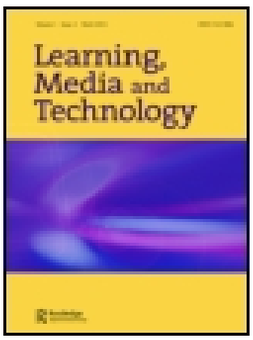

Learning, Media and Technology

ISSN: 1743-9884 (Print) 1743-9892 (Online) Journal homepage: http://www.tandfonline.com/loi/cjem20

Blended problem-based learning for teacher education: lessons learnt

Roisin Donnelly

To cite this article: Roisin Donnelly (2006) Blended problem#based learning for teacher education: lessons learnt, Learning, Media and Technology, 31:2, 93-116, DOI: 10.1080/17439880600756621

To link to this article: http://dx.doi.org/10.1080/17439880600756621

Learning, Media and Technology,
Vol. 31, No. 2, June 2006, pp. 93–116

Blended problem-based learning for teacher education: lessons learnt

Roisin Donnelly*
Dublin Institute of Technology, Republic of Ireland

This paper explores case study research of the group process for teachers as learners in an Online Learning Module delivered in a blended problem-based learning (PBL) environment. Blended learning, as the name suggests, consists of a blend of at least two pedagogical approaches: within the context of this research, blended learning is the integration of the PBL face-to-face learning in a classroom with an e-learning environment. The 10-week module was part of an accredited Postgraduate Diploma in Third Level Learning and Teaching for academic staff (lecturers, librarians, learning technology support staff) from a range of higher education institutions in the Republic of Ireland. This Postgraduate Diploma attracts academic staff keen to experience and implement a variety of pedagogical approaches within their own teaching. Over the four years of the module's existence, there have been a wide variety of subject disciplines in higher education represented. This paper shares experiences and lessons learnt from the case study, and provides a set of recommendations for other teachers pursuing this form of blended PBL with students.

Introduction

The concept of blending face-to-face and online problem-based learning (PBL) is introduced in this paper through an outline of recent case study research on a Postgraduate Diploma Module entitled 'Online Learning' for academic staff in Higher Education in the Republic of Ireland. This module is part of an accredited professional development programme for these academic staff. A specific approach was taken to the design and delivery of this module by using PBL as the dominant pedagogical model.

The aim of the module 'Online Learning' is to enable the participants (lecturers, librarians and educational technologists), through a blended learning approach to PBL, to become aware of the practicalities of designing, delivering, supporting and evaluating an online module in their own subject disciplines. Higgins and O'Keeffe (2004) speak of 'effective e-learning' and 'good content' and express a belief that

*Learning and Teaching Centre, Dublin Institute of Technology, 14 Upper Mount Street, Dublin 2, Ireland. Email: roisin.donnelly@dit.ie

ISSN 1743-9884 (print)/ISSN 1743-9892 (online)/06/020093–24

DOI: 10.1080/17439880600756621

'most, if not all learners learn best through blended learning'. Blended learning, as the name suggests, consists of a blend of at least two pedagogical approaches: within the context of this research, blended learning is the integration of the PBL face-to-face learning in a classroom with e-learning. For example, the classroom is used by the PBL group to discuss critical concepts, and the discussion boards and synchronous chat room in the online environment WebCT, is used to encourage participant dialogue around the concept.

Relevant literature was reviewed to inform the study and is presented in two distinct sections. The first is included as part of the research context and discusses the role of e-learning in professional development and how it has impacted within this field of higher education. The second section explores common features of PBL and e-learning, and surveys relevant studies in relation to combining and blending e-learning and PBL as a method of delivery. It will also discuss relevant theories and pedagogies, the understanding of which is necessary before e-learning is designed or delivered.

An integrated evaluation strategy was used in this study, combining analysis of online questionnaires and analysis of transcripts of online discussions with module participants and tutors over the 10-week duration of the module. Findings reveal that a number of valuable lessons have been learnt in terms of both tutors and module participants in this evolving area: combining face-to-face PBL and Online Learning, and these are detailed alongside possible routes for further research in the area. Participants were very positive about most features of the module, especially the PBL approach, the nature of the online activities and the organization of the website, however, they requested longer time on the implementation of their own online course and more time online to complete the activities. This module goes some way to encouraging participant discourse and interaction, yet the scope and organization of the discussion boards does not develop a true sense of community online, in balance with what has been achieved in the face-to-face PBL tutorials.

Research question

The question that this study aimed to address is: how can blending problem-based learning with e-learning enhance the knowledge and skills of academic staff in a professional development module?

Research context

In recent years, there has been increasing investment in institutions of higher learning in learning technologies with the view to improving the availability and equality of learning. By the year 2000, serious consideration was being given in Ireland, as elsewhere, to the implications of another form of educational delivery namely e-learning. The Higher Education Authority (HEA) stated that Ireland should play a pro-active role in what it called 'Internet-based learning'. It acknowledged the country's leading role in the information technology (IT) industry and went on to point

out that it would be consistent for Ireland to explore the potential for e-learning (Thornhill, 2000).

E-learning also offers the opportunity for lifelong learning; an important consideration for the academic staff enrolling on this module. In an Australian study for lifelong learning through higher education, Candy (2000) identified four categories that graduates participated in to continue their educational development. These were: workplace-based learning; continuing professional education; further formal study; and self-directed learning. The study found that 'this category of learning has been significantly strengthened by the spread of the Internet; an aspect of lifelong learning that deserves a study in its own right' (Candy, 2000, p. 110).

Many teachers and lecturers will admit that they are running an online module when the truth is they are simply uploading lecture notes. If the same notes were distributed in a traditional lecture they would be backed up by verbal explanations, so it is not surprising that students often reject this 'so-called' e-learning approach when all they get is screen text with little or no clarification from the tutor. This argument is reinforced by McPherson and Nunes who state that 'it has not been unusual for lecturers within FE and HE to have no formal training in teaching and learning' (2004, p. 4), yet, students in higher education are expected to develop high-level cognitive skills such as reflective analysis, meta-cognition and problem solving.

As educators, we have a duty to provide our students with the best opportunities possible to help them attain their goals. Information and communication technologies are here to stay and are expected to enhance learning. This can only be achieved if those responsible for the development of online materials understand how vital it is to ensure that the material is constructively aligned within a framework that includes learning outcomes, teaching methods, assessment and evaluation (Biggs, 1999).

Laurillard (1993) believes that university lecturers must take responsibility for what and how their students learn. She stresses the need for course designers to understand teaching methodologies that will ultimately lead to the establishment of a learning theory that is suitable for the student. Laurillard was one of the first to ask serious questions about how information and communications technologies (ICTs) should be integrated into the learning process and furthermore, how the organisational structures of third-level institutions need to recognise and adapt to this change. Jung (2001) also advocated caution regarding the use of ICT for educational purposes. She argues that not enough research has been carried out in the field of e-learning and that educators are being carried along on a wave of technological advancement without questioning the pedagogical processes in a sufficiently rigorous manner.

