Scaffolding Clinical Problem Based Learning Within an Online Collaborative Environment

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ABSTRACT
With a specific focus on addressing the health care needs of regional, rural and remote communities, the new medical school at the University of Wollongong will open the doors to its first cohort of students in January 2007. Clinical placements will see students spend substantial periods of time in general practices located in these target communities – which may be as far as 1200km from campus. Problem based learning (PBL) is the underpinning educational strategy used to facilitate students’ integration of medical science knowledge and clinical competencies. Educational technology has made a significant impact on the quality of the resources used to facilitate PBL in medical education through the development of multimedia clinical cases and online delivery of curriculum materials, readings, and literature. However, the learning interactions remain largely face-to-face. The unique context of this medical school requires the design of solutions that utilize communication technologies to connect learning groups but that do so in a way that scaffolds the learning process that is so embedded in the traditional face-to-face setting. This paper outlines the PBL process currently implemented in medical education and proposes a framework to structure the process when learners engage in web-based environments.

KEY WORDS
Web-based education, medical education, problem based learning, case based learning, collaboration

1. Introduction
In order to tackle the growing challenge of shortages in the medical workforce, the Australian federal government is increasing support for medical education through, among other initiatives, the establishment of new medical schools. With a specific focus on addressing the health care needs of regional, rural and remote communities, the University of Wollongong (UOW) plans to open the doors to its first cohort of students in January 2007. Its regional, rural and remote medicine focus means that the school will rely upon significant involvement from community based clinicians located as far as 1200km from campus. Clinical placements will see all students spend substantial periods of time in general practices in these areas.

The medical school curriculum is based on the University of Sheffield’s outcomes-focused approach which draws from a set of presenting clinical problems as the basis of its core curriculum. Problem based learning (PBL), in Sheffield delivered through Integrated Learning Activities, underpins the core curriculum. The purpose is to support students’ integration of knowledge and skill development associated with medical sciences (i.e., basic, clinical, behavioural and population health sciences) and clinical competencies (i.e., clinical, practical, and interpersonal skills and professional behaviours) that are defined by these presenting clinical problems [1]. An online core curriculum database is used to define the specific clinical competencies and medical sciences knowledge thus guides teachers and students in designing and undertaking teaching, learning and assessment activities.

In most medical schools, students engage in PBL activities face-to-face on campus or in hospital or health care settings when they are on clinical placement. The unique context of UOW’s medical school will mean students, at times, will be unable to be co-located for their PBL experiences. Thus, during the school’s development process, it is necessary to design solutions that utilize communication technologies to connect PBL groups in a way that scaffolds the learning process that is so embedded in the traditional face-to-face setting. This paper outlines the PBL process currently implemented in medical education and proposes a framework to structure that process when learners interact through web-based environments. This framework is derived from the experiences of online collaborative learning across disciplines and from the research and design team’s
specific implementations of web-based collaborative learning in teacher education.

2. PBL in Medical Education

While academic debate continues to rage among medical educators regarding the efficacy of PBL, this approach to teaching and learning is a feature of many medical schools' curriculum strategy. Problem based learning may be considered an 'umbrella' pedagogical approach that can be implemented through a variety of methods [2, 3] which are often adapted to suit the range of disciplines – particularly the variety of professional education disciplines – that have adopted such strategies. For example, PBL may incorporate aspects of case based, project based, and/or group based activities.

In medical education, problem based learning is characterised by the use of clinical case scenarios or triggers (i.e., case based) which focus student group discussion (i.e., group based) to identify learning objectives and engagement in individual student inquiry (i.e., independent learning) and subsequent group refinement and consolidation of outcomes [4].

It is well recognised that PBL realises constructivist notions of learning. This is indicated by:

- clinical case triggers providing authentic learning objects;
- student-centred with learners drawing upon prior knowledge and defining their own objectives;
- with the teacher (or PBL tutor) acting as facilitator;
- independent inquiry supporting deep learning; and,
- group discussion exploring multiple representations and social construction of knowledge.

While specific implementations of the PBL process have slight variations across medical schools [6] they all have similar intent. As defined by Barrows [2], the ultimate objectives of the use of PBL approaches are organising knowledge for use in clinical settings; developing clinical reasoning skills; developing self-direct learning skills; and, increasing motivation to learn.

Using Oliver's concept of learning tasks, resources and supports as a learning design [7, 8], the general PBL process can be illustrated to define the sequence of activities in which student engage independently and as a group. Within this framework, tasks are the assessable and non-assessable learning activities in which students engage. Resources are those (mostly) static information and/or curriculum materials that are used by students while engaged in those tasks in order to develop their knowledge and skills base. Resources might include clinical case scenarios, textbooks and textbook chapters, journal articles, web sites, and past student work. Supports are those scaffolds and tools designed and/or implanted by the curriculum designer and/or teacher to facilitate student engagement in the learning tasks. Supports might include schedules, instructions, prompts, and templates.

