing time constraints as the main inhibiting factor. Other factors cited include difficulty in using the software, fears that the use of eLearning will inhibit attendance at regular classes and even fears that the technology will be used as a surveillance device (Donnelly & O'Rourke, 2007).

In addition to technological challenges for teachers and academic developers, there are issues that arise during the change process from a traditional delivery mechanism, such as the lecture, to a problem-based educational model. Kolmos (2002) has reported that in spite of an extensive staff development programme to introduce teachers to the new PBL model, the change in the nature of teaching caused problems with retention and curriculum. She urged academic developers to be aware of the need to

facilitate the change at individual, culture and organisational levels, which is a comprehensive challenge in itself.

To counter this, the blended PBL module itself strives to be both proactive and responsive to the changing needs of all academic staff from across the Institute, and other institutions of higher education in Ireland. By giving the participants the opportunity to be an online PBL tutor using principles of good practice in PBL, this study provides evidence on the online PBL tutor role and whether it can be as effective as the tutor in the face-to-face problem-based learning tutorial. Central to the delivery of the module has been critical academic discourse in tandem with exploration of innovations in practice. The synergy from the collaborative blended PBL approach in this module could result in the coherent and comprehensive provision of training, support and research work throughout higher education institutions.

Nature of the Blended PBL Approach

Collaborative problem-based learning in this module involves heuristic tasks, conceptual understanding and/or cognitive strategies (Nelson, 1999). The blended PBL problem for this module involved the steps of analysing the need for eLearning in the context of any of the PBL group's subject disciplines, finding and investigating useful information for producing a design of an eLearning module in this subject discipline, finding and understanding appropriate theories, and synthesising a plan of action for the development of such a module.

A critical factor in the success of the PBL approach was the provision of appropriate resources for active research and location of information for the solving of the problem. Organisational support information about the module included: explanation

of PBL and links to some key PBL sites; roles and responsibilities of the participants; the group composition; expectations of time to be spent online individually and in the PBL group; milestones, deliverables and deadlines for the PBL problem; negotiated group ground rules based on netiquette; a database of frequently asked questions; links to relevant interactive tutorials on web researching, interpersonal communications, conflict resolution, self and peer assessment strategies within PBL; and participant home pages. Arguably this is a static environment so far, and the intention is to change it to a dynamic site, to complement the face-to-face PBL weekly tutorials and adapt to the participant group experience and progression of the PBL Problem.

The participants approached the task interactively, and utilized the technologies in a process-supporting manner, making use of the technologies of discussion forums, chat rooms, video and audio conferencing to link to live international experts, blogging software and mind mapping techniques, with supporting software. Building semantic links in this way represents information more visually and also uses more than one dimension.

The Lens of Activity Theory

Activity theory (Leont'ev, 1979; Vygotsky, 1978) was used as a framework to analyze the ways individuals work within the PBL problem as part of the module to design eLearning materials. Activity theory is increasingly being applied to aspects of technology-supported learning because of its emphasis on the mediation of tools and social factors on human activity.

Despite the research and investment of Information and Communication Technologies (ICT) in higher education institutions, many teachers still use it as a neutral

tool; that is, a tool that can be used to carry out the same teaching and learning activities as have been undertaken previously with non-ICT tools. This paper adopts activity theory as a conceptual framework to describe and analyse how the outcomes of a blended PBL module are shaped by their participants and learning environments, and in turn, how these shared outcomes affect the way ICT is used in the module. It enabled questioning the professional development of teachers and their up-take of ICTs and their resulting changing or indeed, opposition to changing classroom practices. Ultimately, activity theory was used in this study to inform the creation of improved teaching materials and the blended PBL environment.

The attraction and power of activity theory as a framework is the theory's capacity to account for significant elements of the broader context of ICT use in education. Moll (1990) suggested that activity-theoretical ideas are having an increasing impact in specific fields of inquiry such as learning and teaching, and arguably this has increased greatly today. Since activity theory was developed precisely to study individual and social transformation, the potential of activity theory should be demonstrated in practice. Arguing that the development of learning technology produces considerable changes in human activity, Tikhomirov (1999, p. 358) recommends that the development of the theory of activity is also required. Activity theory in turn has a new function, specifically to interpret the nature of human activity in today's information society and the challenges it presents to the development of higher education as a result. Correspondingly, Jonassen (2000) has suggested that researchers are beginning to identify how activity theory can inform the designing of learning tasks and environments

by focusing not on the individual learner, but with the activity system, which is a larger and more social unit of analysis.