Literature review

This review sets out to map the landscape of blended problem-based learning (B-PBL) and reviews what has been done previously in the area. Before delving into B-PBL, it is interesting to note some of the main characteristics of PBL in itself. It would be considered by many educators as an innovative approach to teaching and learning. It is generally accepted that in PBL, 'complex, real world problems are

used to motivate students to identify and research' learning issues and to collectively communicate and integrate information (Duch *et al.*, 2001, p. 6).

Content for PBL curricula usually is stated in very broad terms. Precise listing of topics may have the effect of stunting the students in their efforts to search out a wide variety of resources and to discover solutions to problems for themselves. Rather than description of major content, there is extensive listing of content, associated learning outcomes and additional learning outcomes applicable to the problem-based learning process; for example, 'oral and written communication skills or the ability to find and use new resources often become explicit goals that may have been subordinated to content goals without a PBL format' (White, 2001).

Similarly, in e-learning, some common ways of using it in higher education have emerged. Murphy *et al.* (2001) refers to five of these as:

- use of the Web to replace and/or supplement libraries;
- use of electronic media for collation and/or delivery of learning material;
- use of shared electronic 'learning spaces', discussion areas etc.;
- use of simulations, virtual worlds etc.;
- use of electronic assessment and feedback.

Much debate has taken place in the literature on the effectiveness of classroom learning versus online learning. This paper considers a particular approach of blended learning, which in this instance is aimed at taking the best of both and creating an improved learning experience for the participant. In this research context, blended learning is the term used to describe learning events or activities where e-learning, in its various forms, is combined with more traditional forms of teaching, such as 'classroom-based'. Recognising that there are a variety of forms of blended learning to choose from, that adopted by this module involves primary delivery by the online learning environment, WebCT, as a form of e-learning, augmented and supported on a weekly basis by a tutor in a face-to-face PBL tutorial.

Mason (1998) categorises this as a 50/50 model because the online interactions and discussions occupy about half of the students' time, while the predetermined content occupies the other half. This model tends to favour a resource-based approach to learning, giving more freedom and responsibility to the participants to interpret the module for themselves. The tutor's role is also extensive because less of the module is predetermined and more is created each time the module is delivered, through the online and face-to-face discussions and activities.

Loveless *et al.* (2001, p. 79) believe that ICT learning programmes can be effectively used: 'Traditional pedagogy focuses on remembering as much as possible; the new pedagogy helps students focus more on knowing what to know and where to find and how to store knowledge'; this captures the essence of how e-learning was used to complement a face-to-face (f2f) PBL approach in this module design.

In recent years, there have been a growing collection of studies reporting on combining PBL and online delivery. For example, Luck and Norton (2004) explore and compare mature students' perspectives and experiences of face-to-face and online collaborative learning using a PBL approach in an undergraduate Management

Education module for Early Years Education and Care Managers. While no differences were found in grades achieved or in self-reported attainment of course outcomes in this study, collaborative learning was perceived more favourably by online learners than face-to-face learners and these online learners demonstrated a more rapid development of academic literacy skills.

Theoretical base: blending online learning and PBL

As established, a blended learning approach was used as the basis of the module design and this stemmed from the idea that learning is basically a social process that would be compromised if the entire module were to take place in cyberspace away from human interaction (Crook, 2002). Sharan and Shachar (1988) support this concept when they identified that personal involvement (by personal involvement, I mean, the tutor's active encouragement of a more equal relationship) not only motivates students to collaborate but also produces significant achievement. There is a synergy that happens in a face-to-face contact that the computer cannot replicate. The discussion boards, the chat rooms and email were an adjunct to the PBL group experience by complementing the spontaneity and momentum achieved face-to-face in the classroom.

Problem-based learning and e-learning are pedagogical approaches that each support a constructivist theory of learning. The constructivist theory of learning suggests that prior knowledge is used as a basis on which to construct new knowledge. Where participants enter this module with great differences in their prior learning and experiences of e-learning or PBL, a pedagogical approach is required that embraces this theory of learning where participants consolidate their prior learning and find support to construct new learning and integrate new learning with prior knowledge. As well as having different prior learning, participants may also vary in the way they learn.

Vygotsky and Dewey, working within the constructivist tradition, believed that learners do not learn in isolation from others, and cognitive psychology has gradually established that people naturally learn and work collaboratively in their lives (Petraglia, 1998). Essentially social interaction plays a fundamental role in the development of cognition. Therefore interaction is a critical component in such a constructivist online learning environment, as provided by this module, because learning occurs in a social context through collaboration, negotiation, debate and peer review.

In more detail, in this module, the focus is on the learner's construction of knowledge and understanding through appropriate activities. A constructivist approach, where it is argued that knowledge is actively constructed by the cognising subject and not passively received from the external environment, led to an approach that included reflection and tasks-based activities involving learning by doing. This ensured that participants were involved in activities that were relevant and meaningful.

In relation to the module website, the designer's philosophy was simple. The site should be easy to access and navigate with clear instructions. This common denominator reflects the designer/tutor's experiences and frustrations with other e-learning

websites. As a previous student of online learning herself, part of that process was a requirement to explore and critique currently available online learning resources. This method of review highlighted the pros and cons of cyberspace learning. Consequently, this online module component attempts to incorporate the attractive aspects of online learning. A high retention rate on many e-learning courses prompted the desire for this e-learning experience to be thought-provoking and stimulating. Cognisant of Vygotsky's theory of learning having a social base, the interactive activities (outlined in the following section) were aimed at maintaining interest and achieving the module learning outcomes. They 'acted in a co-ordinated way … in pursuit of shared goals' (Argyle, 1991). It is this final experience that reassures the designer that a blended approach to this module was a worthy choice.

Blending interactive activities: online and face-to-face

The module structure is outlined in Table 1.

Social negotiation and collaboration was vital: discussion boards were set up in week 1 to which the participants were encouraged to contribute. These contributions included, amongst others, reflection on current practice, sharing a good idea, peer review of other comments, or providing a link to an external resource.

Key to the module design was creating a situation where these participants were empowered to understand the knowledge construction process by experiencing online education as learners themselves; with the aim of providing these teachers with a much greater understanding of what will be required by their own students. Design of the online activities were based on Laurillard's (1993) Conversational Model, as it was regarded as a useful way of looking at how learning technology could be employed to promote more effective and varied teaching. There were two related components to the B-PBL module: out of its 10-week duration, the first five weeks involved problem-based learning tutorials in a face-to-face setting; this was complemented with online activities (Figure 1).

