

# USING ICT IN A PROBLEM-BASED LEARNING APPROACH

*A student and teacher perspective*

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**Abstract:** This paper discusses the problem-based learning (PBL) approach used in a subject called “Issues in Tertiary Teaching and Learning” that forms part of a Graduate Certificate in Tertiary Education at Victoria University. The first author took the subject as a student while the second author taught the subject and views the experience from the viewpoint of both student and teacher to show how ICT and the PBL approach can support real-life learning. The paper first discusses the PBL approach and then describes the problem-based learning approach used in the subject. The use of ICT was a central component in the approach, and a discussion is presented on how the characteristics of the technology assisted in delivering quality learning experiences. The overall discussion shows that (1) the approach has the potential to encourage deep learning, but this seems to be dependent on the degree of relevance of the problems posed to the individual student; (2) real life learning, in this case, did not revolve around finding “one right answer” to a situation or to developing expertise in a subject area, but being able to approach a situation using systematic problem solving skills; (3) real life learning implies responsibility on the part of the student to both “own” and manage their learning; and (4) the use of ICT in this instance supported the process and was an integral part of the learning environment and learning activities.

**Key words:** Problem based learning, real life learning, deep learning, student, teacher.

## **1 INTRODUCTION**

This paper takes the perspective that a person experiences real life learning when he engages in learning a skill or applying a concept to a real-life situation because of a “need to know,” which is accompanied by a sense of relevance. In other words, a student approaches learning saying, “I want to learn this because it will help me understand and deal with what I am going through now (or may go through) in my life.”

This “engagement” with the object of learning can be observed in what is called the “deep approach” to learning, resulting in a student’s cognitive development.

Recent literature on this approach (Biggs 2003; Cope 2003) describe students as developing a personal interest in the subject matter so that there is a desire to seek relationships between, and beyond, different aspects of the subject matter. It involves relating the content to one’s own experience, developing an understanding of the underlying laws, rules, processes, relating the content to one’s own experience and understanding and thus bringing onto oneself, new insight and perspectives.

The deep approach to learning is differentiated from the surface approach to learning, where a student only considers aspects of the subject matter in isolation; there is no commitment to seek out relationships between these aspects beyond what is required in assessment tasks. There is no personal interest or sense of relevance in what is being learnt, and whatever is learnt can easily be forgotten.

As there are significant similarities in the concepts of “real life learning” and the “deep approach to learning,” this paper will use the phrase “deep learning” to refer to both concepts.

This paper will first discuss the PBL approach and its characteristics and highlight how it can encourage deep learning. It will then describe the case study subject where PBL was used, supported by an ICT system. A summary of the reflections from both authors will follow demonstrating the extent of the real life learning supported by the approach.

### **1.1 Limitations of the paper**

There are many issues surrounding the use of PBL (Schwartz et al, 2001), some including: (1) developing acceptance of the approach, (2) developing students’ responsibility for their own learning and for teachers to facilitate that learning; (3) developing assessment methods consistent with how students are learning in the PBL approach; and (4) understanding that PBL does not focus on developing expertise in content but in developing specific skills useful in problem solving.

While resolving these issues are important in promoting the use of PBL as a way to developing deep learning approaches, this paper only shows how in one case, the benefits of using this approach does have a significant impact on real life learning and on professional development.

## **2 PROBLEM-BASED LEARNING AS A DEEP LEARNING APPROACH**

Problem-based learning (PBL) has been generally described as a learning approach whereby students are presented with problem, and then they undertake a systematic, student-centred process of inquiry (Barrows and Tamblyn, 1980). Schwartz et al (2001) argue that “although the purpose of using problems in PBL is to stimulate learning of information and concepts brought about by the problems, PBL does teach both a method of approaching and an attitude towards problem solving,” (p.2). In this approach, students typically work in small groups. The learning process is facilitated by a tutor, who acts as a moderator of discussions rather than a direct source of information. The learning process is student-centred in that the direction and content of learning, as well as the process of gathering information, is controlled and undertaken by the students themselves. The process can be described as follows (Schwartz et al, 2001, p. 2), where students:

1. are presented with a problem without any preparatory study in the area of the problem;
2. interact with each other to explore their existing knowledge as it relates to the problem;
3. form and test hypotheses about the underlying mechanisms that might account for the problem;
4. identify further learning needs for making progress with the problem;
5. undertake self-study between group meetings to satisfy the identified learning needs;
6. return to the group to integrate the newly gained knowledge and apply it to the problem;
7. repeat steps 3 to 6 as necessary; and
8. reflect on the process and on the content that has been learnt.