The activity system in this case study consists of a group of any size, pursuing a specific goal in a purposeful way. In analysing the activity system of a blended PBL group, the fundamental connection is between the individual participant and the activity system's purpose (this is not a direct relationship, but is mediated by tools). The participants are part of a community, a relationship mediated by rules for acceptable interactions. It is interesting to note that generally communities cannot exist without rules. The tools make activity possible in the first place. The forms for ICT interaction are the Computer-Mediated Conferencing (CMC) software and the PBL tutorial. Cognitive tools are the concepts and language used in the blended PBL activity system. eLearning tools might be an online discussion forum, an online or paper journal or the study approaches that support effective learning.

Tool use is particularly important; the tool through which the participant interacts with the world depends on his/her object, and this shapes the interpretation, relevance and meaning of the mediational tools. That is, the participant perceives and takes up the opportunities of the tools, according to their relevance to the object; establishing a possible relationship between the object of the activity system and how the tools are used. The community consisted of his/her classmates and tutors situated in the socio-cultural setting of the computer room and the virtual learning environment of WebCT, mediated by rules and division of labour. The rules included general rules like computer lab rules and regulations, and more specific ones like the procedures to navigate the VLE. The role that each participant of the community played fall under the division of labour.

Designing Blended PBL Underpinned by Activity Theory

The reconceptualisation of pedagogic practice lies at the core of this research. In particular, the exploration of pedagogic networks through nodes/interconnections/ and (information)flows. Activity theory became a mediating tool which recognized the inter-relationship between the components within the activity system in the blended PBL tutorials. This gave context and meaning to seemingly random individual events. The notion of multiple activity systems within one physical context and how these overlap to become what Engeström (2001) has called 'interacting activity systems' became relevant.

Activity theory is used in this study to inform the designer and tutor's understanding of interactions in blended PBL and was included in the study as an important strand of new thinking about pedagogy. There appears to be growing support in the literature for the use of activity theory for looking conceptually at the impact of technology on learning. Activity systems are a development of activity theory and Scanlon *et al*. (2007) suggests that activity systems are useful in enriching our view of technologically-mediated practical work.

Activity theory has evolved from decades of theorising-based Marxist philosophy and Soviet psychology and related traditions (Vygotsky, 1978; Leon'tev, 1979). The basics of this theory have been detailed very well elsewhere (for example, Nardi (1996) who was instrumental in introducing activity theory into the study of human-computer interaction), so it is not the purpose to do so again here; as a result, only certain elements will be included. As Kuutti (1996) attests, activity theory is not actually a theory as such, in that it is not "a fixed body of accurately defined statements" (p. 25). Rather it is a collection of broadly defined concepts that are open to interpretation. The description

presented here then is my interpretation of the key concepts that have been particular relevant to this research and helpful in providing an explanatory framework for the data.

Lim (2002) within the context of eLearning, considers activity theory to be an appropriate vehicle through which we are able to acknowledge that the relationship between human activity and cognitive tools can trigger changes in activities, curriculum and interpersonal relationships in the environment and are reciprocally affected by the very changes the technology causes. Issroff & Scanlon (2005), in their role as educational technologists in higher education, report that activity theory is increasingly being used to study a variety of contexts which involve technology. They report on their own study which used activity theory to understand students' and lecturers' experiences of technology-based teaching environments. It incorporates many relevant features of interactions such as actors, mediation, historicity and constructivity. As it is dynamic and developmental, activity theory is able to cope with changes, developments and arguably, transformations in learning. As it demands a high degree of understanding of the culture, practices and situations of courses in higher education, Issroff & Scanlon (2002) conclude from their study that activity theory helps the understanding that the addition of technology into a learning situation changes the practice within that discipline.

Activity systems assume that human behaviour is situated within a social context which influences actions (in this study it is interactions with concepts, tasks, people and the PBL experience). Sociocultural approaches to understanding tool use within human activity systems stress the transformative power of the introductions of new tools into existing contexts. The approach taken in this study was to look in depth at interactional elements within the activity system in blended PBL. The rules of the community in which

actions were situated influenced the meanings of actions and the division of labour within the community influenced the way the participants behaved. The tools in this activity system were the asynchronous and synchronous facilities in the VLE, online reflection and the face-to-face PBL tutorial itself. Activity systems can provide a language and framework for describing developments and the language was found to be useful for expressing key features of the blended PBL experience and to consider ways in which participants' professional practice was changing; this was reflected in the approaches they used for facilitation of learning in their own disciplines following completion of the blended PBL experience.