Table 1. Module structure

Activity	Duration
Pre-induction activity online: ● introductions to fellow cohort participants ● personalising profiles on home pages ● ensuring base line competence: completing an online tutorial	1 week
Induction session face-to-face: to ensure ease with using the online learning environment and familiarity with the PBL approach	3 hours
Induction online: activities to continue group bonding	1 week
Problem Part One—exploration of learning theory and pedagogy of e-learning design	4 weeks
Participant presentation via video conference	1 hour
Problem Part Two—implementation of design framework and preparation of exemplar online learning materials	5 weeks

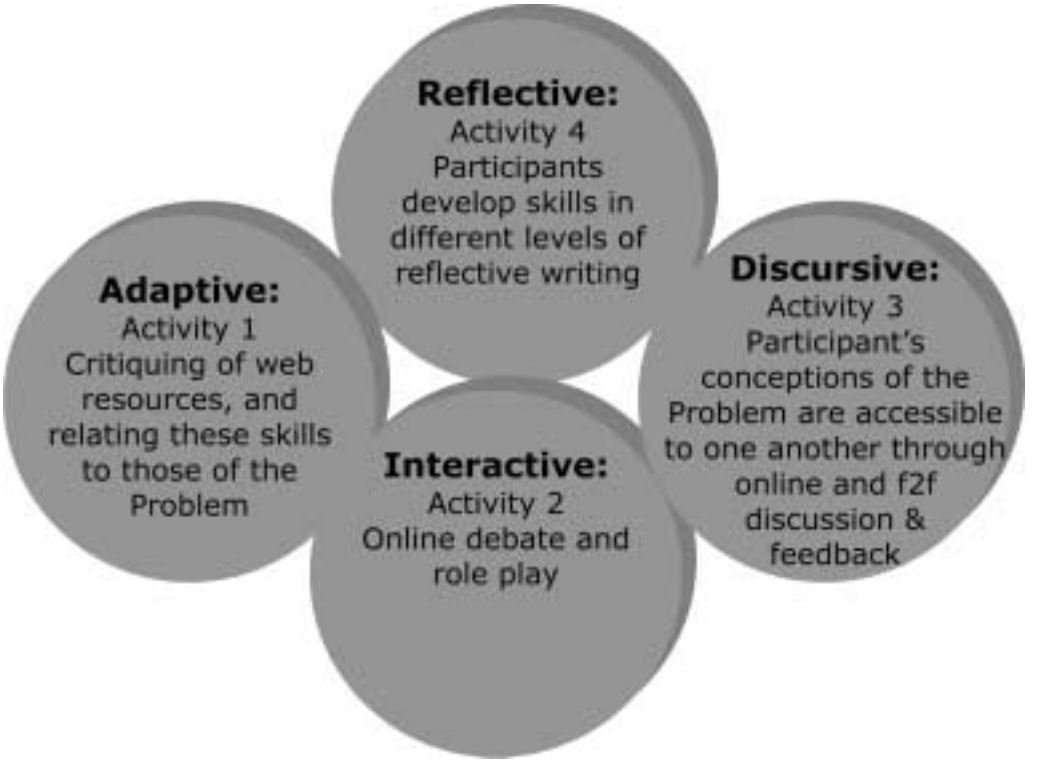

Figure 1. Blending online activities with F2F problem-based learning

Discursive activity

Conceptual learning occurred through active participant involvement in the online activities: by learning online in this way, by its very nature, meant that he/she was actively involved with the learning environment from the moment of contact with WebCT. True, initially, this was not at a very 'deep' level (depending on the internalised learning events which were part of the participant's interaction). They went on to create their own personal meaning by interaction (physically as well as intellectually) with the learning environment and were less inclined to sit back and let it all happen around them as they might in a lecture environment.

Reflective activity

Reflection has been very fashionable in all sectors of teacher education for a number of years. Implicit or explicit in all the writings that focus upon reflective teaching is that increased reflection will translate into action and result in improvements in teaching and learning (Cornford, 2002). Critical reflection persists as a widely advocated technique to bridge the theories–practices divide for teacher development (Martinez & Mackay, 2002). However, when teachers engage in critical reflection,

the focus is often limited to intuitive responses or technicalities. Seldom is the focus on theoretical concepts of teaching and learning, and seldom are learners and learning outcomes at the centre of teachers' considerations. Effective critical reflection is even more difficult for new lecturers, such as on this module, as they are often overwhelmed by the wide range of knowledge and skills demanded by the exigencies of teaching. In fact, ever since Dewey (1933), at least, educators and psychologists have grappled with the problems of how persons learn from experience, and how to identify experiences that are educative. The difficulty, of course, is the sophisticated and subtle problem of how persons extract complex meaning from experience.

The participants were encouraged to keep an online reflective journal of their experiences, which formed part of a later summative assessment. However, at the five-week point, formative feedback was given to the participants on selected reflective journal entries to date. The reflective activity gave them experience of reflective writing and critiquing each other's reflective accounts, all of which contributed towards deeper levels of reflection in their online journals.

There is no doubt that reflective practice in higher education has gained considerable attention, as a learning strategy, in recent times (Herrington & Oliver, 2002). Reflective practice in the case of this online learning module included four related processes: description, analysis, explanation, and reflection. Teacher description of the teaching/learning process could include multimedia and written description of the participants' experience in the PBL group on the module. Analysis involved a kind of problem solving where the individual examined what was effective and ineffective with their learning. Explanation required the individual to communicate regarding the effectiveness of the teaching/learning process. Reflection required the teacher to identify personal meaning or significance. As such, this final element of reflective practice often included disclosure of feelings and subsequent reflective judgments. When such adults are engaged in significant new roles like online teaching for the first time, it is valuable for each of the four processes (description, analysis, explanation, and reflection) to be encouraged and guided through activity.

According to Seale and Cann (2000), graduates of higher education should experience an educational process that cultivates critical reflection skills. They believe that transforming students into critical reflective thinkers will empower the student to cope with an ever-changing society. So, in their online reflective journals, the module participants were required to reflect upon what they had learnt in the module, to integrate their ideas into other knowledge structures, and to consider how their new knowledge could be generalised and applied to other situations in their own subject disciplines.

Adaptive activity

However, such reflection needed to be predicated upon both something to think about and the ability to engage in critical thinking. For the reflection element in this module, the participants were encouraged to work with the content and coherent

body of knowledge that they uncovered for themselves as part of the face-to-face PBL tutorial process, and that which was made available to them in the Online Resources component of WebCT. This was compounded through working with this body of knowledge, and the provision of opportunities to develop their logical processing skills through the critiquing of a wide variety of web resources from each of their subject disciplines. An example of this involved critical evaluation of course websites and participant's being asked tgo contribute their own experiences of use. This was a way to engage them more directly in the learning process as contributors as well as consumers of such pre-selected learning materials.

Interactive activity

There were a number of reasons for the debate activity. Firstly, it was to provide participants with an experience of working as a group in a virtual environment so that they developed an understanding of some of the challenges their students would encounter in the future. Secondly, it was to provide participants with a possible model for a structured online debate in their own subjects and an awareness of the potential for and limitations of using the discussion forum for this activity.

An online role play required the participants to adopt different stances on a topic within the discussion forum. Role play was introduced as an activity online to enable the participants to experience a powerful technique for skills and attitude development.

Methodology

This study was qualitative in nature because it dealt with the learning of academic staff both in a classroom setting and also as participants in an online learning module. In this study, it was important to consider the issues of participant's familiarity with this paradigm, their comfort in taking control of their own learning and any long-term goals about helping them become more independent and autonomous.

