

# Student learning processes using an online PBL module in an art and design education course

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The PBL approach is used to encourage deep learning on tasks that reflect the complexity of 'real world' professional environments. Using an online learning environment as part of the PBL approach enables the students to be self-directed in their approach to problem resolution. This study considers the design of an online PBL module and how students used the online resources in their group work on a professional practice problem. Student interaction is considered from an analysis of online discussions to reveal learning processes. An end-of-course survey reveals student perceptions of this approach.

Keywords: problem-based learning, collaborative learning, online learning, online discussion, art education

## Introduction

While online learning technologies are being widely adopted in tertiary education institutions, an important issue is how these can be used to enhance student learning outcomes. A way to do this may be to use online technologies to enable or support educational approaches that have been developed to foster high-level outcomes. Problem based learning (PBL) is such an approach. This approach was developed in medical schools to prepare students for the complexities of dealing with real cases, rather than text book examples with neat solutions (Boud & Feletti, 1997). Students are motivated to learn by being presented with a problem scenario that is reflective of the real world. The model requires students to be active learners, to investigate the issues and the relevant information and analytical techniques required to reach a resolution (Duch, Groh, & Allen, 2001). These characteristics of PBL make it a good approach to preparing students for a professional environment (Boud & Feletti, 1997). By using online learning technologies to enable or support PBL, with a user and activity-centred design for the online environment, the potential power of the online technologies may be leveraged further by the potential of PBL to foster high level learning outcomes.

Online support for PBL can enable students to maintain their focus on the problem task outside of class times by providing access to all course resources, and communication through online discussions. The relative effectiveness of a PBL approach has been identified as being contingent on the skill of the facilitator (Hmelo-Silver, Chernobilsky, & DaCosta, 2004; Tan, 2004). If the PBL module is online this means that aspects of facilitation need to use online discussions and other online resources to support the students as they move through the stages of resolving a PBL problem. Online discussions can be structured to encourage engagement and participation (Salmon, 2002). If this approach can enable effective student learning on a PBL problem, it may encourage a more self-directed and team-directed learning approach by students. This issue is worth investigation in relation to a PBL approach. Evidence based instructional strategies that demonstrate aspects of PBL in relation to particular types of outcomes have been identified as being a research need (Hmelo-Silver, 2004). Evidence from these strategies may enable educators to make informed choices of how to adapt the PBL approach to particular contexts. This study will consider how online support and facilitation can be used as a strategy to support student learning using PBL in an online environment.

## Theoretical issues in PBL

The broad characteristics of PBL are well-known. A recent meta-analytical study suggests seven core characteristics of PBL approach:

- 1 Learning needs to be student-centred.
- 2 Learning has to occur in small student groups under the guidance of a tutor.
- 3 The tutor acts as a facilitator or guide.
- 4 Authentic problems are primarily encountered in the learning sequence before any preparation or study has occurred.
- 5 The problems encountered are used as a tool to achieve the required knowledge and problem-solving skills necessary to eventually solve the problem.
- 6 New information needs to be acquired through self-directed learning.
- 7 Students must learn by analysing and solving representative (i.e. authentic) problems (Dochy, Segers, Van den Bossche, & Gijbels, 2003, p. 535).

The above study identified that students developed much more effective skills from PBL approaches and that skill development is both immediate and lasting. It also found that while students may acquire less declarative knowledge than students in a comparable non-PBL class, knowledge retention is improved when learning from PBL (Dochy et al., 2003). The PBL approach is perceived to promote learning by encouraging students to actively engage in the most effective learning strategies (Biggs, 1999), and to promote the transfer of effective learning strategies to new domains (Tan, 2004).

Collaborative group work is usually considered to be an essential aspect of PBL. A meta-analysis of research on learning in small groups showed a significant positive effect on learning. This effect is enhanced when students have previous experience of learning in groups (Colbeck, Campbell, & Bjorklund, 2000). A study that considered artefacts, such as reflective writing in learning logs, produced in a PBL environment found that group artefacts reached a higher level of knowledge development compared to those of individuals working alone. While this was generally the case, group functioning did not necessarily improve performance if all the individuals in the group have a poor knowledge base (Chernobilsky, DaCosta, & Hmelo-Silver, 2004). It is clearly important for individuals to develop their own knowledge base through research and study. Group activities can provide a focus for this in a PBL environment, but are not a substitute for individual work.

