

## Chapter 7

# Problem-Based Learning Online

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### Introduction

Problem-based learning (PBL) is a strategy for learning that presents students with ill-structured problems that are “messy like the problems that are faced in everyday life and in professional practice” (Weiss, 2003, p 27) and therefore require an authentic application of their knowledge of a subject. Such problems are usually discussed and managed in small groups as the central focus of their learning and this strategy, is used widely in medical education in particular, has gained importance as an effective pedagogical strategy in all fields of higher education (Bridges & Hallinger, 1998; Orrill, 2002; Dennis, 2003). However negotiating a ‘messy’ problem with fellow students can be a challenge in an online environment. Groups need to establish trust and familiarity with their small group participants without use of a visual communication medium and they have to establish regular and reliable communication as they begin to share group roles in order to negotiate and solve their problem.

This paper discusses a study that explored issues that can impact on the success of PBL when used online. Investigation of such factors as differing expectations of and attitudes to online communication, unequal access time online, possible gender differences in group interaction and levels of collaborative small group skills were investigated and are discussed. Though this type of collaborative small group learning has worked effectively on campus, it has only been with the use of the Internet that a problem-based learning mode can be used by groups that cannot meet face to face. Groups can communicate using learning management systems such as Blackboard™ or WebCT™ as their central space for communication and for negotiation of their problem solving. This paper will explore the aspects of online communication and interaction that are necessary for effective problem based learning through a detailed description of online participants’ perceptions of their experiences. Factors that contribute to effective online problem-based learning will be analysed and discussed.

### Background

The difficulty of people establishing an identity in a textually based online environment without visual or contextual cues has been extensively researched (Stacey, 2002; Rourke, Garrison, Anderson & Archer, 1999) and studies have indicated that in forming online groups, an allowance of time should be designed into initial interaction so that social presence can be established either through carefully structured and modeled online introductions or through other means of mediated communication such as telephone or videoconference. McConnell (2002) describes the PBL process in such a distributed environment as challenging the participants to re-shape their identities as they negotiate their roles in online communities and become accountable to the groups’ purposes and work. From the start of the PBL process, when even defining and understanding the problem needs negotiation, the

members of the groups need to agree on patterns and regularity of communication and establish each other's accountability to the group task. Unlike face to face groups, where meetings are established and access to interaction is therefore more equally shared within the group, online communication spaces can be accessed at all times depending on the technological access of the participants and the time they have to devote to the activity which is dependent on their work and lifestyle commitments. This potential inequality of online interaction access can affect the group dynamics and could result in some members dominating the online communication which could affect the negotiation needed to achieve an outcome with the online PBL task. Differences in the way males and females interact online have also begun to be explored (McConnell, 1997) with some suggestion that females act differently preferring the collaborative communicative environment online to males who are more oriented to a focused problem solving approach and less willing than females to communicate informally for social support (Stacey & Rice, 2002).

There is an assumption that students learning through PBL are engaged, active and self-directed learners who construct their own understanding through interacting with others in small groups to solve a problem (Savery & Duffy, 1998). PBL problems need to be designed well to ensure such outcomes. Weiss defines criteria for developing such problems including setting them at an appropriate level, requiring a knowledge of students' current knowledge so that the problem will challenge them and develop their understanding of the subject as well as expressing them in the ill structured form referred to at the beginning of the article (Weiss, 2003). These problems may have several solutions and can integrate subject areas and require collaboration among the members of the group who discuss and share their ideas, negotiating their solutions and arguing their own rationales while maintaining an authenticity providing relevant applications of ideas that students understand from their own experiences or their projections into future experiences. The role of the teacher changes too in online problem-based learning and in empirical studies, students have reported initial discomfort with problem based learning as well as with this changed role (Hung, Bailey & Jonassen (2003).

The reliance on small group dynamics for effective problem based learning is particularly important in the online environment. Effective structuring of groups and tasks establishes a viable online community and requires an understanding of social constructivist principles underlying the collaborative group process. Earlier studies into online collaborative learning found that online groups could provide a positive experience facilitating learning through participants sharing their diverse perspectives and using the online discussion to clarify ideas and articulate their own understandings (Stacey, 1999). Receiving feedback from other group members helped them cognitively and affectively as they studied at remote distances from one another. The small group computer conferencing space was a helpful environment for seeking solutions to task based problems. However establishing sufficient trust and confidence amongst the members of small groups so that they are able to negotiate the task online is a lot more difficult without face to face meetings.