Gillham (2000, p. 11) outlines the benefits of the qualitative approach as follows:

- It enables the researcher to view the case from the perspectives of those involved.
- It allows investigation of situations where little is known at present and where further research may come later.
- It enables an investigation to be carried out where other methods—such as experiments—are either not practical or are unethical.

There were two stages to the evaluation of the learning experience of participants on this module. Firstly, a qualitative questionnaire was presented to the participants for completion in the final week of the module; this was divided into three main components: the module structure, the role of the tutor, and the module PBL problems and content, consisting of a series of open questions in each. This questionnaire also addressed the participants' perceptions about the online delivery method as well as the educational implications of their patterns of usage of the online PBL resources.

Secondly, a semi-structured focus group was held halfway through the 10-week module to ascertain their learning experience to date; a second focus group took place with these same participants one week after the module ended. A number of issues were identified and lessons learnt for future module re-design and delivery.

Framework for analysis

This study incorporated an integrative evaluation strategy recommended by Draper *et al.* (1996) and the Teaching with Independent Learning Technology Programme in 2001. This approach involves an integration of a number of data collection methods and forms of data analyses. This method provided a comprehensive coverage of features, pedagogical orientation and potential weaknesses in module design. Research consisted of:

- Analysing the participant's online questionnaires: this contained a mixture of open and pre-coded questions relating to user perceptions of the module, the Conversational Model for online activities and the extent to which the module matched their hopes and expectations for their continuing professionaldevelopment.
- The two semi-structured focus groups were conducted with module participants in a face-to-face setting.
- Message analysis was incorporated to yield information on module participants, their learning styles and strategies they put into practice when tackling the PBL problem. Henri's (1992) analytical model, which is designed specifically for the purpose of message analysis, was used to evaluate the nature of participant interaction over the 10 weeks of the module. This model encourages the researcher to examine the nature of messages, in particular the extent to which they are participative, social, interactive, cognitive, and metacognitive. Analysis of individual message content is conducted at three levels: *what was said*, regarding discussion content; *how it was said*; and *what processes and strategies* were adopted dealing with the contents.

A content analysis of questionnaire and interview data was used to identify themes, concepts and meanings in the data using code categories recommended by Burns (2000). A selection of participant quotes from each is provided to illustrate key points throughout the remainder of the paper.

Findings: lessons learnt

There are a number of key findings emerging from this study. They are named as follows and are detailed separately.

- The blended process in PBL.
- The role of the tutor.
- Different forms of interaction and communication.
- The individual learner in a blended PBL group.

The blended process: online and face-to-face PBL

The basic principle supporting the concept of PBL is older than formal education itself, namely that learning is initiated by a posed problem, query, or puzzle that the learner wants to solve (Boud & Feletti, 1991). In this blended problem-based approach, a complex, real problem was given to motivate the participants to identify and research concepts and principles online and f2f that they need to know in order to progress through the problem.

In this case, there was one PBL problem, issued in two parts, and presented to the participants to work on over the 10 weeks of the module; Part One pushed them to explore the pedagogy of online learning, and come up with a design of an online learning course in a subject discipline of their choice; Part Two provided them with the opportunity to implement their design framework in WebCT. The groups working in this PBL process had ample opportunity over the 10 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 revealed the participants' subjective views of the common task. Inclusion of an element of controversy within the problem promoted learning by provoking intensive attempts to clarify and finally reconcile one's own and other learners' ideas.

It can be argued that both cognitive and socio-cultural theories can 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 socio-cultural 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.

Participant 5: Using the computer for E.Learning is a much more social activity than I would have realised. We are in contact with each other daily through the discussion groups.

Participant 6: The process of online collaboration has been a very stimulating and motivating learning experience, albeit a time consuming one. Although my contributions to this learning environment are not as regular as my peers I have found online collaboration an asset to my learning. It is totally student friendly as it allows me to contribute and respond to a discussion that would otherwise be lost if my presence was required in person. This, I believe to be one of the greatest benefits of online learning. The interaction is captured in text and is there to be reviewed at anytime. The main tools

> of interaction utilized by my group have occurred through the discussion boards. Having flexible access to the discussion board has enabled me to participate at a time suitable to me. The discussion board method of online collaboration also supports reflection as an immediate response is not required as it is in face to face tutorials.

This module was based on the belief that interaction between participants in the PBL group was the key element to a successful online and face-to-face learning experience for all involved. The belief was based on a sociological understanding of five dimensions of interaction for describing groups (Parsons, 1951):

1. Affective–Nonaffective focuses on emotions in interactions; in some instances of group learning, expressions of feeling were welcomed and supported, but in others, participants were encouraged to keep feelings to themselves.

> *Participant 3*: From the start I was comfortable with my place in the group, and that the group worked well.
> *Participant 4*: A feature of the group process was one of the group having a lot of ideas, but being slow to drop them.

2. Self-collective describes whether the interaction is aimed at satisfying personal motives or at achieving group goals: are the group members self-oriented, focusing on their individualised learning or are they satisfied to enter into the co-operative tasks and focus on the collective well-being of the group by reaching agreements together? There was a mixed response:

> *Participant 2*: My initial impression of the module was a positive one and the Module Handbook and the Tutors presentation mapped out clear and useful learning outcomes.
> *Participant 7*: The use of ongoing online activities was interesting and the learning opportunities are very wide and varied. With time, however the tasks were no longer required as the actual problem itself began to use most of the time I had allocated to this module.
> *Participant 3*: Typical of these group sessions, ideas were put forward by members of the group that seemed to just disappear without any real acknowledgement by anyone in the group. So almost naturally they would be just parked, and we would move on.
> *Participant 1*: I feel X is a great resource for our group and I feel that I have learnt a great deal just from listening to her ideas.

3. Achievement–Ascription refers to whether persons gain status by performance or by some inherent characteristics. For example, some participants felt much inferior to their peers initially with regards to their experience in using or developing online learning. This was eroded through dialogue about prior experience.

> *Participant 2*: The group reflection was both helpful and personally dispiriting. It is really helpful to hear how other members of the group perceive the situation but that in turn is dispiriting when I don't appear to have achieved the same satisfactions or gains that they have. It assists a 'benchmarking' but is it more what we feel we should say as opposed to what we really feel? It is invigorating to hear the others challenge the concepts and articulate concerns, which indeed have been arrived at on reflection.

Participant 1: I kept selling myself short during the session and I am afraid that others will see me in this way. So my plan for the week ahead is to become familiar with web CT so that my level of confusion will be somewhat resolved before next week. This I hope will put me in a stronger position to keep abreast of the work and keep pace with the group.

Participant 1: Firstly I felt people were frustrated with me because of the questions I kept asking in order to clarify aspects of online design and work for next week. I felt frustrated with people interrupting and finishing other people's thoughts for them instead of letting the person complete the thought for themselves.

Participant 1: As a result of reviewing the ground rules I felt the session went smoothly and I didn't experience the frustration I had experienced the previous week.

