

# The nexus of problem-based learning and learning technology: Does it enable transformative practice?

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## Abstract

This paper describes a qualitative study which took place over a two year period with academic staff engaged on a blended Masters programme delivered with the learning environment based around problem-based learning. At the *pedagogical* level, *transformative* practice has the potential to engage students as critical thinkers, by encouraging them to be both participatory and *active*. By exploring the application of Mezirow's transformative pedagogy framework on blended problem-based learning (PBL), it is hoped that the transformative dimension of this pedagogy is clarified with respect to the role it plays in the development of individuals. Inherent in this is the role given to e-learning technologies, supporting peer-to-peer collaboration in PBL groups as well as learners' autonomy and responsibility for learning.

## Keywords

Computer-mediated communication; improving classroom teaching; pedagogical issues.

## Topics

Blended delivery; e-learning; problem-based learning

## Biography

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## Introduction

The concept and practice of transformative pedagogy lies at the heart of this study. It is embedded in the nexus of curriculum restructuring based on a social constructivist theory of knowledge to take advantage of the capabilities of learning technologies – all to transform academic practice. The research agenda on transformative pedagogies is wide-ranging, referring not only to strategies or styles of instruction but also to the facilitation and management of sustainable transformations, whether individual, social, structural or institutional. From a definitional perspective, descriptions of transformative pedagogy originated in the adult education literature and Myers (2006) believes it has been regarded as an approach to teaching that encourages students to grapple with disorienting dilemmas, critically examine their assumptions related to the contradictory information, seek out additional perspectives, and ultimately acquire new knowledge, attitudes and skills in light of these reflections – all in order to experience personal and intellectual growth.

The intentions of transformative educators have not changed much in the last few decades but the context of their action is no longer the same. In the context of today's knowledge-driven, technology-oriented society, Calvert (2006), amongst others, has argued that learning technologies have been recently presented as the panacea to democratise education, improve the quality of learning, advocating peer-to-peer collaboration and giving learners a greater sense of autonomy and responsibility for learning. It is argued in this paper that it is important to take advantage of the possibilities offered by e-learning to support innovative conceptualizations of the well established pedagogy, problem-based learning. However, there has been a sense of disappointment previously that the transformatory potential of technology is being missed or resisted. Transformative learning theory is being proposed in this study as a means to understand the complexities of education in an age where information and communication technologies (ICTs) are constantly reshaping and redefining our accepted notions of what it means to teach and learn in a higher education environment.

Recent learning technology conference agendas reflect this trend with topics for exploration such as spreading innovation, and redesigning pedagogy. This study aims to fill a gap in the literature on innovative learning by describing a programme of e-learning, a strong element of problem-based learning and a substantial focus in online problem solving skills to enable the transformation of practice of the participants.

## Potential of Transformative Learning in a Blended PBL Module

From the outset, it is important to consider if educational transformation can only be obtained by designing for it explicitly, as is the case in this current study. One can argue that it is better to seek a balance in

looking at gradual cumulative benefits versus transformation. A number of previous studies, including one by Whitelaw *et al.* (2004), on academic staff participating in instructional development, have shed light on changes in attitudes towards technology-enhanced instruction and change in pedagogical style in relation to the presence of transformative learning experiences. More recently, Kitchenham (2006) conducted a study with 10 teachers who experienced perspective transformation as they learned to use educational technology and integrate it into their classroom teaching. This holds interest for this current study which is exploring perspective transformation at an individual level for a small number of academic staff using learning technologies with a student-centred pedagogy such as PBL; the transformation in perspective is explored in how they approach learning on the module and how they carry it through to their own classroom practice.

One of the most illuminating definitions of transformative learning was put forward by O'Sullivan (2003):

*Transformative learning involves experiencing a deep, structural shift in the basic premises of thought, feelings, and actions. It is a shift of consciousness that dramatically and irreversibly alters our way of being in the world. Such a shift involves our understanding of ourselves and our self-locations; our relationships with other humans and with the natural world.* (2003).

Mezirow's approach (1997) is more direct in describing transformative learning theory as covering the conditions and processes necessary for students to make the most significant kind of knowledge transformation: paradigm shift, also known as perspective transformation. In 1990 he described perspective transformation as

*the process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand and feel about our world...changing these structures of habitual expectation make possible a more inclusive, discriminating and integrating perspective...and involve making choices or otherwise acting upon these new understandings* (167).