Boud (1985) identifies characteristics of problem-based learning subjects, some of which are:

1. Students draw upon their current base of experience in order to make a contribution their learning.

2. There is an emphasis on students taking their own responsibility for their learning as they are expected to plan, organise, search for information, and evaluate their learning.
3. The nature of problems require that the approach to the problem-solving is multidisciplinary or transdisciplinary and thus staff and students are drawn into areas outside their expertise.
4. The approach involves having to use theory for practice: theory is drawn naturally into knowledge through the demands of problem-solutions (Argyris and Schon 1974).
5. Students are confronted with the need to know how to approach a problem and acquire new knowledge (Woods 1983).
6. The role of staff changes from that of instructor to that of facilitator. Less emphasis is placed on the presentation of information, more on assisting students to acquire skills of learning and problem-solution (Knowles 1975).

Cope (2003) presents a framework that identifies the factors that are associated with deep learning. These factors are categorised into: factors describing the learning environment, and factors describing the nature of learning and assessment activities. For example, some factors in the learning environment would be (1) the subject is well organised and has clear goals, (2) the student has responsibility for their own learning including some control over the content and approach to learning, (3) the teaching is stimulating and demonstrates the lecturer's personal commitment to the subject matter and stresses its meaning and relevance to the students, and (4) assessment feedback is appropriate and timely. Some factors in the nature of learning and assessment activities are (1) the tasks should be active and experiential, (2) the tasks should encourage the student to reflect on the content and the learning process, and (3) assessment tasks expose students to different perspectives on a topic. He used this framework to identify how ICTs can be used to support deep learning. His argument is that if the technology is able to support a learning environment and a set of learning and assessment activities that adhere to these factors, then deep learning is possible. As a result, there is a perceived higher quality of learning outcomes. He presents the factors as a framework to justify the development of certain learning systems. His framework is presented here to show the ICTs, in and of themselves, do not promote quality or deep learning. It is how these technologies are used.

The following case study describes a subject whereby WebCT was used, and in comparing it to the framework shows that it can serve as an example of how technology can be used to support deep learning.

### 3 CASE STUDY

The subject used in this case study is called “HEG1706 - Issues in Tertiary Teaching and Learning.” The class is conducted over a 12-week period and is offered to teaching staff at Victoria University, Melbourne as part of a 3-subject Graduate Certificate program in Tertiary Education. The subject typically has about 20-25 students in a class, broken down into two groups of 10-15 students.

The subject is designed to explore some contemporary problems in tertiary education and training within the Australian tertiary education and training system. These problems are used to explore tertiary education policy and practice in the classroom and workplace. As a PBL approach is used, it is also designed to introduce participants to this method of learning.

#### 3.1 Learning Outcomes

The subject is designed to enable students to achieve the following learning outcomes:

- Respond to changing environments in tertiary education and training
- Develop information literacy skills in the field of tertiary education and training
- Understand key features of the Australian tertiary education and training environment
- Interpret and implement tertiary education policy; and
- Understand the potential and limitations of problem based learning within tertiary education and training.

The subject is taught using a mixed-mode approach. It includes lecture/discussions, regular face-to-face problem based learning group sessions, individual and group research, and online communication using WebCT. There are three assessment tasks:

- Report of one PBL cycle (40%)
- Contribution to online discussion (20%)
- Submission for a change to local policy or practice (40%)

Students are assessed using a framework called the Structure of the Observed Learning Outcome (SOLO). It is an approach to assessment originally developed by John Biggs and Kevin Collis (1982). At its heart is the specification of desired learning outcomes in terms of a hierarchy based on the *quality* of student response. It is a form of criterion-referenced assessment, where the criteria for achieving a grade are pre-defined. In SOLO assessment, learning outcomes are pre-defined for each grade level, with the expected learning outcomes becoming more complex at each level.