The value of PBL as a structured way of facilitating the development of high levels of student capability and the experience of resolving 'real-world' problems make it an effective model for course development to enhance learning outcomes. The next section considers how online technologies have been used in PBL approaches to create an activity-centred design for the technology.

## PBL and online technologies

When online technologies are incorporated into a PBL environment, they can perform a range of key roles, such as presenting problem scenarios in realistic ways using videos as problem starters (Keppell, 2005), providing research resources such as specialised databases (McAlpine & Clements, 2001), or supporting group work with online discussions and peer review processes. The online technologies can be tailored to support particular functions or be designed as a learning environment that supports most of the processes associated with PBL. An example is the Case Analysis In Organisational Situations program (Waters & Johnston, 2004). This enables students to work in groups to consider problems in Organisational Behaviour. The approach used presents a problem and asks students to submit solutions at regular stages. Additional information is tailored to the students' responses. In this way the same scenario can take different paths for each group. Support tools include an online tutor and group discussion board and a group reflective diary. Pre-and post surveys of student learning showed that many students moved from taking a surface approach to learning at pre-test to using a deep approach on completion of the online course – one of the aims of using PBL (Waters & Johnston, 2004).

Facilitation is an important issue for the developers of online courses using PBL. Student work in small groups with a facilitator was identified above as a core characteristic of PBL. Introducing online support raises a number of questions, such as can online tools and support guidelines substitute for close

facilitation, or can facilitation be effectively done online? Students may work in groups on a problem-solving task with minimal direct supervision. In one study students carried out a problem-based task with an online discussion and guidelines on group work for support, and the option of organising their own meetings face-to-face. Students found this approach to be engaging and staff were happy with the reports produced by students, but some students reported difficulties in managing groups (McAlpine, Scoufis, & Brooks, 2003). The role of a facilitator includes group management and ensuring that students follow processes through and reflect on them. The absence of a reflective process means that students may miss important points that they need to learn (Hmelo-Silver, 2004). Providing facilitation online is a potential alternative. An online module in PBL format in an Art Education course used practising teachers as online tutors to provide students with a direct link to the school environment (Snepvangers & McAlpine, 2004).

## Research questions

The effectiveness of PBL has been seen to be contingent on the facilitator (Tan, 2004). In this study, most facilitation is provided online. The research questions are focused on the effectiveness of this environment in supporting the critical outcomes from the PBL activity. Key questions are:

- 1 How effective is the online facilitation in enabling and supporting cognitive processes that lead to the development of problem-solving skills? This question is focused on how the students used the online environment and how effective it was in supporting their challenge of learning to work on a complex and shifting problem.
- 2 How can people manage to contribute as an individual in the context of working with other people? This question seems central to the idea of group process and effectiveness of any possible group product.

## Research method

To investigate student learning processes and roles and activities within groups, an interpretative approach is used. By triangulating data from different sources, a more complex perspective of student learning processes can be built up (Carr & Kemmis, 1986). To address the research questions relating to online facilitation of PBL and how people manage to contribute as an individual to the working of an online group, knowledge is needed about student perceptions of the problem task and the group process, and about how the students worked as a group to develop a resolution. The investigation was carried out using two indicators of student learning:

- 1 An end of course survey. This had groups of questions on perceptions of use of the online technology, the resources and guidance provided in the online coursework, cognitive aspects of learning from PBL, group work and group processes, and the overall learning outcomes. Each group of questions was followed by an open ended question to allow qualitative responses.
- 2 Analysis of contribution to online discussions. The discussions of two groups were selected. The analysis focused on the process students used to resolve the issues and produce a report.

Analysis of these indicators enables an interpretation of perceptions of learning in this mode and its outcomes, and the processes students used. From these, conclusions as to the effectiveness of aspects of the approach can be derived.