Other models of transformative education, particularly those of Boyd & Myers (1998) (concept of individuation) and Freire (1985) (view of social transformation), have contributed to the discussion. One of the recognised unresolved issues in the theory and one which this study aims to address, is adult development, involving shift or progression. According to transformative learning theory, paradigm shift or perspective transformation is the result of several conditions and processes. In his earlier work, Mezirow (1975) names stages leading to transformation, starting with a disorienting dilemma and ending with restored equilibrium. The exploration of the transformative potential of blended PBL in this study is based upon Mezirow's (1975; 1995) conceptual framework of stages leading to transformation: activating events, the identification and articulation of underlying current assumptions, critical self-reflection, critical discourse and opportunities to test and apply new knowledge and perspectives.

Cranton (1994: 22) has discussed how the theory evolved into a comprehensive and complex description of how learners "construe, validate and reformulate the meaning of their experience". Centrality of experience, critical reflection and rational discourse are three common themes in the theory. However over the years, a number of critiques have emerged to Mezirow's theory, the most contentious being the emphasis upon rationality; although many empirical studies support Mezirow's assertion that critical reflection is central to transformative learning, others have "concluded that critical reflection is granted too much importance in a perspective transformation" (Taylor, 1998: 33-34). Although the theory of transformative pedagogy has been much discussed and debated in the literature, Taylor (1998) has suggested that its practice has been minimally investigated and is inadequately defined and poorly understood.

However this study recognises that definitions of transformative learning are problematic and few take account of the radical sociocultural changes resulting from the introduction of digital technologies such as the Internet and wireless connectivity. The transformative nature of the learning in this module on a Masters Programme for academic staff, described below, is about change in beliefs and attitudes towards e-learning and PBL. In this study, the learning is not just at the levels of knowledge and skills acquisition in blended PBL. It is argued that the participants need to radically transform their approach to thinking and learning to both e-learning and problem-based learning in order to maximise the benefits offered by the blend. Presenting new information to them on this area is not enough to guarantee optimal learning; they must recognise the limitations of their current knowledge and perspectives. What is required is a true transformation of the participants' existing knowledge.

A major focus of transformative learning theory within this study is the consideration of ways of what Zepke *et al.* (2003) term working with the participants to bring about a transformation in their learning and practice. Inherent in this is the importance of interaction in bringing about learning, whether or not this interaction takes place face-to-face or online and the need for power-sharing between participants in the groups. PBL is well established in higher education, academic development and elsewhere and its virtues are long known. Much has already been written about the PBL tutorial process and Myers Kelson & Distlehorst (2000: 168) have been useful for providing a detailed description of PBL unfolding.

The participants on the module were a cohort of academics, both lecturers and support staff, studying how to design e-learning courses for a higher educational context. Table 1 provides a breakdown of the blended activities in the PBL module and estimated time for completion of each activity.

**Table 1.** Activities in the Blended PBL Module

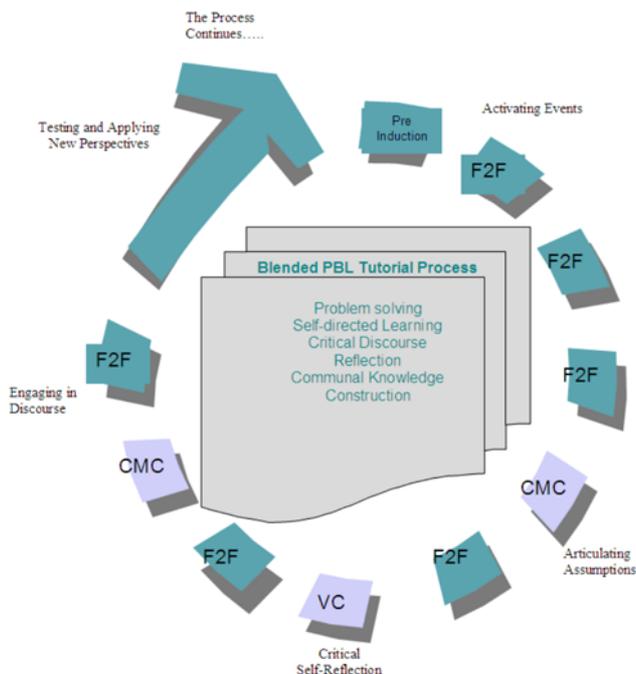
Features of a Blended PBL Environment	Duration of Activity
Face-to-face PBL tutorials	10 x 3 hours
Between tutorials: researching, reading, planning, designing ideas	Over 10 weeks
Online reflective journal entries	1 per week x 10 weeks
Video conferencing session	3 x 1 hours
Asynchronous discussions	5 per week x 10 weeks