The blended PBL groups in this study were pursuing a specific goal in a purposeful way. In exploring the nature of the PBL group's face-to-face and online discourse, a challenge for the research was to understand the dynamics of the collaboration process in blended PBL and to document the contributions that occurred from components of the activity system. These PBL groups can be explained through these dimensions of activity theory: as individuals, as a group of individuals, goals, tools and resources, regulations and rules, individual accountability and group products. Analysing collaborative PBL activity, the basic unit of analysis needed to emphasise the relationship between human agents and objects mediated by cultural means, tools and signs was devised by Engeström (1993). Figure 1 is a diagrammatic representation of the relationships in terms of 'roles', 'divisions of labour' and 'community' that are always embedded in cultural-historical organisations, both formal and informal. The model, utilised by the University of Helsinki, suggests the possibility of analysing a multitude of relations within the triangular structure of activity. However, the essential task is always

to grasp the systemic whole, not just separate connections. In the model, the subject refers to the individual or sub-group whose agency is chosen as the point of view in the analysis. The object refers to the 'raw material' or 'problem space' at which the activity is directed and which is molded and transformed into outcomes with the help of physical and symbolic, external and internal mediating instruments, including both tools and signs. The community comprises multiple individuals and/or sub-groups who share the same general object and who construct themselves as distinct from other communities. The division of labour refers to both the horizontal division of tasks between the members of the community and to the vertical division of power and status. Finally the rules refer to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system.