## Research Context and Design

This project was designed to analyse the factors contributing to successful problem-based learning in an online environment. In particular, the impact of factors such as differing student access to online technology, and the process of developing collaborative group interaction skills within small online groups were studied. The project was designed to provide research findings and processes for use within the tertiary system upon which practice and theory can be built for effective learning in an online environment.

The aims of the project were to:

- investigate, record and analyse the factors influencing the collaborative group learning strategies used by postgraduate students in completing a problem based learning task through computer conferencing;
- investigate and compare students' perceptions of their collaborative interaction in small group situations;
- compare and analyse the effects of differing online access to the interaction patterns of the small group collaboration and
- analyse the findings in terms of learning strategies for effective problem-based learning through small group collaboration through computer conferencing.

Two groups (five in each group) of postgraduate Education Faculty students of mixed age and gender distributed across several Australian states were studied as they participated in the online problem based learning task. Because most of the students were in full time work and studying part-time and because of the geographical distribution of the group members, face to face meetings were impossible. Communication was therefore centred on a whole class online conference space (within WebCT Vista™) as well as small group conferencing spaces which were established for the purpose of completing the problem based learning task in two modes, one open to possible access by the whole class and one closed only to the group membership. Other forms of communication were encouraged amongst participants and they had access to email, telephone, (including group telephone conferencing if needed), and a synchronous chat facility for small group online communication.

The participants were studying about media and technology use in flexible and distance education in a Masters level program of Professional Education and Training. Other resources supporting learning were a set of readings and a detailed study guide, audio CDs of interviews with experts in the field, recommended texts for further reading and additional links to appropriate web based sites. The unit assessment originally required students to select one of the seven topics and apply the content of the topic to an individual project through creative assessment tasks that students found appealing and challenging. The assessment design, however, meant

that students had little reason to interact with each other or the teacher in the online environment once they began the task and in fact had little reason to complete all the topics covered in the unit, as they could effectively ignore many of these and still find a pathway that allowed them to pass the unit.

During a redevelopment of the unit, the unit assessment was redesigned to provide a more interactive and engaging online environment and more effectively achieve the aims of the unit which included critically analyzing and evaluating media, texts and technologies in a context relevant to the learner. In the new course design, students first chose a topic from the range detailed in the study guide, which they studied in depth and discussed online, taking it in turns to moderate the discussion. Secondly a jigsaw approach was used to form groups made up of different topic experts who could begin their problem based learning task with their expertise to be shared with their new group. The task was open and ill structured with clear criteria provided to guide the final group assignment. It required more information than was immediately available, an application to authentic contexts with which they were familiar , but the group needed to discuss and negotiate possible multiple solutions and to collaborate to achieve their assignment outcome.

***Problem Based Learning task.***

Flexible, Online and Distance Education has become widely used in all sectors of education and professional learning especially since ease of access to Information and Communication technologies has made it possible for all institutions to become flexible, online and distance providers. Your group has been given a generous grant of funding to develop the courses of an institution or training group which have been previously taught in traditional face to face mode into flexible, online and/or distance mode. Your group must describe the process and decisions about media that will be required in a report that will be presented to the executive and staff of your educational context. As can be expected there will be some people resistant to these developments.

**Figure 1: PBL Assignment**

The initial response to the new design was positive and groups interacted enthusiastically producing high standard group solutions. However in evaluating the unit it became obvious that there were discrepancies in participants' experiences and when frequency of interaction was analysed there were patterns of dominance by some students that seemed to have caused difficulties in some groups' dynamics. This study was therefore designed to research the students' experiences, their online access and attitudes in the second offering of the redesigned course in order to better understand how best to design online problem-based learning. ...in order to be able to achieve what?

Due to ethical concerns about potential coercion being perceived by the participants, data gathering began after the semester was finished and semester results had already been submitted when students were contacted by a research assistant. A representative sample of three participants volunteered from each of the groups and they responded to emailed interview questions. The interview questions asked about ways students accessed the online conference, their ease of computer access, their frequency of interaction and whether this was sufficient to interact effectively with the group. They

were asked to describe the group's collaborative process as well as the differing roles members played and then asked about difficulties, differences in interaction or interactive dominance by members. They were finally asked to identify the type of learning they achieved and the influence of the group on this learning.