Synchronous chat sessions	10 x 30-60 mins
International guest tutor collaboration	3 x 1 week



**Figure 1.** Shows two screen-shots of the blended PBL module in the virtual learning environment 'Webcourses', one showing the problem/task space and the second illustrating a selection of the virtual resources.

Figure 2 shows the blended PBL tutorial process as discussed in this study at the centre of the transformative learning cycle which participants experienced. The tutorial process consisted of the traditional PBL steps of problem-solving, self-directed learning, critical discourse and reflection and communal knowledge construction. A blend of face-to-face, computer-mediated conferencing (CMC) and video conference (VC) events, preceded by an online pre-induction session which all the participants experienced, prompted a series of stages leading towards transformative learning. These stages were activating events, articulating assumptions, critical self-reflection, engaging in discourse and testing and applying new perspectives.



**Figure 2.** The Transformative Potential of Blended PBL

The following is an overview of the each of the transformative stages shown in Figure 2 which took place on the professional academic development module at the heart of this study. The transformative potential of blended PBL is based upon Mezirow's (1975; 1995) framework of stages leading to transformation: activating events, the identification and articulation of underlying current assumptions, critical self-reflection, critical discourse and opportunities to test and apply new knowledge and perspectives.

Activating events in the module triggered the participants to examine their thinking and that in turn exposed the limitations of a participant's current knowledge/approach. Strategies used for this involved

understanding the participants' backgrounds through a pre-module questionnaire and blended induction activities, providing conflicting viewpoints to motivate the participants to examine their own perspectives of e-learning and PBL and creation of disorienting dilemmas through the PBL problem to challenge what the participants believed about e-learning. The goal of the problem was to intrigue the participants to increase their motivation to learn. Furthermore, allowing the participants to reach a problem-solving impasse recognised that they could be motivated to learn when their current knowledge was insufficient to solve an interesting problem. The participants needed to recognise that new information or a new approach was required. It was not enough to hand participants an unsolvable problem, the tutor needed to convince them that the impasse could be resolved and create conditions that encouraged their success. Tutors can present missing pieces in many ways – from a simple explanation to helping the participants derive an idea or approach for themselves.

It has been suggested that in a learning community such as on this module, the initial (induction) stage of activity should not be attempted without adequate opportunities for face-to-face interaction. Within the blended PBL module, it was vital that group members did not become disenfranchised and it was essential that further events be provided for rich interactions for the group in order to maintain, revise and develop the initial intentions. Cranton (2006) believes that becoming self-directed learners, through the establishment of learning goals, leading discussions and sharing resources to generate knowledge is wholly consistent with the emphasis on learner decision-making advocated by proponents of transformative pedagogy.

The activating event typically exposed a discrepancy between what a person has always assumed to be true and what has just been experienced, heard or read. In order to bring about a catalyst for transformation, the participants on the module needed to be exposed to viewpoints that may have been discrepant with their own. They were introduced to new technologies such as video conferencing, asynchronous and synchronous discussions, audio, blogging and online reflective journals, all displaying information to them in interesting and different ways.

Opportunities for the participants to identify and articulate the underlying current assumptions in their current knowledge/approach all required that they explain their thinking. Strategies employed were the use of a critical questioning technique, asking the participants to explain their reasoning and the thought processes which propelled them. This helped them identify their assumptions by offering counter-examples, alternative scenarios and differing perspectives. It involved having them make a prediction about an event or procedure in designing e-learning and required them to explain their predictions in online discussion. This was particularly effective when the actual outcome provided a disorienting dilemma. Having the participants talk through their thinking and problem-solving strategies was especially helpful by using a failure-driven approach as the critical event. Providing them with a challenging question or problem and having them talk through the thought process was done in small groups of five-seven and through direct interaction between the participants and tutor online and face-to-face. Having them evaluate specific positions and solutions and reading and justifying their critique was done as a small group discussion or as a written assignment. Through an exploration of conflicting readings or alternative solutions, participants were asked to defend one online and provide in-depth reasoning. This process marries contemplation about the subject matter with self-scrutiny.