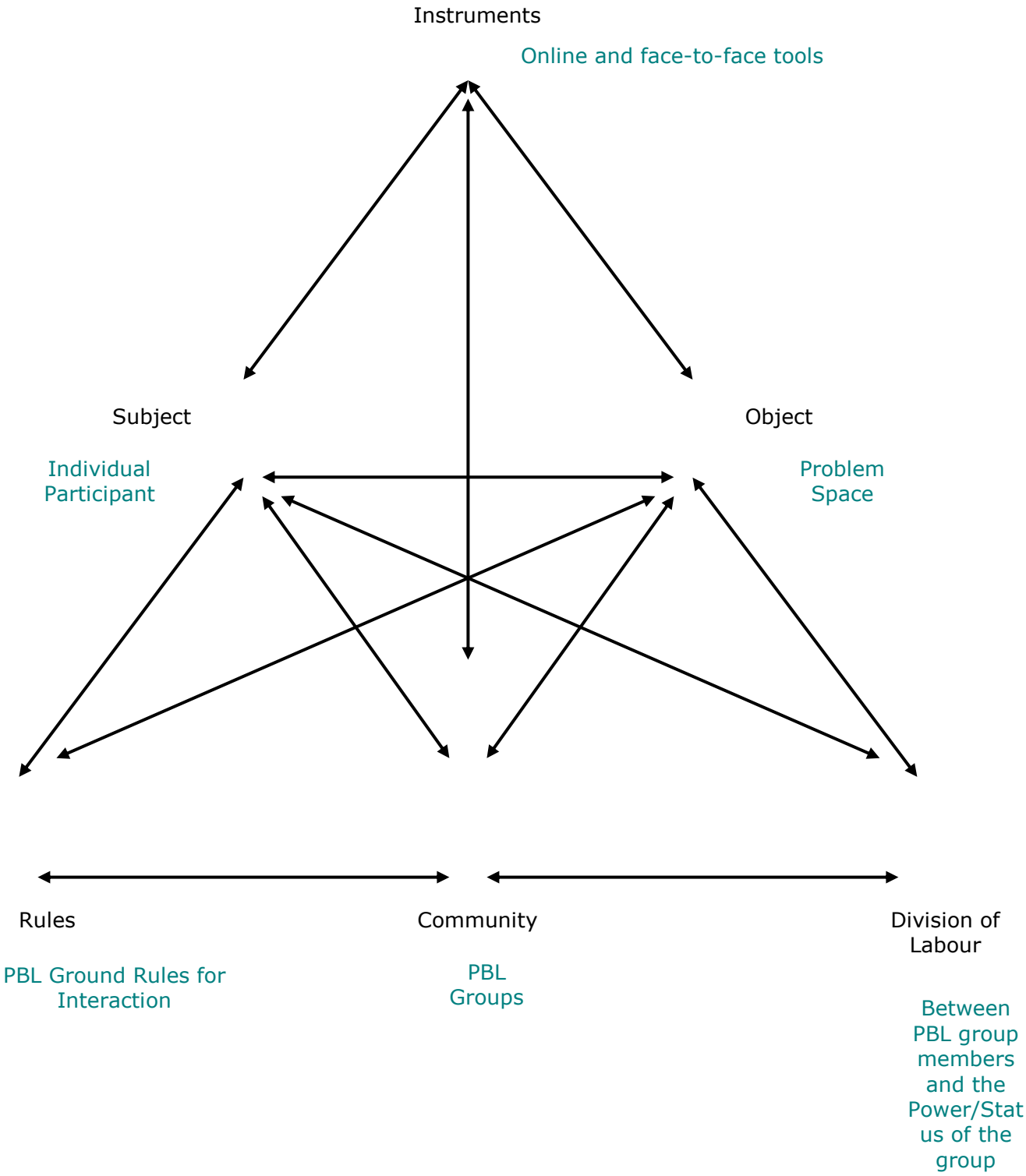

Figure 1 Blended PBL as an Activity System (Adapted from Engeström, 1997)

The object of this work is to facilitate the module participants with necessary skills and awareness so that they can collaborate in the development of eLearning materials. The outcomes include the intended ones for the participants such as ownership of the learning process and successful activity completion i.e. development of materials as well as knowledge, understanding and skills and associated ones such as skills development. Unintended outcomes such as possible dissatisfaction, non-engagement can have a negative impact on the process. The instruments may include online communication tools such as email, discussion fora, and the face-to-face PBL tutorial, all which may be used to support the development of understanding and encourage engagement. The community consists of the participants, the tutors and guest tutors and the learning designers/technicians who are supporting them in developing the materials. The division of labour determines the roles taken on by the individuals in the module and the tasks and decision-making powers of the participant, the tutor and the guest tutors. Finally, the rules regulate the use of time, the online behaviours, the measurement of outcomes, and the criteria for rewards (or awards).

A fundamental connection is between the individual participant in the blended PBL group and the rules and division of labour in the activity system. This relationship is not direct, but is mediated by tools, which make activity possible in the first place and also mediated by rules for acceptable interactions. The same activity will look quite different if we take the point of view of another subject in the community, for instance the tutor. Yet both subjects share the overall object - enhancing student learning.

The blended PBL activity system is always heterogeneous and multi-voiced. Different subjects, due to their different histories and positions in the division of labour,

construct the object and the other components of the activity in different, partially overlapping and partially conflicting ways. There is constant construction and renegotiation within the blended PBL activity system. Coordination between different versions of the object must be achieved to ensure continuous operation. Tasks are reassigned and redivided, rules are bent and reinterpreted. There is also incessant movement between the nodes of the activity: rules may be questioned, reinterpreted and turned into new tools and objects. In this constructed, need-related capacity, the object gains motivating force that gives shape and direction to activity. The object determines the horizon of possible goals and actions. An activity system does not exist in a vacuum. It interacts with a network of other activity systems, such as the guest tutors from different institutions and it receives rules and instruments from certain activity systems (e.g. the tutoring staff). Thus, influences from outside 'intrude' into the activity system.

Constantly working through contradictions within and between its elements, conflicts emerge in blended PBL between the increasingly complex problems of designing eLearning or blended curricula for different disciplines and the online tools available for use on the module. Conflicts and misunderstandings easily emerge. It is argued that these tensions provide levers through which transformation of practice can be facilitated in blended PBL. The idea of internal contradictions as the driving force of change and development in this activity system is key to the operation of the blended PBL groups. The breakthrough into a specifically human form of activity requires that what used to be separate ruptures or emerging mediators becoming unified determining factors.

Lewis (1997) suggests that activity theory can help in the understanding of research communities, specifically within distributed collaborative working groups who are learning experientially, tacitly, constructively and contextually. Suggesting that communications technology can provide support in certain phases of activity, he argues that this will only support learning if the activities are structured so as to reflect working practices. Attempts to consider all the relationships influencing human learning activities are likely to fail due to the multitude of interdependent parameters, but it may be that the complexity may be constrained if only certain parameters are examined one at a time.

Activity systems such as these blended PBL groups are in constant development, always changing through the actions of new participants, purposes and tools. In this study, tools are both physical (the pedagogy of problem-based learning, books, journal articles, web resources, software, virtual environments) and cognitive (concepts, language, memory). These tools both enable and constrain activity in the blended PBL groups through their affordances. The pedagogy of PBL is a tool that affords the participants on the module a way of approaching instructional design, thereby shaping associated ways of thinking (and not thinking) about learning. Employing PBL to create an eLearning course, which is what the groups on the module did, constitutes an action within the teaching and learning activity system.