Students were also offered an option of a phone call to clarify or seek further detail after they sent their replies to the emailed questions. The participants were able to access the conference to identify important computer conference messages to check and support their perceptions about the group interaction so that those messages could be analysed. The frequency of online interaction was also analysed through frequency statistics gathered through Web CT™. Student feedback, mainly gathered through online evaluation questions posted at the end of semester and which were pertinent to this study, were included as data.

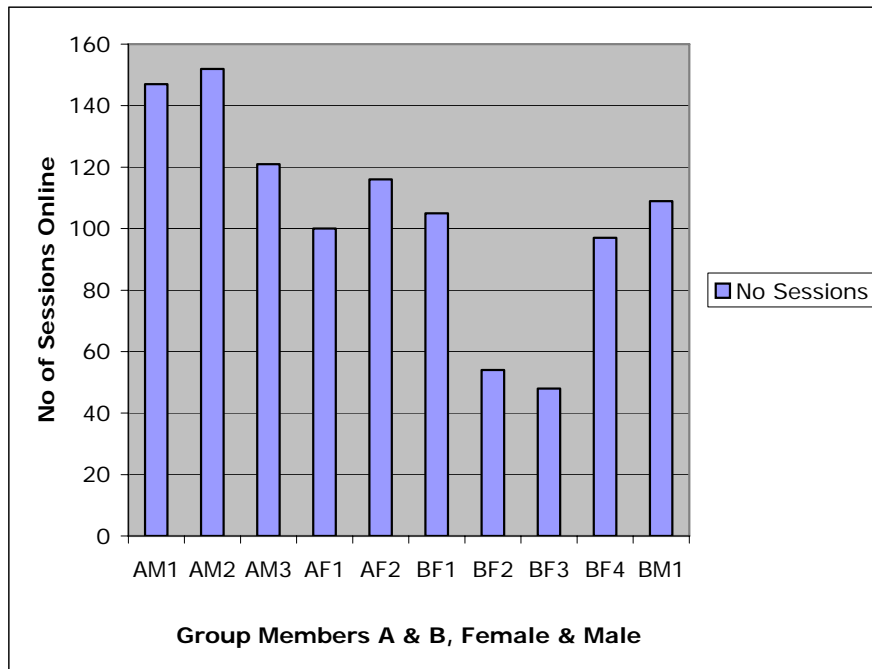
## **Results**

Group A (3 males, 2 females) developed a successful solution for the problem based task. The group members developed a sense of community through their experimentation with another online conferencing system, Moodle, which they linked through Web CT. This enabled them to share drafts and communicate more privately as well as to share a technical point of interest and comparison. They therefore had no need to use the closed group space which was provided for them for sharing drafts of the assignment.

Group B (1 male, 4 females) had a commonality of work context in higher education but initially lacked a commonality of purpose. They used the closed group space equally with the open group space (80 postings in each) moving to the closed space as they reached the point of sharing assignment tasks and drafts.

### **Analysis of the data revealed that:**

1. Frequency of access to the conference was a factor in successful collaboration (see Figure 2). Those participants who participated collaboratively talked about at least daily interaction by the time of the task completion while those who were perceived as less collaborative said the group discussion should only need accessing two or three times per week.



**Figure 2 Frequency of Online Access**

2. Expectations of the group members coming to a collaborative group task led to different levels of satisfaction with the process. Each group had a disaffected member who, though benefiting from the groups’ final submissions, continued to be negative about the group experience.

3. Ease of access to and experience with the Internet in the sample affected the participants’ responses to the task. Four respondents had ease of access from home and/or work and were therefore not constrained in their access. This also affected their ability to take leadership roles in the groups. One exception to this pattern was a member who successfully negotiated her work related infrequent online interaction with the group while still meeting her task commitments.

4. Collaborative group skills could not be assumed and need careful teaching, often needing more interaction online than that required face to face.

5. Use of methods of synchronous communication were preferred for establishing social presence of the group members and for ongoing organization of a group’s progress.

6. Gender differences were difficult to draw conclusions from in this small sample of two women respondents who represented the female population of the group. However male members were more active online and more active in initiating threads. Males also welcomed an autonomous approach whereas female participants in the research preferred a more structured teacher directed design.