Critical self-reflection occurred as the participant considered where these underlying assumptions came from and how these assumptions influenced or limited understanding. Strategies used to promote critical self-reflection were online reflective journals and reflective writing assignments, requiring a response to specific tutorial experiences either face-to-face or online. Transformational learning was both a social and solitary process (Taylor, 1998). The most solitary part of transformational learning was critical reflection, which required that participants privately examined their current assumptions. Critical reflection was likely to occur outside the PBL tutorial, as the participant absorbed and integrated what happened in the tutorial. Writing assignments were a very useful vehicle for inviting participants to engage in solitary reflection. They kept an online reflective journal for the 10 weeks of the module duration, which consisted of questions, observations and experiences, both positive and negative. It involved keeping track of the 'eureka' moments of transformational learning (when they suddenly understood a new concept or perspective), as well as conflict and confusion. Allowing the participants time at the end of each PBL tutorial to write in their journals was an effective tool to encourage participation. At the half way point in the module (5 weeks), the participants had the option to turn their journals into the tutor for formative feedback and at the 8 week juncture, to exchange aspects of their journal with their peers.

Critical discourse with other participants and the tutor took place as the groups examined alternative ideas and approaches. Critical discourse was the most social aspect of transformative learning. Strategies were used to create opportunities for the participants to reflect through dialogue, both face-to-face and online, thus extending the discussion and debate from the face-to-face tutorial to the online environment. When introducing a new e-learning strategy, concept or paradigm in the PBL tutorial, asking the participants to analyse the approach and compare it with their previous assumptions on concepts led the discussion. Making time in class for more extended periods of discussion and debate was important. However, not all the discussions were critical. Transformational learning is unlikely to occur when participants use discussion to reinforce their existing perspectives or to persuade others of their viewpoint. All participants needed to have their assumptions respectfully challenged. Inviting a participant to play devil's advocate and challenge everyone's assumptions, including that of the tutor was useful when asking them to explain and defend a viewpoint they disagreed with. This challenged participants' thinking habits and brought to the discussion points that might not otherwise have been raised.

Sustaining these conversations outside the PBL tutorials through the asynchronous discussion forum and synchronous chatroom sessions provided an opportunity for participants to continue challenging assumptions and consider new perspectives. The PBL group problem encouraged the small groups of five-seven participants to engage in critical discourse especially as it involved analysis, comparison and integration of ideas, readings and approaches to e-learning course development in higher education.

For transformational learning to move from thought to action, participants need opportunities to test and apply new knowledge and perspectives (Taylor, 1998). Creating activities that empowered the participants to apply new approaches with a high likelihood of success were used through the presentation of the PBL problem. A number of strategies were implemented: returning to the disorienting dilemma and having the participants approach it with their new knowledge; and requiring the participants to embrace the development of the PBL problem by approaching it from multiple perspectives. The participants were assigned different perspectives and they discussed the varying outcomes in the tutorial or they were asked to tackle the same problem more than once. Online role-playing and debating activities gave the participants the opportunity to try out new perspectives. Asking them to observe and interpret events, readings and experiences using their new knowledge was also instructive.

When all these processes occur, participants are more likely to revise their underlying assumptions, adopt a

new paradigm and apply it accordingly (Cranton, 2002). Within it, the tutor needed to strike a careful balance between support and challenge. Trust amongst the participants and the tutor was especially important in a module that uses writing and discussion as a strategy for critical reflection and discourse. Conversely, Cranton (2002, p66) argues that although student empowerment and support are important, an "environment of challenge" is the central ingredient for transformative learning. It is asserted that the participants on the module must have their beliefs and assumptions actively challenged. Boyd & Myers (1998: 98) recommend that tutors practice "seasoned guidance" and "compassionate criticism". Push too hard and the participants resist, push too little and the opportunity for learning quickly fades. It is argued that to be an agent of change, the tutor must understand the process of change and be both the catalyst and support mechanism necessary for transformative learning in blended PBL.