SOLO assessment depends on the *quality* of the student response rather than the *quantity* of the student response. It depends on the assessor making a judgement about the quality of student work using pre-defined criteria at a number of different levels rather than counting the number of correct facts in that work. It is therefore a qualitative assessment rather than a quantitative assessment.

### 3.1.1 Problem-based Learning cycle

The class was conducted as follows:

1. In the first meeting, the problem-based learning approach was first explained to the students. An overview of the problems to be used in the class were presented, and assessment was explained. WebCT was introduced, an brief tutorial was given on how to access class materials and the discussion boards.
2. In the second meeting, the first problem was introduced. The problem was described in two paragraphs, using language that placed the student in the centre of the problem (“You are the course coordinator of this program and you are faced with this situation ...”). The students, with the guidance of the facilitator, identified about five or six key learning issues (the things the students needed to know more about). The students then decided who would be responsible for finding out more information about which issue. The students were given two weeks to research their assigned issue. Over that period they were to send in discussion board postings on their progress.
3. The third meeting was held after a fortnight. Students took turns summarising their findings on each of the issues and then, as a group, discussed the different approaches to a problem. The end aim was not for the students to agree on a solution, but to understand how to approach the problem, and to incorporate this understanding and problem-solving approach to their own professional practice.
4. The succeeding meetings followed the same fortnightly pattern, until all five problems were tackled.

The topics involved in the five problems used are outlined in Table 1.

*Table 1. Problems used in the PBL approach for HEG1706*

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1. Problem-based learning – is a PBL approach appropriate for your course? If so, how would you go about introducing PBL into the course?
  2. Core Graduate Attributes – How would you proceed to incorporate the development of information literacy and its assessment in the core subjects in your course?
  3. Learning styles – What would you recommend in answer to the issue of using learning style assessment to select students for group work and then matching learning activities to the different learning styles?
  4. Quality – How would you go about designing a quality management system that meets the requirements of AQTF, AUQA, and ISO 9001?
  5. Assessing group projects – How would you assess group projects in a way that accounts for individual contribution?
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## **4 REFLECTIONS ON THE RESULTS**

The authors were both involved in the subject, Roger as the subject coordinator/facilitator and Gina as the student. Both reflected on the results of the subject and answered the following questions:

1. What was your impression of the subject? How would you compare the experience with that of a traditional lecture/class format?
2. How did the subject, in your view, create a learning environment that supported deep learning?
3. How has the subject helped you develop your professional practice?

For brevity, these reflections were synthesised and are presented below in point form.

### **4.1 The student's perspective: Gina**

In Gina's reflection, the following points were made:

1. The difference between the lecture format and problem-based learning format presented a challenge – the student is no longer a passive recipient of information – and thus required a different pattern of study behaviour.
2. "Engagement" or deep learning was not immediate while undertaking online discussion; initially a surface approach to learning was taken.

This was a direct result of Gina's decision to first focus on putting in enough effort just to pass the online discussion component. Engagement was evident only when the problem on group assessment was discussed, as this problem was a key issue in Gina's teaching practice. It was in this problem that Gina derived the most benefit – she retained more information and felt she “learnt something important” as a result.

3. The use of the WebCT discussion board tool was found to be appropriate mainly because of its asynchronous nature. Gina was able to contribute to the online discussion at her convenience. But it was only the medium and not the motivation for learning.
4. There seemed to be an average of about 100 postings per problem. Gina found that this caused information overload, and she felt she did not gain the full benefit of the discussion because she was not able to read and cognitively process everything.
5. In the face-to-face discussions after the online discussions, Gina felt the need to be told what the right answer was, in order for her to “confirm” or “justify” what she felt she knew about the problem's solution.
6. In hindsight, there was the realisation that part of the learning was not just the content generated by the problem-solving process, but the learning was also about how to approach a particular problem using the method of “finding something out using valid literature.”
7. In addition, because the problem of group assessment prompted Gina to examine and improve her teaching practice, the learning from the subject launched Gina into a further exploration of practice resulting in further learning. Thus, it is argued that real life learning occurred in this instance with the problem being the starting point for inquiry beyond the classroom.