It is important to understand how changes come about in blended PBL through the reciprocal and unified processes of *internalisation* and *externalisation.* Thoughts, innovations and imaginations are the internal processes that can be manifested externally and lead naturally to new artefacts and social practices. What drives appropriation, and thus development, are the contradictions and tensions between individuals and socio-

cultural influences, between two or more elements of the blended PBL activity system, and between different such activity systems. Resolve or transforming these contradictions (instead of merely shifting them elsewhere) is key, thus resulting in a change in the activity system: the construction of a new practice. Such a change is a long-term cyclical and spiral process of internalisation and externalisation that Engeström and Middleton (1998) call "learning by expanding".

It can also be argued that both cognitive and sociocultural theories provide insights into the learning mechanisms of PBL. Particularly of interest to this study was that problems used in PBL give rise to epistemic curiosity (Schmidt, 1993) that will in turn trigger the cognitive processes of accessing prior knowledge, establishing a problem space, searching for new information and reconstructing information into knowledge that both fits into and shapes new mental models. At the same time, proceeding through the PBL process requires the learner's metacognitive awareness of the efficacy of the process. Yet, all this does not take place in a vacuum. As discussed previously, it occurs in a social system within a larger cultural context. The knowledge that the learner seeks is embedded in and derives from social sources: in this case it is online third level learning and teaching. From this perspective, learning is not an accumulation of information, but a transformation of the individual who is moving towards the learning community. The sociocultural context of PBL is the group meeting face-to-face and online that stimulates the social process of the online learning problem in a scaffolded way.

Data analysis and Discussion

Activity theory facilitates the consideration of interaction in social contexts, which is considered a good starting point for studying contextually embedded blended PBL practice. Specific themes analysed in the study are the potential of networked technologies, the blended PBL group composition, space-time compression and boundary blurring within the activity systems in blended PBL. The use of direct quotes is used in this section of the paper to provide evidence of both the shared enthusiasm for the blended PBL process and also some real concerns voiced by the participants. Whenever possible by using the words of the participants themselves, key issues within the activity systems of blended PBL will be highlighted. For inclusion of all participant quotes, the following applies:

FG = Focus Group Interview (either indicated by 1 or 2 for the first or second interview)

RP = Reflective Paper (numbered 1-17 for each participant)

PO = Participant Observation (the date of each observation is provided)

F2F = face-to-face (abbreviation used in participant quotes)

The potential of networked technologies

Internal activities such as thinking emerge out of practical external activity and at the heart of this is the individual participant and their culturally defined context. The interactivity of technology environments is a very important feature for learning. Interactivity makes it easy for students to revisit specific parts of the environments to explore them more fully, to test ideas, and to receive feedback. Noninteractive environments, like linear videotapes, are much less effective for creating contexts that students can explore and reexamine, both individually and collaboratively. Since an

ultimate goal of education is to prepare students to become competent adults and lifelong learners, there is a strong argument for electronically linking students not just with their peers, but also with practicing professionals.

The challenge for education is to design technologies for learning that draw both from knowledge about human cognition and from practical applications of how technology can facilitate complex tasks in the workplace. These designs use technologies to scaffold thinking and activity. Computer scaffolding enables learners to do more advanced activities and to engage in more advanced thinking and problem solving than they could without such help.

Scaffolded experiences can be structured in different ways. Some research educators advocate an apprenticeship model, whereby an expert practitioner first models the activity while the learner observes, then scaffolds the learner (with advice and examples), then guides the learner in practice, and gradually tapers off support and guidance until the apprentice can do it alone. Others argue that the goal of enabling a solo approach is unrealistic and over-restrictive since adults often need to use tools or other people to accomplish their work. Some even contend that well-designed technological tools that support complex activities create a truly human-machine symbiosis and may reorganize components of human activity into different structures than they had in pre-technological designs. Although there are varying views on the exact goals and on how to assess the benefits of scaffolding technologies, there is agreement that the new tools make it possible for people to perform and learn in far more complex ways than ever before.

Blended PBL group composition

Based upon their extensive research into PBL groups, Myers Kelson & Distlehorst (2000) make a case that the ideal tutorial group in PBL consists of five to seven students/participants and a group facilitator, commonly referred to in the literature as a "tutor". There were three multidisciplinary groups in this study of between five and seven academic staff; having such small groups of participants, all from different subject disciplines, encourages an inquisitive and detailed look at all the learning issues, concepts, facts and principles inherent in the problem. All three groups were presented with the same PBL problem.

The small groups working in this PBL process have ample opportunity over the ten weeks to share their ideas and decide on promising strategies to solve the learning issues associated with the problem. Discussions of suggestions, hypotheses, opinions, evaluations and conclusions reveal the participants' subjective views of the common task. Inclusion of an element of controversy promotes learning by provoking intensive attempts to clarify and finally reconcile one's own and other learners' ideas.