Participant 2: A debate was opened up by a trainer in my department about the need to address e-learning and before long here was I making pronouncements about the wisdom of this approach, the potential of WebCT, and engaging with much more experienced people than myself about e-learning as a pedagogy! Already this module is paying off, I would not have had the same confidence yesterday and it adds to my credibility in the others' eyes.

Participant 1: In relation to where I am now, well I don't feel on the periphery anymore. I did feel this when I wasn't able to keep pace with the workload at the beginning. Every time I checked there were zillions of new messages posted and everybody seemed to have their work done for the PBL group on time. I however was racing at the last minute and I think people were getting frustrated with me. Having been able to spend time on the work in hand I now feel reasonably more informed about online learning. However I do feel that every time I feel I have caught up on my colleagues level of comprehension they seem to have shot ahead to another level.

4. Universalism–Particularism describes how consistently persons in similar roles are defined by one another in the interaction. This involves the role of the tutor, whether to treat all participants alike, supporting an expectation for uniform performances and behaviours, or to emphasise individual differences, supporting an expectation for diversity.

Participant 2: Have I been very foolish to think I should take on something outside my comfort zone? There's a nice quote in one of our handouts: 'If you're not failing every now and again, it's a sign you're not doing anything very innovative'.

Participant 3: Chaos and freefall doesn't suit me, I quickly wanted order in the form of full participation, a decision and task completion.

5. Specificity–Diffuseness refers to the degree to which attention to the curriculum is focused narrowly or broadly. In this instance, this refers to the PBL problems and whether the resulting discussions are narrowly focused on the traditional content of the curriculum or whether a broader array of topics, including personal concerns, was seized upon as a valid experience for learning.

Participant 4: All of the members of the group would be task orientated, and able to listen and focus. Whilst there is compromise in consensus, I would be of the opinion that we maintained a certain quality to the work.

The remaining five weeks on the module continued to use a PBL approach to explore online teaching and the development of online learning materials, but the emphasis shifted from the role of pedagogy to practising using the technology.

> *Participant 5*: There is no substitute for experiential learning: being made to engage with the module actively exposes one to the realities of the theory and I certainly am learning by doing.

Questionnaire responses indicated that PBL required complex social interaction, and attempting to do this fully online at times was difficult. By the end of the module, the participants appreciated the blended nature of the module delivery:

> *Participant 1*: On a positive note, the face to face sessions have been very stimulating, providing me with infinite learning opportunities as I listen to and, debate with my colleagues. The face to face tutorials can be described as a live chat room without the need for keyboard skills. Discourse is exchanged in a more familiar fashion and clarity is provided immediately instead of waiting for a response via the discussion boards.

but this was not the case early on:

> *Participant 2:* The temptation to shout across the screens and get a F2F interaction was overwhelming—does this medium suit my learning style?

The Self-Collective dimension of this study occurred as part of the PBL process when the participants were aware that they would be learning from each other. However, this benefit was not maximised due to issues within the group where some members were not so inclined to share their experience or were receptive to aiding and mentoring the weaker members. This was contrary to how it was supposed to work.

Achievement–Ascription was experienced by some of the module participants, but not all: some felt they had gained status within the group by their performance during the module. Others felt distinctly that they had not performed to the best of their ability and as a result, had their status diminished in the eyes of their other better-performing peers.

> *Participant 3:* I felt at times that some group members thought I had a tendency to raise matters that were in fact not relevant, and we were bringing undue pressure on ourselves.

> *Participant 5*: Without a doubt I was highly dependent on the research made available by the others on the module but I still did engage with it and built on to my limited existing knowledge in a true constructivist way. Equally I could read all the printed material about the pros and cons of chat rooms but would never have truly understood it without actually experiencing a chat room situation with my peers.

Some of the module participants would have liked to have seen more emphasis on implementing their website, as opposed to pedagogy and design, as they felt that this should be one of the main outcomes of the course. This needs to be further negotiated with the group at the beginning, as it is an equal outcome of the course; the design is just as important as the implementation of an online learning course.

Specificity–Diffuseness did occur in this module. The problem was not narrow in focus. The resulting problem-solving enabled generalisability across diverse problems encountered in the participant's own professional teaching lives. Using a real-life problem presented an ever-changing variety of goals, contexts, contents, obstacles and unknowns which influence how the problem should be approached. The participants had to 'think through' the real-life problem, based on situated cognition. By this is meant, knowing, and not just learning, is inextricably situated in the physical and social context of its acquisition and use. It cannot be extracted from these without being irretrievably transformed.

They proceeded to analyse the problem online in their PBL group in the online discussion boards so that a range of theoretical and practical issues were teased out which could further be discussed online with peers, fixed resources/experts in the area and the module tutor. This happened in a discursive and dynamic way and encouraged each participant to construct their own meaning from the problem and its implications. Through collaboration and socialisation, the participants needed to listen, articulate, clarify and negotiate in their quest to create meaning.

> *Participant 6*: Another personal revelation is my inability to be creative and 'make sense' of an online element in abstract. I was physically 'floundering' until X physically posted up her rationale for the module and Y posted the instructional design template. When I physically had these in front of me in a hard copy format I at last felt a true sense of direction and could comfortably engage with the problem and the questions posed from thereon. I suspect in group-role terms I would have to be classified as a follower as opposed to a leader in relation to creativity but as X so supportively pointed out online that is only in relation to one aspect of the work and I may be a leader in some other aspect.

The role of the tutor

Hughes and Daykin (2002) have suggested that a move to online delivery needs a greater attention to design and development of facilitator skills than has been previously recognised. So why do these skills matter in online delivery? Just as the teacher manages discussions and learning activities in the traditional classroom, so it is online. However, online teaching has some special challenges: students often have not met one another or the teacher, the nature of communication is limiting and void of visual cues, and there are challenges keeping tabs on individual students' learning when they are studying remotely. The role of the online teacher or facilitator is therefore both special and crucial for effective learning outcomes and enjoyable learning experiences. Striking a balance in this blended learning environment between being in PBL tutor mode on some occasions and in online tutor mode on others, proved to be the most challenging experience of the module for the tutor. There were other issues from the tutor's perspective also, particularly a need to have a more explicit idea of the PBL group process online. The tutor's role was defined early in the module and made explicit to the participants: of encouraging participation from the students, showing interest in their progression,

responding positively to their enquiries, providing helpful feedback on module work, and making the students feel that their contribution to module activities was valued.

> *Participant 7*: The commitment and flexibility of the tutor in this online learning model is enormous and you can only really realise this through experiencing it. Technology can be unreliable and there is no fallback other than to have the tutor there and try to pick up the pieces.
>
> *Participant 5*: The tutor started the session with a reflection on events since the last f2f meeting, and it sets the tone for this constant reflexivity in what we do. It has a type of bonding effect and gave a sense of purpose and direction for me. Again, I cannot imagine this in a total online scenario—a blended environment is definitely more suited to my learning style.
>
> *Participant 4*: Up to this we have been engaged in what Shuell (1992) describes as 'guided construction' where we have played a very active part in our own learning and constructed knowledge about E.Learning through discovery. Guided construction also recognises the very important role played by external guidance, in our case, the tutor and other online resources.