## **4.2 The Teacher's Perspective: Roger**

In Roger's reflection, the following points were made:

1. In offering the Graduate Certificate in Tertiary Education, it seems the learning and teaching approaches often send more powerful educational messages to participants than the content, in other words that the “how” is more important than the “what”.
2. The focus of this professional development course is on developing the broad capabilities that are required of a tertiary teacher to operate effectively in the complex and changing environment. This included strong information literacy skills so that they could locate, evaluate, manage and use knowledge relevant to the situations they faced in the



classroom. Some of this knowledge is to be found in books and journals, much of the practical knowledge that beginning academics need is found elsewhere, experienced colleagues and transient websites being two important sources. We also knew that many of our students had a great deal of difficulty in using the formal tertiary education literature, let alone using it to help them with teaching problems. We also wanted to encourage these academics to come to grips with the policies that impact on their practice, whether those policies are at national, state, university or departmental level. It seemed that these aims could not be achieved with a traditional lecture/ discussion format and so that resulted in a shift to a PBL format.

3. There was a dramatic development in information literacy skills as participants learnt how to access information that is relevant to the learning issues the group has identified.
4. There was a growing realisation of the sense in John Biggs's theory of constructive alignment (Biggs 2003) as it was revisited problem after problem. The results of final assessment task which is a formal submission for change in a policy or practice show that students were able to achieve the learning outcomes of the subject. Some are directed to course leaders, some to heads of school, some to Deans and some to the Vice-Chancellor but they almost all demonstrate that these teachers can now use evidence from the literature to support their arguments for changes in policy and practice aimed at improving student learning.
5. Roger was concerned about the following:
  - a) When something that he regarded as important is rejected by the group as inconsequential or unconvincing.
  - b) The reliance on websites rather than on books and refereed journal articles, even when they are available online.
  - c) Students who actively participate in face-to-face sessions but do not participate online, as they find the work harder in PBL than they expected

## **5 DISCUSSION AND CONCLUSION**

The reflections on the experience highlight the following:

1. The PBL approach has the potential to encourage deep learning, but this seems to be dependent on the degree of relevance of the problems posed to the individual student. This was evident from Gina's reflection that her engagement in the process was maximal when the

problem was directly relevant to her own professional life. In the next year, one group identified the same problem that engaged Gina as the least effective of the five they tackled because they had already thought through most of the issues relating to assessing group projects. This raises the question of whether the problems used should be identified by the participants themselves if they are already practitioners – a further step towards real life learning.

2. Real life learning, in this case, did not revolve around finding “one right answer” to a situation or to developing expertise in a subject area, but being able to approach a situation using systematic problem solving skills. This is evident in Gina’s reflection that while she did not perceive herself as an expert in group assessment techniques, she was able to begin a process of systematic inquiry into her own practice, thus developing other, perhaps more effective, means of group assessment. It is clear in this implementation of PBL that “solving the problem” is far less important than using the problem as a stimulus for powerful learning. Returning to the problem at the end of the cycle is almost anticlimactic – it provides a sense of closure but the important learning has already happened by this stage.
3. Real life learning implies responsibility on the part of the student to both “own” and manage their learning. The benefit of the learning to the student is dependent on the student’s approach to the learning activity: unless a student “engages” with the material, then quality learning is not achieved. This has implications for the student (the student has to have a desire to learn) and for the teacher (the problems posed need to be relevant to the student in order for the student to want to engage). The challenge for the teacher is to develop a series of practice-based problems that raise important learning issues while at the same time engaging all (or most) learners. Effective problems are, to some extent, intriguing puzzles with no obvious solution rather than well-defined problems with one correct answer. Problems like this are not only pedagogically effective but also mirror what practitioners face in real life.
4. Finally, the use of ICT in this instance supported the process and was an integral part of the learning environment. It supported deep learning in that it provided a convenient means to interact and communicate ideas, which is a central component of the problem-based learning approach. In following Cope’s (2003) framework of factors affecting deep learning, the technology had the potential to provide quality learning because (a) it provided a means to obtain feedback in an appropriate and timely fashion, (b) it supported a process of inquiry that was active and experiential, (c) the discussion boards exposed

students to different perspectives on a topic, (d) the asynchronous nature of the technology gave the student a sense of responsibility over their own learning, and (e) having students search for information using the Internet provided some control over the content and approach to learning.

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