As evidence of their social and cognitive commitment within this module, the nature of the blended PBL approach employed includes actively contributing to and engaging in online discussion, responding to peers, making valid arguments and coherently sharing ideas in writing. To participate in such a manner fosters cognitive depth, shared knowledge and a sense of community amongst the participants. The communication that flows is an intellectual stimulus and source of personal satisfaction for the participants.

Having a small group of participants encourages an inquisitive and detailed look at all the learning issues, concepts, facts and principles inherent in the problem. So although the module is currently small scale, it is envisaged that the number of these PBL groups will grow incrementally, as the demand for this postgraduate diploma course continues to develop.

The work of de Boer & Collis (2002) was explored for its focus on an acquisition model and a participation model, advocating that a balance should be found between the two. The PBL problem was designed for this module to be an authentic, complex and sustained activity (with strong tutor support and peer collaboration). The participants use this purposeful activity to organise their study, to give meaning to their acquisition of information and to provide a framework for the creation of a realistic product.

Space-time compression within the activity systems in blended PBL

Within blended PBL, the communication technologies have made it possible to compress the space-time dimension and help in breaking the barriers of national and regional boundaries. The dialogue opened with the international guest tutors on the module has created opportunities for international cooperation into the future, with invitations to join online courses as guests in Australia and Finland.

A number of facets were evidenced with interactions between participants and the international tutors: (provision of technical assistance, ideas, questions, dealing with disappointment, provision of encouragement, making comparisons/similarities/threads and the stimulating role of the interaction with the international guest tutors):

> *The video conference link with the guest tutor from the University of Tampere in Finland was the highlight of the module for me and I believe a marvelous opportunity for the whole group; we had all heard of this*

> *technology for teaching before, but no-one had actually taught themselves or had learned previously in this way.* (Participant 2, RP15)

> *Being in a blended community of like-minded individuals was a positive and exciting experience – especially having guest professionals. Experiencing live video conferencing, podcasting and blended PBL tutorials have left me with a great sense of achievement as a learner.* (Participant 5, RP13)

> *It was wonderful to be able to communicate with such knowledgeable academics from halfway round the world.* (Participant 7, FG2)

Bringing internationality into the groups, to discuss the variety of ways of using different media in education, proved highly influential to broadening perspectives for the participants on the module. Robertson (2007) similarly examined the dynamics that shape practice when eLearning technology is introduced into face-to-face teaching. When these two activity systems come into juxtaposition, activity theory is successful in identifying the tensions and contradictions that emerge.

Boundary blurring within the activity systems in blended PBL interaction

The nature of the blend was an important finding and involved the transition from the face-to-face PBL tutorial to online interaction. Indications were that the online forum was used for three outcomes. Firstly to organize work for the f2f tutorial:

> *In terms of distilling the online and F2F contributions and disentangling the contributions of each to the group process and product is quite difficult to do. Did our contributions to the discussion forum contribute to our F2F work? Ostensibly, at times there seemed to be little interaction between the two. Should there have been? Are they so different that they don't carry over? Are they so interwoven that they cannot meaningfully be divided apart?* (Participant 1, RP6)

> *I know there are days when you have bad moments but I thought PBL worked really well alternating between the f2f and online learning environments.* (Participant 3, FG2)

Secondly, there were a number of misunderstandings which took place online that needed to be clarified in the f2f tutorial:

> *I discovered that whilst I really enjoyed working in an asynchronous online forum, I still needed the f2f contact for clarification on certain aspects of the problem that I felt could not be teased out thoroughly online. I then found I became more motivated from f2f sessions than from online encounters.* (Participant 4, RP11)

> *It's difficult to formulate sentences online, to say what you really mean. There is too much happening with the PBL dynamic and f2f and online dynamics in our group to contend with, and new language on the screen. It was all very new. And we weren't giving the tutor an opportunity to see us as students working at a high level. I think there would be more of a chance of hitting that high level online if there was not so much of it happening in the f2f tutorials.* (Participant 5, FG1)

Thirdly, as a source of positive peer feedback:

> *My peers' positive response puzzled me – was it a case of them being polite or perhaps others do not wish to leave their true opinions online in a permanent public forum like the discussion forum.* (Participant 1, RP1)

Blended learning within PBL cannot be regarded simply as a type of technology-intensive activity that replaces the functions of the classroom-based tutorial. Instead, those effectively incorporating blended learning must think about how it might enhance, extend or transform the face-to-face PBL tutorial experience, not simply replace it.