Transformative learning theory also recognises that changing one's perspective is not simply a rational process. Being forced to consider, evaluate and revise underlying assumptions can be an emotionally charged experience. Participants have successfully used their current paradigms to do well in school and to their in their own disciplines in the past and they may be reasonably reluctant to abandon what they believe is the right way to think, create and solve problems. Illeris (2003) has suggested that resistance to perspective transformation is common, even among participants who are motivated to learn. For this reason, tutors who wish to facilitate transformative learning must create an environment that encourages and rewards intellectual openness (Taylor, 1998).

The change to a new way of learning through blended PBL, with associated changes in the participants' beliefs about different aspects of learning and teaching can mean that the learning can be difficult as it is working at the transformative level of beliefs, values, attitudes and ideologies. When any of these, having been held for years are challenged, turned upside down or replaced by new ones, it can be experienced simultaneously as difficult and enjoyable.

New learning requires the activation of prior knowledge and the active construction of richly elaborated relationships among ideas. Wilkerson & Gijsselaers (1996), in writing theoretically about PBL, believe these networks or schema make it possible for learners to retain new concepts and skills and through practice during the process of learning, to organise them in a variety of ways for use in familiar and unfamiliar situations. Knowledge embedded in a context similar to that in which it may eventually be used is more easily recalled than isolated knowledge.

Johnson-Bailey & Alfred (2006) submit that transformative pedagogy not only focuses on developing participants' understanding of alternative perspectives and experiences on an individual basis, it also expands their awareness of how societal forces impact people. However, the blended PBL approach adopted in this study seeks to fundamentally and respectfully change participants' attitudes and analytical skills to facilitate their growth, whilst the module is delivered through a face-to-face and online format.

## Methodology and Methods

A naturalistic, interpretative, qualitative approach was used to analyse the data collected for this study. As a research approach, it has presented a series of "slice-of-life" episodes during the blended PBL tutorial process and afterwards, revealing the range of applications and use of the knowledge in professional teaching practice.

The research methods employed to collect face-to-face and online observational data from three PBL groups with a total of 17 participants in this two year study on a blended PBL module were participant observation, online discussion logs, open-ended focus group interview and self-reflective papers. The approach taken to the collection of data of blended PBL groups was multi-faceted with two levels being taken to the analysis of the data. Level One was descriptive in nature and through video observations explored the interactions between the peers, the tutors and the content of the blended PBL tutorial. Level Two was a thematic analysis of interactions in blended PBL through a combination of online logs, focus group interviews and participant self-reflective papers.

There were three PBL groups in this study, with each group choosing their own name as part of forming collective identity for the module; Table 2 shows any basic assumptions they had about either PBL or e-learning upon entry into the class.

**Table 2.** Sample for the Study

Number	Attribute
17	part-time postgraduate learners in total
9	had completed a PBL module previously
5	had prior experience of blended learning
8	males
9	females
15	subject disciplines in higher education represented: Group 1: 'CPD Challengers' (psychology, social science, culinary arts, information literacy, adult literacy); Group 2: 'The Apprentices' (Biology, Apprentice Plumbing, Apprentice Joinery, Apprentice Metalwork, Adult Literacy); Group 3: 'Cyber Club Seven' (Architecture, Marketing, Culinary Arts, Refrigeration, Printing, Fine Art, Chemistry).

## Results

The use of direct quotes is used in this section to provide evidence of both the shared enthusiasm for the potential of transformation in the blended PBL process and also some real concerns voiced by the participants. The following acronyms relate to the different data collection methods from the PBL groups: RP: Reflective Papers (numbered 1-17); PO: Participant Observation (via video recording); FG: Focus Group (numbered 1 and 2). Two participant verification sessions were held to check, confirm and be certain about the findings from the study. Whenever possible by using the words of the participants themselves, key issues will be highlighted; pseudonyms were used as part of the informed consent obtained from the participants.