## Developments in the Art & Design Education course

This study is a follow-up to an earlier study (Snepvangers & McAlpine, 2004) of an upper level art and design education course. The art and design education course occurs in the third year of the Bachelor of Art Education (4 year degree program) and the Bachelor of Design/Bachelor of Art Education (5 year degree program) at the College of Fine Arts (COFA), The University of New South Wales (UNSW). As the third in a series of learning and teaching courses, the complexities of classroom management in visual arts and design are explored. The compulsory course deals with preventative classroom management and issues surrounding the learning and teaching of secondary visual arts and design. The course, occurring in year three, has a pivotal role in the degree programs. One outcome of the course is to inculcate COFA

students to undertake a semester long (fourteen week) internship in a secondary school. The internship directly follows the course, so preservice students need to be adequately prepared to undertake collaborative practice based tasks in a professional setting. The students have been into schools previously, however, the internship is a strong indicator of their capacities within a sustained professional environment.

The course has evolved from a clinical supervision model with an eight week in-school component, to, in 2000, a lecture-based on-campus course. The move from a within school component, to lectures acknowledged increasing costs and time involved in deploying full-time lecturing staff into an increasingly busy pool of available schools. Another area which became increasingly difficult to sustain and manage was the requirement in the course that students engage in group activities, such as writing individual lessons to collaboratively generate a group program, thus modelling the practice of real teachers in actual schools. However, it was increasingly difficult for students to get together, to meet face-to-face (ftf) and equitably collaborate on a visual arts and design program. The need to collaborate was ongoing and finding the time to 'get together' became increasingly problematic. While the changes structure allayed these issues a different obstacle emerged as, whilst practice-based, limited opportunities were available for students to engage with practitioners to actively practice collaboration and work with classroom problems and issues. An online component for the course addressed two learning dilemmas. First, it was designed as an alternative to the session long, lecture based tradition of writing individual essays with its corresponding focus on the provision of basic knowledge and content overload. Secondly, there is the important consideration for the lecturer who must manage the students' ability and willingness to collaborate with peers and co-teachers on tasks in the interests of student learning.

Assessment of group work in the past reveals a number of dilemmas; for example, more academically able and committed students often carried the whole group, deserving or not so deserving, towards higher grades. In the new course design group work attracted both individual and group feedback and grades, together with a planned imperative for all students to be actively engaged in the learning task. With the textual base of online discussion new possibilities also emerged for all students to become active participants. An asynchronous written record does not allow you to sit idly by, allowing more capable or committed students to do the work. In other words, a planned level of accountability was part of the revised version of the course, with increased opportunities for interaction and communication, accessible any time. Central to the particular context of the art and design education course and course design was the need to:

- experience group based learning tasks as preparation for collaborative team-based work in a range of diverse secondary, tertiary, museum and community-based contexts
- address the challenge of finding time to 'get together' on-campus, in a changed work commitment & study environment
- provide an active learning, group-based alternative to the semester long, lecture based course of writing individualised essays, focused on passive reception and content overload
- manage the student's ability and willingness to collaborate with peers and co-teachers on tasks in the interests of student learning
- provision of an online classroom management scenario which was salient for students in art and design education.

### **Online facilitation**

The online component of the course is approximately four weeks, occurring in the middle of a fourteen week teaching semester. The online course is structured to:

- 1 Present the problem scenario. This involved the provision of recommendations to a first year out teacher with a range of classroom management problems. The setting is Manic High School, with 'The Class from Hell'. To illustrate the complexities of the problem, various individual male and female characters were introduced at various points in the scenario. In addition, Occupational Health and safety questions about space and Duty of care were subtly knitted into the problem/scenario as the first year out teacher struggled with the vagaries of teaching digital and photographic concepts and skills. The complexity of the localised and particular management situation was central to the scenario.

- 2 Provide guidelines for the process of making recommendations to the first year teacher, working in small groups.
- 3 Provide online discussions for each group. The online PBL component uses collaborative online discussion and group tasks to strengthen and scaffold a new set of group learning opportunities, building on the initial task by focusing on reflection, peer interaction and group dialogue. The online discussion component discussed in this paper, was designed to make visible the complexities and connections involved in understanding classroom management as a conversation, using online discussion rather than a series of 'teacher tactics' or 'hot tips' for undergraduate preservice teachers.