## Discussion

An effective collaborative group process was found to be essential for online problem-based learning and this required a course design that provided time and a structure for learning group skills. Interaction levels online have to be set early in the semester just as on campus group meetings have to be established to ensure a group can function effectively. A lack of agreement about online frequency was the basis of group difficulty in this study as groups need to negotiate an agreed realistic frequency of interaction to avoid discrepancies and disagreement in commitment to group tasks. To succeed, PBL required reliable online group participation and this requirement had to be accepted by all group participants. One male Group A member believed that participation should be voluntary as it did not suit all learning styles and another male responding with frustration to this particular group member's unreliable appearances online spoke of "the non availability of group members for periods of time meant frequently you felt like you were talking to the walls."

Frequency of interaction was seen as the basis for creating an online community by one active female member of group B, "difficulties were really people not being able to access the discussion forum to develop a sense of cohesion." Another male member of the same group described how frequent participants also took leadership roles: "I tended to perceive those that contributed lots and engaged more often online with others as the individuals who took it upon themselves to help moderate threads and organize contributions." Negotiation of cognitive understanding could also occur only if the group regularly interacted because initially in this group "It was more a case of, if anyone proposed something it was stuck to, just because no process was developed for group decisions with people dropping in and out."

Both groups accepted leadership by competent members intent on completing the task satisfactorily and patterns of participants who dominated the group in the early stages in leading the task organization changed as those who showed greatest understanding of successful problem solving were given group approval to proceed with leading the groups to finalise the assignments. However, it was possible to be timely and effective without constant access if communication of commitment was clear. In analysis of group posting frequency and distribution (see Figure 2), one member (BF2) showed a much lower rate of interaction but through interviews was described as having participated effectively through posting targeted messages that responded to the cognitive task and efficiently provided her required contributions to the task and to the group. Her work-related infrequency of contribution had been negotiated with (and accepted by) the group in the early stages of the activity whereas BF3's lack of frequency online was more problematic as her lack of regular online interaction meant the group could not rely on her for a response when needed.

Several group members were uncomfortable with the online group interaction initially, reflecting similar frustrations in transition to traditional PBL described in research as new roles are experienced by students (Fiddler & Knoll, 1995, cited in Hung et al, 2003). One male Group A member participated from the start with a negative attitude about the process of group learning stating that his "access is also constrained by personal interest/motivation". He had to travel with his job and saw online group work as inflexible and, though he achieved a rate of online access similar to the other group members, his level of dissatisfaction did not decrease by the

end of the course as other studies had found (Schultz-Ross & Kline, 1999, Fiddler & Knoll, 1995 cited in Hung et al, 2003). A female member of Group B stated: "I found it very difficult to work collaboratively" and was also critical of the online group process perceiving a need for leadership yet resenting this when it occurred. This study found that the participants came to the collaborative group task with differing attitudes and expectations and that these attitudes continued to affect the outcomes with further differing expression of levels of satisfaction with the online PBL process. The self-directedness and lack of traditional teacher directedness in online PBL meant that some participants maintained a level of dissatisfaction inconsistent with their level of grade.

Though adults with training and workplace experience can be assumed to have some group skills, roles still needed articulating and defining and the online medium made time for establishing social presence an important component of this process. Dennis (2003), in comparing online and oncampus PBL, found that the online process took more time to establish. More time for group work and a structure for scaffolding group interaction so that more discussion and negotiation could occur, was perceived as important by group members. Achieving this negotiation of roles and task framework takes longer online and if time is not provided this can be a major factor in less effective PBL. As one male member of Group A stated: "I think the skills of collaboration have to be taught. It's very much a social thing as well as an intellectual tool. Proper introduction to the group is important and developing agreeable ground rules for interaction are important to build a stable foundation."

Internet access and experience online also played an important part in online PBL effectiveness. The group members with easy Internet access (often able to combine work and study from a network based computer) took over the group organization and set up a structure of timed tasks and deadlines. These members also happened to have a comfort level with online group work which helped in their leadership roles. This was sometimes through previous online group experiences and computer conferencing experiences and they communicated easily online with the groups. Development of such online group communication skills could not be assumed and was recommended as a scaffolded and modeled teacher-led process by participants, reinforcing results found in research analysed by Hung et al (2003, p 20).

The importance of establishing social presence through synchronous communication reported previously by Stacey (2002), was again supported. As a male member of group B explained: "I also think that regular synchronous discussions with the others in my group would have helped me to better make sense of where my colleagues were in the collaborative task at a given time." He made the point that this was more than providing a chat facility (the one used in this project was unreliable and not successfully used) but was a commitment in the unit design and in the group's goals as "In our group, a couple of people tried to hold some chat sessions, but without much luck as the others simply didn't seem to have the time, or perhaps didn't think they were important enough to commit the time to participate."