One of the major issues that emerged from the analysis of the data was the individual participant's perception of change to their own behaviour, attitude, learning approach and practice taken over the ten weeks of the module. All 17 participants expressed strongly that at an individual level, they reached a transformation in their learning. This is evident from the range of positive responses on transformation from the Participant Verification Sessions; for some it was in how they would change their behaviour to operate in a group-based learning setting in the future:

*I needed to change my behaviour; to do this I needed to recognise what occurred on the module and why. I appreciated that this form of reflective activity needed to be self-regulated. I am aware of the need to change how I communicate with others and this became particularly poignant for me as a member of a PBL group in a blended environment. I made a conscious effort in the module to be more succinct and accurate when making comments in a group situation and to think faster on my feet in the f2f sessions. I can use this awareness now for the future. (Aidan, RP1)*

For other participants, individual changes in attitude, belief and value towards pedagogy and technology were evident:

*I have come to some startling revelations and new insights during this module. Some experiences and critical instances have altered some of my fundamental views about learning and teaching. In participating fully in the blended PBL module, I have helped the group process and I have learned what I wanted to know about e-learning technologies. Armed with this I have continued to grow as a learner in a way that I am very proud of. (Padraig, RP3)*

The boundary between participants' work in the group and their professional practice was a major source of change and development, at both a personal and a professional level. Group members were challenged to consider their existing practice in the context of their work in the group. They were also challenged to contemplate their practice as learning members of the group. All 17 participants indicated that for them, transformations in learning approach extended to their own practice. For each, this involved testing and applying new perspectives with regards to their learning and extending this to their own teaching situations and disciplines. Conceptually testing and applying new perspectives related to the application of understanding. For only two of the participants from all three groups, the duration of module was too short for transformation to occur but even at that, they considered that it laid the foundations for it over a longer time period.

*Change does not come easy to individuals or institutions for that matter. We are all creatures of habit. Our institutions will have to initiate and adapt training programs such as this blended PBL module, in order to prepare lecturers for the increased expectations of the 'new' student that is emerging. This is essential as learning is becoming more self-directed. (Caolan, RP11)*

The following example will assist in understanding how a triangulation of methods was accomplished. The participant observation of the face-to-face PBL tutorial (with the CPD Challengers group) suggested conflict between the theory and practice of blended interaction for those who felt that the blend of online and face-to-face PBL was not always in harmony:

*I had an expectation that the f2f and online would almost go hand-in-hand and complement each other, and I feel it didn't. Even though I have been reading on this over the last couple of weeks, it now seems that the f2f and the online together can actually complicate things because the way we do things f2f and how we communicate is very different from how we communicate online, and it is very difficult to bring the two elements together. (Sorcha, PO, 08/02/05)*

This was also experienced in an online discussion board posting with the same PBL group where difficulty was identified in linking what is covered in the face-to-face PBL tutorial to asynchronous online discussions.

Message no. 1013 [Branch from no. 1010]  
Posted by Eimear on Tuesday, January 25, 2005 9:23pm  
Subject: Re: Linking the F2F Tutorial to our Online Groupwork

Just a quick word to Dervla and Caitlin – sorry you missed today's tutorial - hope everything is okay.

..... today in class was good but it is very difficult to convey here online what we covered. Much of it was subjective and there were many different opinions and 'piggy-backing' on each other's ideas. There is no way that I can capture the spontaneity of it for you here in this posting, which is very frustrating. I guess we could try an online chat but if you can't make that, I'll bring you up to speed at the start of next week's class.

We have three more Tuesday tutorials before the lastclass..... we left today with the sense that there's a lot of time left, although I personally think it's going to be difficult to keep a balance between the f2f and online work. Looking forward to hearing from you both.

This triangulated with the data from the second focus group interview when a different participant from a different PBL group discussed their experience in relation to the synchronization between the f2f and online tutorials:

*I think it is a weakness of e-learning that in many cases it relies on written communication because although people can misinterpret things in any form of communication, when you are online, it is much more complex and intricate to re-explain what I mean than what I can*

*do in the f2f tutorial. (Aine, FG2)*

## Discussion: Individual Perspective Transformations

According to Mezirow (1991), the principal goal of adult education is reflective and transformative learning. However, not all change is transformative and not all critical reflection leads to transformative learning. Conceptually critical self-reflection in this study involved internalisation of learning for each participant. Both Illich (1970) and then later, Kolb (1984) have argued that learning is the creation of knowledge through the transformation of experience and transcends the particular institutional context that society has reserved for that purpose. Using Kolb's view on learning, if we substitute a particular type of change for transformation, then arguably, change becomes a condition for learning. Kolb has identified *reflective observation* as one of four important steps in the transformative process. Through reflecting on their observations, experiences and learning throughout the module, the participants transformed their assumptions about e-learning and PBL, becoming open to alternatives and new ways of thinking.