A facilitator was appointed for each group. These were practicing art teachers who had brief meetings with the students, but worked mostly online. Their role was to guide the group towards a resolution of the scenario, without providing any 'correct' answers themselves. Facilitation has been identified as an important role in the PBL approach (Hmelo-Silver, 2004). In a classroom environment the facilitator may meet with the students regularly to guide their learning. This is to ensure that the students undertake the cognitive processes required to relate new knowledge to prior knowledge and to elaborate their knowledge by collaboratively developing a solution to the problem. In this case, the facilitator role was split between guidance, support and resources within the online course, and facilitation by online discussion. The scenario setting, resource support and guidance roles of the facilitator are reduced, and the students are given online support for a more self-directed approach. This design was arranged to ensure that the students attained the full benefit of working in a PBL environment.

A short engagement over the four weeks was considered much more effective in terms of generating online discussion, rather than a full sessional involvement. Clear articulation of tasks to be delivered and presented, rather than a mere invitation to participate in the discussion were also key ideas. The short timeframe also allowed for the creation of a virtual professional environment, with the support of external art and design professionals (tutors), active in the field and also engaged in postgraduate studies at COFA. To illustrate developments in the 2004 version of the course, firstly the suggested change is noted then the way the course was transformed is discussed.

- *Provide a stronger rationale for 'why' online learning and 'how' to work online.* To address this question further resources and examples of context and application were introduced very early in the online segment of the course. Group processes were also highlighted through peer assessment and online group skills resources and discussion.
- *Increase lead-in time and technical specifications.* The technical aspects of the task were started much earlier than the first iteration of the course.
- *Schedule one other face-to-face meeting with tutors.* The second face-to-face (ftf) meeting with tutors was scheduled mid way through the task, to provide a progressive feedback loop that went beyond the initial meeting.
- *Reduce content to further focus on learning activities, rather than the presentation of knowledge.* It was hoped that by limiting the scenario to just one smaller section, without the requirement to address everything the complexities, interactions and significance of actions and actors could be enhanced.

The online survey results for the 2004 cohort are considered in the next section.

## Results

### Technical preparation

One of the matters identified in the previous study of the 2003 cohort was greater preparation for student use of the online technology. Most students in the 2004 cohort agreed with the survey question 'After the initial problems of connection were overcome, access to the online materials was consistent and effective'. The majority of open ended responses (12) were positive. Providing more lead time and direction on using the technology appears to have been successful in preparing the students for an online learning activity.

## Online resources

Research Question 1 is concerned with online facilitation. The online materials were designed to provide access to resources needed in the form of readings, guidelines for online study and working in groups, and communication among students in small groups working on the problem task. Each small group had a facilitator who was a practicing art teacher based in a school. The students met with their facilitators, but most of this communication was online. Facilitation was thus a mix of online support and guidance, online communication and meetings. The online materials were designed to form part of the facilitation role. A range of survey questions regarding ease of use of online resources, support and guidance provided all had positive responses on the survey. The students' perception of the online course was clearly favourable. The open ended question showed a much more positive response in 2004 than in 2003, such as:

Good to see another way of learning – great to actually take part in it.

While not all comments were positive, and some students were less enthusiastic about using the online environment, the majority of the students responded in a positive way. This suggests that the online resources provided an important support role as part of the facilitation process.

## Cognitive processes

Facilitation in PBL is there to ensure that an appropriate level of cognitive development occurs while working on a resolution of the problem (Hmelo-Silver et al., 2004). Table 1 shows the questions on cognitive aspects of the problem scenario. At a cognitive level, the PBL approach is designed to present students with a challenge, to foster the elaboration and enhancement of existing knowledge structures while the students construct new knowledge based on their efforts to meet the challenge. By learning that they can resolve complex problems of a professional nature it is expected that students will learn an approach to problem solving that they may apply in a future professional environment. The questions in Table 1 were included to determine whether the students perceived that they were appropriately challenged, that they built new knowledge on their existing knowledge structures, and that they felt they developed problem solving capabilities.