The premise for this study was that a tutor who values a cohesive, supportive and productive PBL class will accentuate exchanges of positive affect; they will encourage collective and achievement orientations toward learning; they will show appreciation for the uniqueness of each particular participant; they will facilitate open and diffuse discussions about the problem.

Many online courses supply the framework for communication, but this may often not be used without a concerted effort in activity design and by the tutor to develop a sense of community and a social environment. Collison *et al.* (2000, p. 30) suggest the moderator needs to 'build a climate that will foster professional learning or collaboration by crafting communications that support a sense of safety in the discussion areas'. This social environment needs to be facilitated from the beginning of the module. Many authors speaking of e-learning refer in a derisory manner to courses where notes are simply transferred to an Internet site. Steeples *et al.* (2002, p. 323) refer to 'quick fix' courses offered under the e-learning banner where material that would be provided as part of face-to-face traditional courses are provided on-line. 'These courses frequently operate at the level of information transmission with no opportunities for learners to engage with tutors or peers'. Noble (1998) refers to institutions caught up in this kind of growth of online courses as operating as 'digital diploma mills'. Preece (2000) believes this is an uninspired method of teaching. Pedagogically sound online courses consistently stress the importance of the learning community and skilled tutor interaction.

> *Participant 2*: Another learning outcome from this situation is that I would never advise anyone to undertake the role of online module development in a singular personal capacity; seeing our group in progress makes me realise how interdisciplinary the whole process is and synergies would be lost if left to one individual.
>
> *Participant 3*: Our group work skills are hugely tested in an online environment and yet we have overcome a lot of the inherent barriers (lack of confidence in the

> use of IT; lack of access and reliability of the technology), and moved forward towards a solution.

Networked computers can provide vehicles for learning materials and interaction but participants still need the 'champions' who make the learning come alive—the e-moderators (Salmon, 2000). Coppola *et al.* (2001) identify a number of roles played by tutors in e-learning, but focus on three particularly crucial ones: the cognitive, managerial and affective roles. Using this as a focus, future research is being planned on the role of the tutor in a blended, problem-based learning environment.

Forms of interaction

Learning occurred in this module through collaboration with others. The key to collaboration was found to be giving the participants the opportunity to experience online learning as a participant, firstly as an individual, then in pairs (with one participant in a mentoring role to establish partners to support peers' levels of confidence), and finally moving them towards a series of online group and reflective activities. Therefore, the engagement begins with content-centred academic interaction between individual participants and online resources, and moves towards collaborative interaction among the participants, complemented by social interaction between the participants and the tutor; the latter took the form of interpersonal encouragement and assistance (Jung *et al.*, 2002).

Why ask the participants to collaborate? Collaboration as a member of a group working toward three common goals: learning collaboratively, problem solving collaboratively and achieving individual curricular outcomes collaboratively. Towards the end of the problem, the group of eight participants divided into two groups of four, so that each sub-group could work on the areas of the module curriculum that was of particular interest to them: some on academic writing in formulating the group report, and the others on website development. Overall, members of the group are supporting one another's efforts in achieving individual outcomes.

Duffy *et al.* (1998) believe that two distinct types of interaction occur in the collaborative problem-solving process: conversation and issue-based discussion. Conversation is the general discussion that takes place between members of a group where assessment of the group knowledge base and perspectives relevant to the problems are expressed. It is 'me' focused, involving a lot of 'Here is what I think'. Conversations seek common ground in terms of meanings of statements and beliefs in the broad domain of the problem and conversation is exploratory rather than systematic. Arising out of these conversations, issues are discussed and analysed in detail and become the basis of more focused-based discussion. Unlike the exploratory nature of conversations, issue-based discussion is product focused. It is in the issue-based discussion that we attend to both the argumentation elements and quality of critical thinking. The differentiation Duffy *et al.* (1998) make between conversation and discussion illustrates the way the participants in this collaborative problem-solving process have

moved back and forth between the two as they proceeded through the various stages of the problem. Collaborative problem-based learning involves heuristic tasks, conceptual understanding and/or cognitive strategies (Nelson, 1999). The PBL problem for this module involved the steps of analysing the need for online learning in the context of any of the PBL group's subject disciplines, finding and investigating useful information for producing a design of an online learning module in this subject discipline, finding and understanding appropriate theories, and synthesising a plan of action for the development of such a module. Having a small group of eight participants encouraged an inquisitive and detailed look at all the learning issues, concepts, facts and principles inherent in the problem.

From a constructivist viewpoint, studies on web-based learning environments have shown that there are three critical components to interaction. First, an academic (learner-to-content) component occurs when learners access online materials and receive task-oriented feedback from the facilitator or from a technology-driven feedback system. Second, collaborative (learner-to-learner) component occurs when learners are engaged in discourse, authentic problem-solving, and product-building using web-mediated communication and collaboration tools. This integration component helps learners validate their learning experiences, and requires a level of reflective articulation that promotes collective knowledge-building and a deeper personal understanding of what is being studied. Thirdly, an interpersonal/social component occurs when learners receive feedback from the facilitator or peers and colleagues in the form of personal encouragement and motivational assistance. Social interaction can contribute to learner satisfaction and frequency of interaction in an online learning environment. Without the opportunity actively to interact and exchange ideas with each other and the facilitator, learners' social as well as cognitive involvement in the learning environment is diminished (Grabinger & Dunlap, 2000).

The work of de Boer and 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 used 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.

In terms of supporting the participant online, it was clear that they gained much from sharing their thoughts with fellow learners and often made significant advances in their own thinking through trying to communicate their ideas online (with the semi-permanence which is not present in face-to-face exchanges). Group communication was encouraged and enhanced because the participants were aware that the WebCT archives clearly showed who participated and how much. Why is this so? From the evaluation of the module, participants pointed to a certain form of peer pressure, in that they did not want to let their peers down in the PBL group work. They felt that this form of accountability was important for participation online. In addition, they appreciated the fact that these same archives can be

visited by them when constructing their reflective journals, to assist their memory of activities.

The use of the communication features of WebCT on this module have paved the way for personal interactions between the tutor and the participants and amongst themselves in their PBL group. One of the most salient features of online learning is that it allows learning to be place and time independent (Vrasidas & McIsaac, 2000). Adult learners can arrange their learning around their professional lives without being constrained by time and place.

Participants interacted with each other through posting email and discussion board questions. When the PBL group met electronically through WebCT, their online participation was negotiated with their peers in their PBL group. In addition to this, the online module component was used as a forum for the participants to practise skills such as contributing to a threaded discussion. Therefore, in this module, online learning was used for its benefits to the development of a group's process … just like face-to-face PBL. Real-time online events also featured in this module. The synchronous chatroom feature of WebCT was used for problem-solving areas of the curriculum, so that the tutor could help students on a one-to-one basis, or one-to-small group basis.