*Reflection on this module has led to my changing the way I feel about group work and the activities and interactions associated with it. Looking back now I realise that I lacked the fundamental attitudes necessary for genuine reflection: open-mindedness, responsibility and wholeheartedness. This journey took place during the entire module but I only realize it now. (Loirin, RP4)*

*Reflecting during and after this module has made me realize what a learning journey I have been on; it has been a long time since I felt so unsure of my footing in learning but I feel I am a much stronger person as a result of coming through it. (Maeve, RP14)*

Mezirow (1991) has suggested that individuals can be transformed through a process of critical reflection in his theory of transformative learning. Specific indicators are becoming more reflective and critical, being more open to the perspectives of others and being less defensive and more accepting of new ideas. Kelly *et al.* (2007) have argued that online communities which rely on written communication between participants have great potential in encouraging reflections. This was the case on this blended PBL module as writing involved more than reporting, it was also a reflective act which was an essential part of the process of knowledge construction and arguably in this study, a transformation in learning. As it is writing, CMC is useful for promoting higher order learning say Garrison & Anderson (2003):

*There is sufficient evidence to suggest that writing has some inherent and demonstrable advantages over speech when one person or a group is engaged in rigorously thinking through a problem. (34)*

Arguably, lecturers have the freedom and responsibility to choose those pedagogical strategies that will provide the most appropriate environment and experiences for their students. However Butler (2003) in an Australian HE academic development study, reports that when academic staff who have been lecturing for some time meet authentic educational models (such as PBL) for the first time, they will go through some form of adult transformational learning process where their world views are challenged and changed. This process will be experienced by them as disorienting and confusing in the early stages but will eventually be resolved by authentic learning.

Catalysts for transformative learning are "disorienting dilemmas", situations which do not fit one's preconceived notions. These dilemmas prompt critical reflection and the development of new ways of interpreting experiences. When adults world views are challenged and perhaps changed, their perceptions of their learning can be negative and the learning event can be perceived as making their lives more difficult, and they question the worth of this unsettling process. Their long held beliefs about learning and teaching are challenged and contested by the educational model. Butler (2003: 5) has termed this negative period of learning as "the pit" and reports that at some idiosyncratic point, each person's learning perceptions start to head upwards very rapidly and they eventually reach what he calls "the ecstasy of learning that rewards adults who change their behaviours to more fulfilling processes for themselves and their students." In this way, transformative learning involves reflectively transforming the beliefs, attitudes, opinions and emotional reactions that constitute our meaning schemes.

The presence of specific conditions in the blended PBL experience suggests that the participants have experienced a transformation in their learning. These conditions include: learning creatively, through contributing, experimenting and solving problems; learning as active citizens by taking responsibility for their own learning; engaging intellectually with ideas by using thinking skills and grappling with ideas and concepts; and reflecting on their own learning through the use of metacognition to evaluate their own progress.

Nevertheless in exploring what a transformation is in the context of blended PBL an important factor to consider is how different can it be for each of the participants? All perceptions of transformation can be considered valid, as everyone is different. For some there was a change in mindset, in how they think about and design problem-based and e-learning:

*The whole process of learning in blended PBL requires a change in mindset as a teacher - that is the biggest thing for me. (Darragh, FG2)*

*We were required to work with PBL, collaborative group work and e-learning which are three very difficult approaches to deal with in themselves. Trying to get someone's mindset around them all in a blend, that was the transformation for me. (Ryan, Participant Verification Session, 05/02/07)*

This module has shown that radical change is possible and quickly. Wells (2000: 56) has suggested that learning is "the transformation that continuously takes place in an individual's identity and ways of participating through his/her engagement in particular instances of social activities with others." However, we cannot teach transformation; we cannot even identify how or why it happens. This module was about teaching as though the possibility always existed that the participant would have a transformative experience. There are ingredients in the blend of problem-based and e-learning which have the potential for transformation, but it is not guaranteed. In every strategy we use, we need to provide an ever-changing balance of challenge, support and learner empowerment.

The transformations on the module experienced by participants occasioned a significant shift in perception of a subject or a new world view; for some, such transformation was sudden and for others, it was protracted over a number of weeks. The transformed view may represent how learners think or practise within a particular discipline, or how they perceive, apprehend or experience particular phenomena within

that discipline.