**Table 1: Survey questions on cognitive development**

			SA	A	NS	D	SD	Mean
13	The problem/project topic had some features that were familiar to me	26	9	13	2	2	0	4.12
14	I found the problem/project topic appropriately challenging	26	4	19	2	1	0	4.00
15	The problem/project enabled me to build on knowledge I already had	26	6	17	2	1	0	4.08
16	I developed new knowledge by working on the problem/project	26	8	17	1	0	0	4.27
17	I learned little that was new by working on the problem/project	26	1	5	1	15	4	2.38
18	I learned a method of approaching new problems by carrying out the problem/project tasks	26	5	16	3	2	0	3.92

Note. SA – Strongly agree, A – Agree, NS – Not sure, D – Disagree, SD – Strongly disagree.

The data from Table 1 suggest that the students' perception was in accord with the intended outcomes from these processes. A later question (question 30) indicates that the problem skills would be valuable to them in a professional capacity, an important intention of the PBL approach to this course. Open ended responses from both cohorts were mostly positive. Comments from the 2003 cohorts suggested that there were too many problem tasks, which made the activity too large to address effectively. The students were given a choice of scenarios to respond to in 2004, to ease the volume of work. Comments from the 2004 cohort suggest more positive perceptions of the process.

## Facilitation and learning outcomes

Table 2 indicates that the students responded positively to questions about facilitation and their perception of the learning outcomes. They were strongly positive about developing problem-solving skills that they felt would be useful to them professionally – one of the main aims of the PBL activity. They were less positive, however, about the effect of the course tutor – the group facilitator in this case. Some open-ended comments elaborated on these perspectives.

**Table 2: Survey questions on facilitation and learning outcomes**

			SA	A	NS	D	SD	Mean
28	The course tutor provided effective guidance and feedback	25	2	11	3	8	1	3.20
29	I felt that I developed a deep understanding of the course content	26	4	16	3	3	0	3.81
30	My studies in this subject helped me to develop problem-solving skills that will be useful to me professionally	26	7	15	4	0	0	4.12

Note. SA – Strongly agree, A – Agree, NS – Not sure, D – Disagree, SD – Strongly disagree.

Comments on the problem task were generally favourable, such as:

Activity was one of the most useful activities in teacher development because it had a practical side to it as well as the cooperation amongst a different familiar group of people.

The online environment was also seen to be effective:

I think it was structured very well with many support systems in place. It was actually very comfortable learning environment as we knew where and how to get help and knew clearly what was being asked. This led to more constructive time on task and created a more meaningful group environment.

Comments about the facilitator, however, were more equivocal, such as:

Our tutor was helpful in the face to face meetings, however she did not provide us with any feedback on our solutions. I feel she could have even posted more messages about how we were going. We did not even know if we were on the right track.

In response to the first research question, the students appeared to be happy and supportive of the overall facilitation provided for the activity by the online environment, and they perceived that they had developed the critical teamwork and problem-solving capabilities that the PBL activity was introduced to develop. Surprisingly, the support and guidance provided by the facilitators were less valued. Additional consideration of this role appears to be needed.

## Group processes and online discussions

To address the second research question about how and what can individuals manage to contribute in the context of working with other people, the content of the online discussion was analysed to investigate the problem-solving process. Two groups, A and B, are focussed on for the purposes of this paper.

### Problem definition

Following a brief introductory post to all groups by the course lecturer, the online discussions that were analysed focused mostly on group process, how to respond and make meaning of the task and aspirations for group functionality. For example: in Group A, the first post is a hello and hope you are enjoying your break type post, then another student begins to suggest an organisational structure for the whole task and group to follow. The post proffers advice from a student perspective about technical requirements by offering an interpretation of the lecturers post, rather than responding to the lecturer directly:

... the best way to see everything is to make sure you have the 'threaded' button clicked. And also make sure the 'all' button is clicked. This means that we can have the problems organised into folders you can see, and all our responses under each, thus this would keep everything easy to view/keep us going off topic.

So, right from the beginning students were making autonomous moves about how to negotiate and work with the problem, firstly as a technical exercise. However, embedded within these more instrumental posts are clues about the social and motivational aspects of working collaboratively. For example, in the quote above, the student uses the words 'we' and 'our' to begin to suggest a working relationship, without presuming that everything will always be completed as a group 'we' together.