The individual learner in a blended PBL group

As stated earlier, the academic staff on this module were lecturers, librarians, learning support staff—all adult learners; it was found working with them that part of being an effective tutor involved understanding how these adults learn best: knowing that they were autonomous and self-directed; the tutor needed to allow the participants to assume responsibility for group leadership. The tutor also needed to be confident to act as a facilitator, guiding participants to their own knowledge rather than supplying them with facts. It was important for the tutor to recognise that these academic staff had accumulated a foundation of life experiences and knowledge and that they needed to connect learning to this knowledge/experience base.

Kelson and Distlehorst (2000) discuss the development of the individual within the PBL group, and how the PBL students are expected to develop individually as learners and as problem solvers. They concluded that the group can facilitate this if each individual assumes mutual responsibility for the others' excellence. In this study, an end-of-problem reflection sheet was used to evaluate individual and peer performance to develop outcomes in individuals.

By adopting a role, each participant had the opportunity to be actively involved in the group process. The time spent outside of the PBL group facilitated the development of skills such as literature retrieval, critical appraisal of information, seeking the opinions of peers and experts, all of which formed part of the summative assessment criteria for the module.

> *Participant 8*: This blended learning approach has enabled me to make some sense of this concept, experiential learning has forced me out of my comfort zone and

> made me 'engage'; group work has increased my level of understanding (collaborative learning) and the constructivist nature of the module has enhanced my understanding of the area.

These module participants were also relevancy-oriented. It needed to be clear to them from the outset of the module that there was a good reason for learning about 'Online Learning', and for using PBL as the learning approach to do this. The learning had to be applicable to their own teaching practice or other responsibilities to be of value to them.

> *Participant 7*: There is no doubt that a student needs to be very committed to the process for it to work, and again this relies heavily on the 'perceived need' being very real, and not contrived.

Therefore, the tutor needed to identify objectives for the participants before the course began. This meant, also, that the learning theories and concepts of Online Learning needed to be related to a setting familiar to them. This need was fulfilled through the PBL problem, and letting the participants choose an area to develop that reflected their own interests. These participants needed to be treated as equals in experience and knowledge and allowed to voice their opinions freely both in class and in the online discussion boards.

To assist with the facilitation role, the tutor provided each module participant with an interactive handbook, reviewing their familiarity with the PBL process and introducing them to the online technology of WebCT. Dennen (2000) argues that providing students with participation and collaboration guidelines such as these, and documenting process as well as product, seem to be key factors in creating a successful PBL environment for individual students who are separated by time and space.

At the face-to-face induction, the tutor and the participants engaged in developing a set of ground rules and group roles for both the face-to-face and online participation; these were then posted to the WebCT module website for further review and editing if necessary. A full and comprehensive induction is vital for setting one's students in the right direction for learning.

> *Participant 4*: Using Web-CT in the beginning was a bit frustrating but after the induction and with time and practice, I found that I got used to the logic of the system. The experience of being a student will be invaluable when coming to design my own course in the future.
>
> *Participant 8*: The energy generated at the induction was positively charged with excitement and enthusiasm as my colleagues and I embarked on an exploratory journey of online learning.

Conclusion

What questions, issues or concepts does this case study illuminate or challenge? The work here raises questions about participants' readiness to engage in the blended process in PBL, how different forms of interaction and communication can occur in a blended module, as well as the role of the individual learner in a blended PBL group

and the tutor role. In this respect it challenges some of the rhetoric about both PBL and online learning. It is very easy to plan on paper how one can integrate a constructivist, socio-cultural context for learning, yet, putting this into practice with activities that are truly meaningful and authentic for learners in a limited time frame can challenge the design skills of many tutors.

> *Participant 4*: We have had good face to face sessions and as X said today we have all learned hugely from sitting around the table on Tuesday mornings. This is a real endorsement for blended learning and I cannot even begin to imagine what the course must have been like as an E. Learning course delivered totally online.

Having determined the findings of this research, the following recommendations are offered to anyone designing and implementing a blended PBL course in a third-level context.

This research has suggested that following the main principles of constructivism and engagement are vital to create collaborative and authentic learning for individual participants on B-PBL modules. The self-directed learning focus of PBL turns out learners who are motivated, know what they want to learn, set their objectives, find resources and evaluate their learning progress to meet their goals. Although the participants have felt that there was an increased workload with the PBL format, they did appreciate that the pursuit of the learning goals was their own domain with the group performance being evaluated by peers. They also acknowledge that the self-directed learning trails that they found themselves on in the PBL group did lead to a greater awareness of individual interdisciplinary thinking.

The design of such courses benefits from scaffolded collaboration; working online individually, then with a mentor, and then in small PBL groups, will more adequately prepare individuals for collaborative work online, followed with collaborative activities conducive to reflective guidance of group interaction. Completing an individual reflective journal provides participants space in which to record, revise and synthesise their thinking, producing artifacts that can be evaluated by the tutor, who can give formative, individualised feedback. After individuals can gain experience with the flow of activities face-to-face and are thinking deeply about the problem, their online collaborative work can begin. The group can meet online with the asynchronous feature of an online learning environment designed to scaffold students as they organise their task, then synthesise, post and critique the results of their deliberations. Many technologies can meet varied individual needs and each technology has its own particular instructional strengths. The design of this module needed appropriate selection and choice of a blend of delivery methods to meet the learners' needs. Thus the role of technology in this instance is ultimately the same as the tutor's: to be a facilitator in online learning (Huang, 2002).

Notes on contributor

Roisin Donnelly has been a lecturer/researcher in higher education since 1992. In 2003 she became a member of the professional body The Higher Education

Academy. She has completed a number of online learning courses, including 'E-Moderating' from LTSN-ICS and Online Tutoring from Oxford Brookes University. A range of publications to date reflects her teaching/research interests, including E-Learning Pedagogy, Design, Collaboration, and Evaluation. Her continuing research in higher education is through the Doctorate of Education from Queen's University Belfast; her research specialism is an exploration of the role of the tutor in propagating a sustainable model of educational development based on blended problem-based learning.

References

Argyle, M. (1991) *Co-operation: the basis of sociability* (London, Routledge).

Biggs, J. (1999) *Teaching for quality learning at university: what the student does* (Buckingham, Society for Research into Higher Education & Open University Press).

Boud, D. & Feletti, G. (1991) Introduction, in: D. Boud & G. Feletti (Eds) *The challenge of problem-based learning* (New York, St. Martin's Press), 1–14.

Burns, R. B. (2000) *Introduction to research methods* (London, Sage).

Candy, P. C. (2000) Reaffirming a proud tradition: universities and lifelong learning, *Active Learning in Higher Education,* 1(2), 101–125.

Collison, G., Erlbaum, B., Haavind, S. & Tinker, R. (Eds) (2000) *Facilitating online learning: effective strategies for moderators* (Madison, WI, Altwood Publishing).

Coppola, N., Hiltz, S. & Rotter, N. (2001) Becoming a virtual professor: pedagogical roles and ALN, paper presented at the *International Conference on System Sciences*, Hawaii. Available online at: http://www.hicss.hawaii.edu/HICSS_34/PDFs/CLALN01.pdf (accessed 10 May 2003).