## Limitations

Whilst studies of this kind are useful in helping practitioners vicariously gain insights into their own practice, the findings of this study should be taken as tentative. Knowledge about the ways in which blended PBL groups work should help us in our practice and stimulate both discussion and debate about the purpose of asking learners to participate in this form of learning.

The subjective, partial and open-ended nature of the interpretation of the blended PBL participants' discussions is acknowledged. The findings were interpreted in the light of blended PBL literature and other literature. Three challenges were encountered during the study. First, the impact of the researcher's subjectivities both on the participants' behaviour and on interpretation of the data need to be acknowledged. Many participant statements fitted into several themes, which meant accepting the ambiguity and inextricable complexity of experience. Taking this into consideration, themes identified emerged from the analysis and were refined through subsequent conversations with the participants in two verification sessions in February 2007. Aspects of interaction and transformation can only be generalised in the naturalistic sense; that is, to similar contexts of practice.

Second, the study was small scale; focusing on the interactions of three PBL groups of 17 participants enabled the performance of an in-depth analysis of the data, yet the small number of participants limits applicability of the findings. Although generalisability was not an intention of this study and no groups are the same, for future research, the intention is to replicate the study with other groups to see if the conclusions are sustained. This additional research across other groups could be used to determine how widespread the interpretations are. The study focused on how the participants in the groups interacted with one another in a blended environment and to an extent the learning that was transferred to professional practice. Applying Activity Theory as an analytical tool for representation to support the analysis of the differences/similarities across different learning groups in blended PBL is a promising area for future research, as is a focus on the interplay between the levels of transformative learning reached in blended PBL academic development and its actual impact on students' learning in different disciplines.

A final challenge concerned the notion of addressivity of 'compliant talk' by the participants in the study. Due to the dual role in the relationship between the researcher as tutor and the academic staff who were learners on the module and participants in the study, it is acknowledged that the possibility that the participants may have said what they thought you wanted to them to could be considered a limitation. However by building triangulation into the research process this possibility was lessened.

## Conclusions

While it is not feasible to extrapolate the findings of the investigation beyond the present context, the analysis of the potential of transformation within blended PBL raises a number of issues worthy of comment. Transformation can be reached in blended PBL within a ten week period, particularly at an individual perspective level. This can be evidenced by a change in participants' behaviour in the group setting, individual changes in attitude, belief and value towards pedagogy and technology and transformations in learning approach extending to their own professional practice.

There are implications for curriculum design involving the provision of an authentic context for learning and the structure of the PBL tutorial group which can lead to individual perspective transformations. It is contended that there is a need to focus on interactivity within blended PBL and its critical application. The blended format coalesces web-based and face-to-face instruction into an entirely new model that holds potential to transform both learning and teaching in higher education. Providing streamlined blended learning experiences to explore essential topics and materials and engaging them in discovering educational technology can enable academic developers to support staff in beginning a journey of transformation. This journey involves the academic staff actively connecting their learning on the module with the potential for their own learners and seeking out ways to integrate what they are learning into their practice. By gaining new perspectives, their vision grows and extends to incorporating new facilitation strategies such as PBL and tutoring with technological means. They begin to awaken to the possibilities of technology for fundamentally transforming their objectives for their learners and their subject. Participants in blended PBL academic development ideally leave the course not only with more knowledgeable about the content matter, but with an expanded worldview, greater compassion, heightened self-awareness and with a commitment to produce change. Instead of serving as an impediment to transformative pedagogy, learning technology can be a highly effective conduit for this style of learning and teaching in higher education.

To fully understand the journey of transformation, there are some key points worth remembering; there is no set timetable for this journey as some participants move through some stages more quickly than others; comfort level, interest, technology access and time are important determinants of any individual's timeline. When institutions in higher education recognize the need to learn technology and pedagogy as an opportunity to transform teaching and learning, this can open up new opportunities for all involved.

However, the improvement of educational practice is notoriously difficult, especially when the goal is to foster transformation in thinking and practice. Tyack & Cuban (1995) have argued that pockets of effective teaching exist but they seldom last long or spread beyond a few dedicated pioneers. Clarifying the principles of effective problem-based and e-learning pedagogies and sustaining the means to support its enactment in a wide range of departments and institutions constitutes an abiding challenge of professional development for teachers.

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