### **Planning an approach as a team**

The students moved through preoccupations with being correct with both technical matters and the requirements of the task. Questions about 'How will we work?' are supported by lengthy posts, which set out an analysis of the problem using headings compiled by individuals who suggested a structure for the group to work within. The online collaborative environment meant that all of the readings were read with some groups dividing the reading amongst group members. The most successful groups provided an organisational format to structure the reading for all group members to follow so that readings are completed with a question in mind, or some other recording device is planned to collate individual postings.

### **Research and investigation**

Hey so are we going to pick, for example, a problem [name of student] identified and turn it into a thread and then come up with better solutions in that particular thread?? Just trying to make sure I understand before I analyse a problem and post something. (Group A)

This post is directly followed by:

Hey [name of student] – this is a good point as I guess we didn't really specifically discuss what we were going to post after all but maybe at this stage it is good just to brainstorm (at least that is what I did). then soon we can choose which areas to expand on as individuals in conjunction with the reader and questions we need to answer?

The task and scenario highlight how preventative approaches to classroom management involve collaborative work by a range of individuals, in other words a group task. Each scenario can be understood in terms of a range of factors (physical, social, relational) which can be thought about in advance and are specific to a particular context. By designing the activities and system support as a group task with online resources, one of the main outcomes of the activity is that individual students don't feel that they have to solve all of the possible management scenarios in every possible future classroom environment on their own. The two quotes above prefigure the range and kind of actions needed to resolve through discussion and deferral, particularly complex classroom management dilemmas. This was in addition to their individual contributions. The most successful groups made one set of documents for contributions to be made, or they delegated each team member one of the tasks/readings.

### **Developing a resolution**

Through the research and investigation phase one student in Group A reported on what everyone had completed to date. The post even reports on what was agreed at the last lecture and who left early, and who was not available on their mobile phone. For this student the role of equity and inclusion was paramount to group process. Other actions that lead towards a resolution of the task included:

- questioning assumptions by clarifying previous posts
- asking fellow group members to "disregard what I said" and deferring to others
- reflecting and re-interpreting what has been said from your own viewpoint
- tracking each other
- creating a new thread for the completion of the task.



## Discussion and conclusions

Taking a PBL approach using online technologies to provide a learning environment to support the process may be a way to enhance student learning outcomes. In this study the transition from lecture and essay-based course to an experiential PBL approach has brought about a significant enhancement of learning outcomes. Students were faced with the complexity associated with a real school environment, both in relation to the problem scenarios and the requirement to work as a team to consider all of the ramifications of the scenario and the most effective way to resolve it. Online technologies played a major role in enabling the group process, by providing online access to resources, guidelines and communication among students and with the group facilitators.

Group process, actions and operations made manifest in the manner of conducting oneself in response to the activity, dominated online discussions. In other words, how the group began then maintained functional operations to address the task, was the topic of the majority of postings throughout the online discussion. Other key observations from the discussion include:

- the important role an individual can play in moving the content, meaning and significance of the activity forward, using social dimensions; for example: collaborative and inclusive language and reportage, or suggestions made as drafts
- the importance of delegation; for example in two successful groups one person has been allocated the task of organising the responses, making tables and collating group material
- the way that online discussion allows all members of a class to contribute in an inclusive way
- the respect for each group member and their contribution to the task and some of the difficulties if all group members are not participating or using effective social dimensions in group process
- importance of autonomy and independent choice in a given activity, together with some key ideas in relation to group functionality.

The success of PBL has been seen to be dependent on the effectiveness of the group facilitator. In this course, the role of the facilitator was divided, as the facilitator did not manage the group process. Presentation of the problem scenario was online, as was access to resource materials. Much of the guidance for working in groups, normally provided by a facilitator, was also online. Online discussions enabled communication processes among group members that remained there for reference and later reflection and review. The online discussion became a group artefact, an evolving document in the same way that the group reports evolved as a product and a reflection of the group's approach to the task. The group facilitators were part of the online discussions. Their role, however, was less active than is traditionally expected of a PBL facilitator and, as the students observed, less critical to the outcomes of the task. 'Facilitation' through the medium of the online environment appears to have enabled the students to work in self-directed groups and to reduce the reliance on a teacher as facilitator. This is a potential benefit of an online learning environment used with a PBL approach – one that is worth investigating further.

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