> *If we highlighted an issue or problem online then we sorted out some of our problems at the next f2f meeting.* (Participant 2, FG2)

> *The beauty of the mix between f2f and online is that you would never reach that on your own. Even in 10 weeks, you would never acquire that amount of knowledge as an individual in a lecture situation*. (Participant 7, FG2)

> *In the online environment learners need to get over the barrier of admitting they need help. I think where the strength of PBL comes into play is that the help can come freely from peers.* (Participant 5, FG2)

> *F2f was good for delegating and organizing, and the discussion forums were good for following that up and backing it up, as were the online chats as well. (*Participant 4, FG2)

From a pedagogical perspective, it is important to be aware that teaching and learning in blended learning environments can be highly unstable and fluctuating and consideration of the relevance of continuity between the face-to-face and online environments is crucial.

Arguably academic staff today work at the intersection of education and information technology, attempting to balance many skills, roles and responsibilities of teaching and learning. Fuelling this tension, the context in which academic staff work is rapidly changing because of new educational philosophies and practices, as well as the explosion of information made available through the Web. The ability to adjust individual practice in the midst of reform is an essential skill for education professionals. Academic staff work in an environment that will inevitably undergo periods of both organizational and pedagogical transformation. Furthermore, these staff are often physically isolated from colleagues who share similar job descriptions, limiting their ability to collaboratively diagnose tensions, respond to new priorities and models of teaching and learning and design new strategies.

Within this study, the theory of interactivity was informative for exploring tensions in blended PBL as it goes beyond individual knowledge and decision making to take a developmental view of minds in context. As the participants in blended PBL worked, thought about and solved problems together they demonstrated an accumulated set of habits and values. Learning was not an isolated act; rather it was situated in time and space and influenced by the surrounding actors, resources and behavioural constraints. As agents in the learning process, through their activities, the participants influenced the contexts in which such learning took place.

There are several good reasons for academic developers to consider the social and organisational context in which innovations in technology will be integrated to professional development courses. Thinking, learning and even knowing, are activities that are shaped by the activities in which academic staff participate. Tools, structures and work-settings are created during regular participation in social activities in the online and face-to-face PBL environment and cognition is inherently context and historically bound within each PBL group.

Tensions existed within the module and these tensions and how they were resolved (or aggravated) provided continuous transformations, the development of new practices. Contradictions arose when new ways of thinking or doing came in conflict with traditional or currently accepted ways of thinking and doing and occurred within each of the participants and among activities, resulting in tensions within the system. There was only one case of an exaggerated contradiction where one group almost reached crisis proportions and it almost led to a breakdown of the PBL group itself.

> *Our group suffered severely for several weeks from misunderstandings and a complete disagreement on our concepts and ideas of how to move things forward; this was the storming phase, and when one of the others in the group highlighted in an online posting the tension that had developed in the face-to-face tutorial, well that really set me off.* (Participant 4, FG2)

Very often, in the course of everyday activities, tensions or breakdowns in the groupwork were negotiated and repaired to an extent, but not all tensions or contradictions were obvious to the participants engaged in the given activity. Furthermore, the participants in some of the groups did not share consistent motivations or conceptions, despite their participation in the same activity. Tensions that occurred in

the group learning setting led to a changing in the division of roles between the participants in the group:

> *There was a competition for ongoing control of the discussions which added to confusion in the disorganized periods. I felt I did not have a great influence on our group work f2f, because some of the others wanted to take the development of our work in a different direction from what was uniformly agreed; at times they seemed oblivious to the fact that they were blatently doing this; but after each tutorial I waited to see what would pan out in the subsequent online discussions.* (Participant 6, RP1)

However, on reflection, the tensions and contradictions provided opportunities for expansive learning on the part of the academic staff on the module. Blending f2f tutorials with online support involves exploring the distribution of workload between the two for each individual participant; it is important to be explicit about the nature of the work (for example, is there something that needs a full unpacking in the f2f tutorial or can time be saved by completing it in 10 minutes online?) Some individuals were unsure when to do work, online or face-to-face; the findings have indicated how the technology facilitated this distribution, and the extension of the f2f tutorial let the participants achieve a greater level of knowledge and skill that they would have had in just the 3 hour classroom.

> *So I think that what you produce together in PBL and with the support of the technology is definitely a greater product than what you would produce individually. There are one or two individuals who could do the whole thing on their own but the end product would be very much a different thing.* (Participant 3, FG2)

Collis *et al*. (2003) found that mastering the coherent use of online components often require a large amount of self-discipline on the part of the learners. The online context may direct attention more towards mastering a new technological medium than on the content of the PBL problem at hand. Further research would enlighten the extent

participants regulate their use of learning strategy in accordance with changes in task and context, when they are entering the online learning environment.