Cornford, I. (2002) Reflective teaching: empirical research findings and some implications for teacher education, *Journal of Vocational Education and Training,* 54(2), 219–233.

Crook, C. (2002) The campus experience of networked learning, in: C. Steeples & C. Jones (Eds) *Networked learning: perspectives and issues* (London, Springer), 293–308.

de Boer, W. & Collis, B. (2002) A changing pedagogy in e-learning: from acquisition to contribution, *Journal of Computing in Higher Education,* 13(2), 87–101.

Dennen, V. (2000) Task structuring for online problem based learning: a case study, *Educational Technology and Society,* 3(3), 329–335.

Dewey, J. (1933) *How we think: A restatement of the relation of reflective thinking to the educative process* (Revised edn.) (Boston, D.C. Heath).

Draper, S. W., Brown, M. I., Henderson, F. P. & Mcateer, E. (1996) Integrative evaluation: an emerging role for classroom studies of CAL. *Computers and Education,* 26(1–3), 17–32.

Duch, B., Groh, S. & Allen, D. (Eds) (2001) *The power of problem-based learning* (New York, Stylus).

Duffy, T. M., Dueber, B., & Hawley, C. L. (1998) Critical thinking in a distributed environment: a pedagogical base for the design of conferencing systems, in: C.J. Bonk & K.S. King (Eds) *Electronic collaborations: learner-centred technologies for literacy, apprenticeship, and discourse* (London, Lawrence Erlbaum Associates), 51–78.

Gillham, W. (2000) *Case Study research methods* (New York, Continuum; London, Continuum).

Grabinger, S. & Dunlap, J. (2000) Rich environments for active learning: a definition, in: D. Squires, G. Conole & G. Jacobs (Eds) *The changing face of learning technology* (Cardiff, University of Wales Press), 8–38.

Henri, F. (1992) Computer conferencing and content analysis, in: A. E. Kaye (Ed.) *Collaborative learning through computer conferencing* (Berlin, Springer-Verlag), pp. 117–136.

Herrington, J. & Oliver, R. (2002) Designing for reflection in online courses, in: A. Goody, J. Herrington & M. Northcote (Eds) *Research and development in higher education* (Perth, HERDSA), 313–319.

Higgins, K. & O'Keeffe, D. (2004) An online digital engineering module companion using biomedical applications, in: *Proceedings of the Fourth Annual Irish Educational Technology Users Conference* (Waterford) 3rd–4th June 2004. Available online at: http://www.ilta.net/Edrech2004/papers/higginsk.pdf (accessed 10th January 2006).

Huang, H. (2002) Toward constructivism for adult learners in online learning environments, *British Journal of Educational Technology,* 33(1), 27–37.

Hughes, M. & Daykin, N. (2002) Towards constructivism: investigating students' perceptions and learning as a result of using an online environment, *Innovations in Education and Teaching International,* 39(3), 217–224.

Jung, I. (2001) Building a theoretical framework of web-based instruction in the context of distance education, *British Journal of Educational Technology,* 32(5), 525–534.

Jung, I., Choi, S., Lim, C. & Leem, J. (2002) Effects of different types of interaction on learning achievement, satisfaction and participation in web-based instruction, *Innovations in Education and Teaching International,* 39(2), 153–162.

Kelson, A. & Distlehorst, L. (2000) Groups in problem-based learning (PBL): essential elements in theory and practice, in: D. Evensen & C. Hmelo (Eds) *Problem-based learning: a research perspective on learning interactions* (London, Lawrence Erlbaum Associates), 167–184.

Laurillard, D. (1993) *Rethinking university education—a framework for the effective use of educational technology* (London, Routledge).

Loveless, A., DeVoogd, G. L. & Bohlin, R. M. (2001) Something old, something new—is pedagogy affected by ICT?, in: A. Loveless & V. Ellis (Eds) *ICT, pedagogy and the curriculum—subject to change* (London, RoutledgeFalmer).

Luck, P. & Norton, B. (2004) *Problem based management learning—better online?* Available online at: http://www.eurodl.org/materials/contrib/2004/Luck_Norton.htm (accessed 19 May 2003).

Martinez, K. & Mackay, G. (2002) Structuring critical reflection in professional experience, paper presented at *AARE,* Brisbane, 1–5 December.

Mason, R. (1998) Models of online courses, *ALN Magazine,* 2(2). Available online at: http://www.usdla.org/html/journal/JUL01_Issue/article02.html (accessed 10 January 2006).

McPherson, M. & Nunes, M. B. (2004) *Developing innovation in online learning: an action research framework* (London, Routledge).

Murphy, D., Walker, R. & Webb, G. (Eds) (2001) *Online learning and teaching with technology: case studies experience and practice* (London, Kogan Page; Stylus, VA, Stylus Pub).

Nelson, L. (1999) Collaborative problem solving, in: C. Reigeluth (Ed.) *Instructional design theories and models: a new paradigm of instructional theory* (Mahwah, NJ, Lawrence Erlbaum Associates), 241–268.

Noble, D. (1998) *Digital diploma mills. Part II: the coming battle over online instruction.* Available online at: http://www.firstmonday.dk/issues/issue3_1/noble/ (accessed 19 May 2003).

Parsons, T. (1951) *The social system* (New York, Free Press).

Petraglia, J. (1998) The real world on a short leash: the (mis)application of constructivism to the design of educational technology, *Educational Technology Research and Development,* 46(3), 53–65.

Preece, J. (2000) *Online communities: supporting sociability and designing usability* (Chichester, John Wiley & Sons).

Salmon, G. (2000) *E-moderating. The key to teaching and learning online* (London, Kogan Page).

Schmidt, H. G. (1993) Foundations of problem-based learning: some explanatory notes, *Medical Education,* 27, 422–432.

Seale, J. & Cann, A. (2002) Reflection on-line or off-line: the role of learning technologies in encouraging students to reflect, *Computers and Education,* 34, 309–320.

Sharan, S. & Shachar, H. (1988) *Language and learning in the co-operative classroom* (New York, Springer-Verlag).

Shuell, T. (1992) Designing instructional computing systems for meaningful learning, in: M. Jones & P. Winnie (Eds) *Adaptive learning environments* (New York, Springer Verlag), 19–54.

Steeples, C. & Jones, C. (Eds) (2002) *Networked learning: perspectives and issues* (London, Springer).

Teaching with Independent Learning Technology Programme (2001) *Overview of the TILT Project: TILT—Teaching with Independent Learning Technologies* (Glasgow, University of Glasgow).

Thornhill, D. (2000) *Symposium on Open and Distance Learning. Speech by Dr. Don Thornhill, Chairman, Higher Education Authority* (Dublin, Higher Education Authority).

Vrasidas, C. & McIsaac, M. (2000) Principles of pedagogy and evaluation for web-based learning, *Education Media International,* 37(2), 105–111.

White, H. (2001) A PBL course that uses research articles as problems, in: B. Duch, S. Groh & D. Allen (2001) *The power of problem-based learning* (New York, Stylus Publishing), 131–140.