The indications of gender difference was not substantial though analysis of online interaction showed that the male members of the groups were accessing the online conference more than the females (unlike previous results, Stacey, 2002) and they

tended to initiate threads more than the female participants did. While the two female participants both expressed a need for a more structured and teacher defined process, the males participants responded more positively to an autonomous approach for the problem based tasks.

“I think that the original instructions helped shape the types of interactivity exhibited by the members of our group. These instructions were quite open-ended and intended to 'get us started' rather than being strictly directive. Thus, the group independently developed the topic for the assignment, and then how we would undertake to complete the assignment (as a group), how we would go about accomplishing the task, and so on. This allowed group members to participate to the degree that their own personalities and skills as online learners allowed “ (male Group B).

## **Conclusion**

The effectiveness of the collaborative group process was a major factor in the success of online problem based learning. Group members who showed greatest understanding of successful problem solving were given group approval to proceed with leading the groups to finalise the assignments. Collaborative group skills needed careful teaching and use of as many forms of communication as possible, both synchronous and asynchronous, helped develop social presence and collaborative communities online.

Ease of access to and previous experience with the Internet and computer conferencing was also a point of importance and the group members with easy internet access and conferencing experience took over the group organization and set up a structure of timed tasks and deadlines while comfortably communicating with the group online. Reliable online participation was a requirement for successful PBL. The participants who were most collaborative also participated most frequently online however, one exception showed that a member could participate effectively with a much lower rate of interaction as long as this was negotiated and expected and they reliably provided their required contributions to the task and to the group. Males in this study were found to be more interactive and more appreciative of the autonomous nature of online PBL.

The study achieved its aims in identifying ways groups could establish effective small group collaboration online through reliable and regular communication and an agreed accountability to the group's successful completion of the problem-based learning task. Differing access capabilities for online interaction, whether caused by ease of computer or Internet access or by work or lifestyle constraints could be overcome by negotiation with the group to meet obligations with fewer, but reliable, postings. Not all students found online group interaction a satisfactory experience despite gaining successful results, as preferences for more traditional teacher-directed learning are still preferred by some students. Ways of improving strategies for more effective

online problem-based learning were identified and developed to produce collaborative small groups who actively engaged in their learning through authentic tasks.

### **Changes implemented from recommendations of the study**

The design and facilitative role of the teacher is crucial to ensuring greater student confidence in the PBL process and in the subsequent teaching of this course, modifications have been introduced to its design that have solved many of the issues identified in the research. The perception of some participants in problem-based learning is concerned with the differing role of the teacher. Used to a more traditional teacher-directed approach, some students have complained of the teacher's facilitative role as 'not teaching.' Mifflin (2003) argues that PBL is often described too simply when it is "a complex and multi-faceted approach" (p 51) and she is concerned that PBL is perceived as self teaching when, if structured carefully and with a rationale explained, can be established as a teacher facilitated self directed approach most effectively.

### **Changes that were integrated into subsequent offering of the course were:**

1. A more explicit discussion of collaborative group skills and roles was established. Group roles such as facilitator, researcher, editor and reporter were divided among participants with a weekly timeline of expectation of interaction. Resources about collaborative learning explaining how to collaborate online were provided and discussion of these encouraged in the early weeks of groups interaction.
2. A more scaffolded process was established with directions about facilitation given to the group members who regularly reported back to the teacher and the whole group conference. This enabled an ongoing social and teacher presence and provided security to those students who prefer a traditional teacher-directed course. Though the teacher's role is still facilitative it can provide security to those used to traditional teacher led courses when they feel confident that the teacher is aware of the small group progress, which is not always as obvious in an online environment.
3. Additional communication choices were encouraged, particularly arranged synchronous communication either through provision of telephone conferences or online synchronous communication (available via the internet with synchronous chat or with audio and video communication) set up at a point of group choice during the PBL process. The teacher joined these discussions initially to answer any immediate questions and issues that had

arisen. Each group planned the discussion and used it to discuss aspects of the task. They summarised the outcomes and reported that such synchronous processes had solved many issues quickly and had also given a greater sense of social presence as well as a sense of a collaborative community.

4. Models of problem solutions were offered (though this is counter to notion of the ill structured problem that students negotiate) in response to some participants' suggestions. However these were not taken up and groups preferred to tackle the PBL task with an original approach relevant to their experiences and contexts.

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