> *People use the word blended very easily, but there are many aspects inherent with its design and use. When you get to a certain depth in the f2f tutorials then what else is WebCT being used for? Is it just a repository for information from week to week, so that you are not able to have the chance to actually have deeper conversations online? Instead you are having the deep conversations in the f2f tutorial, and you want to use WebCT to progress your product at the end also.* (Participant 5, PO, 15/02/05)

> *How do I sustain the meaningful discussion about the problem from the f2f tutorial to online? I thought it was very interesting when the Australian tutors came into the module, and the deep level of discussion that took place that week, because it had to; they were at a distance and the engagement needed to happen, breaking issues down and exploring them was crucial.* (Participant 1, PO, 15/02/05)

The Mutual Tutor Voice: Reflections

This penultimate section of the paper includes reflections by all the tutors and guest tutors involved in the module. In this sense, the opinions emerging are in agreement over the key issue of how the technology can be used to alter the tutor's role in PBL. Technology use is highly compatible with the new tutor role in blended PBL. It can facilitate a change in the tutor's role also by making it easier to act as a diagnostician and coach for the cognitive aspects of task performance in the group. Moreover, technology often puts tutors in the role of learner alongside their students. This is a big change from the traditional role of the tutors as the one with all the knowledge and right answers. Instead, students are given the chance to see their tutors perhaps acquire a new set of skills. Tutors who are not threatened by this change in roles report that the experience sensitizes them to the learning process in unexpected ways, giving them new insights into their students as learners. Engaging in the process of exploring technology with their

students further provides tutors with an opportunity to demonstrate aspects of problem solving and learning that are rarely made visible in more product-oriented classrooms.

Firstly, PBL places tremendous demands on tutors. They need to think deeply about the things that are most important for their students to learn and to design or adapt problems that will support learning those concepts and skills. They must learn to structure their classroom in such a way that different students or groups of students are working on different aspects of the problem at any one time. To do so requires also that they teach their students how to work cooperatively and that they develop skills in supporting student interactions. They must learn to diagnose the thinking of individual students, even when those students are working in groups. Also they must develop skills in supporting their students' thinking while still leaving the student the autonomy to explore and test out new ideas. This kind of teaching calls not only for a high degree of pedagogical skill but also for broad content knowledge and for continually tackling new material.

Adding technology to the mix exerts yet another set of demands. It has been argued in this paper that the combination of technology and a problem-based approach to teaching is powerful because it exerts pressure to rethink and restructure all aspects of the classroom. The other side of this double-edged sword is that tutors are being asked to make major, labour-intensive changes, and some if not many will be reluctant to do so.

Technology-supported constructivist approaches are particularly energy-intensive for tutors who themselves have not been taught in this way and who need to acquire both the pedagogical and the technological skills required. Even when they have mastered the needed skills, many tutors find it difficult to sustain constructivist teaching approaches over time. Some aspects of constructivist learning may be directly stimulated by

technology, notably an increased level of collaboration, heterogeneity of roles, and greater complexity and authenticity in assigned tasks. Other aspects, such as involvement with content that incorporates multiple academic disciplines, may not be caused by technology per se, but are often reinforced by technology use.

Conclusion

Engeström (cited in an interview in Land & Bayne, 2004) has cautioned that "networked learning, virtual worlds, digital worlds should not be conceived of as closed worlds. The connection to the physical world oftentimes tends to be suspended or nearly excluded…The closed world phenomenon is a real challenge and I think we need mixed worlds" (p. 106). In the future, activity theory will be used as an analytical tool to explore the naturalistic, dialogic data in this case study. It can provide a way to explore the complex process of discovering how learning emerges from activity in sociocultural contexts and how certain events afford opportunities to learn or inhibit learning. Activity theory was helpful in this study to situate the behaviour of the participants and tutor on a blended PBL module for teacher professional development within a social learning context.

Activity theory appears to be a useful tool in supporting the analysis of the blended PBL classroom. It helps the researcher frame questions to explore during the research and through the data analysis. Further work needs to be completed within the study described and it is hoped that this will lead to the identification of factors that support effective collaborative learning within the frame of online and face-to-face PBL as well as provide an indication of the value of such a process for the participants. The

paper has been written at a time in the study when the tutors have just begun the second phase of developments.

The lessons learnt from the analysis described above have been shared within the participants and the PBL groups have planned to revise their ways of working, for example, synchronous communication is now the preferred and intended approach for online collaborative communications. This is already an indication of the value of this type of analysis within the complex blend of online and face-to-face PBL described in this paper.

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