This framework of the learning design has emerged as a method of describing both contextualised and generic instructional approaches. Further, learning designs are suggested as a way to meaningfully incorporate digital learning objects (i.e., discrete multimedia educational resources) [9, 10].

![Figure 1. PBL learning design defined by a sequence of learning resources, tasks and supports.](image-url)
to facilitate integration of knowledge; encourage self-directed inquiry; engender interest in the subject matter; and, link to course objectives [6, 11].

Other resources facilitate the self-directed aspect of the PBL process as students engage in inquiry related to learning goals developed from the case scenario. Some PBL implementations may leave identification and selection of information resources completely to the individual student’s discretion while others provide a subset of resources from among which students may make appropriate selections depending on their learning objectives.

It is in the development of resources — case scenarios and curriculum materials — where educational technology has had its greatest impact in facilitating PBL within medical education. Medical schools, professional associations and educational publishers have made significant investment in developing clinical cases in multimedia formats. Over the years, these multimedia cases have developed in scope reflecting the state of multimedia learning resource development in general. This has included collections of comprehensive cases which utilise a range of rich media elements such as video and animation to more discrete learning objects technically structured for web-based delivery.

Educational technology has further enhanced the independent inquiry stage of the PBL process. Increasingly students have access to a vast range of CD and web-based resources, digital library collections, course notes, video lectures, and multimedia resources for specific content domains. For example, anatomy is one area in which the development of rich multimedia educational materials has led some medical schools to completely remove lab-based dissection or pro-section from the curriculum. However, it is the implementation of the PBL learning tasks and associated supports in which educational technology has had variable attention.

3. Supporting PBL Collaboration Online

Engagement in PBL learning tasks traditionally takes place in face-to-face mode with tutorial groups meeting to receive case triggers (whether they be on paper, online or on CD, or through structured interaction with real or actor patients). Independent research tasks would occur between subsequent face-to-face meetings of the PBL group. Depending on the structure of the medical school curriculum and the stage in which the students are enrolled in their program, these face-to-face PBL groups may occur on campus or in a hospital setting while students are on clinical placement. In medical education to date, there has been limited exploration of extending the PBL group collaborative process when students are, by necessity of the curriculum, disparately located.

This will become a particular challenge for UOW students enrolled in the third phase of the medical school program. During the entire academic year, students will be placed in general practitioner offices located throughout regional, rural and remote communities in Australia. In many instances, individual students may be located several kilometres from their closest peer(s). Thus, travel to a mutually convenient PBL group location during the clinical day will be near impossible. As such, it is imperative to explore how communication technologies might be best utilised to continue and extend the rich PBL face-to-face interaction that these students will have experienced on campus and during local hospital placement at earlier phases in their course of study.

The simple solution to this problem would be to suggest these students engage in their PBL activities through the learning supports of synchronous chat spaces and whiteboards and/or asynchronous discussion bulletin boards available through any commercial learning management system. However, the communication tools in themselves are akin to the PBL tutorial room, tables, chairs, and whiteboard. It is the process of facilitation that is the key to the learning experience. So the solution to the problem really must focus on what structures (or scaffolds) and systems can be put in place to support the process when students are at a distance and the facilitator may or may not be present online. Certainly lessons can be learnt from initial investigations in medical education as well as other disciplines that utilised technologies to support collaborative PBL distance and/or blended experiences. We would not be the first to postulate the need for tailored tools to support PBL interaction. Technologies have been designed to support the collaborative learning process in general — some have specifically focused on PBL structures. While systems that support collaborative learning are often comprehensive incorporating a number of tools, many focus on providing scaffolding in selected areas (e.g., structuring group discussion or creating collaborative writing spaces). The enhancement of a solution to support online PBL collaboration in medical education might draw upon the ideas and experiences from across the disciplines within a framework of the PBL activities themselves. As such, from the perspective of the tasks, the learning design framework can be used to develop a storyboard (see Figure 2) of how PBL might be scaffolded within the online environment with the specification of resources and supports.
Task 1: Student/s read the clinical case/problem scenario

With an emphasis on multimedia and hypermedia educational resources within the field of educational technology for more than a decade, a focus for problem-based learning in medical education (and health education more generally) has been the development of clinical case scenarios. In some instances, online PBL systems have been designed with embedded cases (see for example STEP as described in [12]). However, the emerging emphasis over the past five years on reusable learning objects suggests a move away from medical schools investing in and sole reliance on in-house created case resources that are locked into a static online environment. Further, the availability of case material from a range of sources, including the development of learning object repositories tailored specifically for medical education (for example IVIMEDS), and the need to adapt cases over time suggest online collaborative PBL environments link to, rather than embed, clinical case resources.

The key support usually provided by the PBL tutor during this task is in helping the students make the link between the case and the overall curriculum. Within a web-based environment, the curriculum coordinator could construct a descriptive textual link as they select a particular case trigger learning object for each PBL cycle. In the UOW context this would include a link to the online core curriculum database. This may replace the need for a tutor to provide the facilitation at this early stage of the process and assumes self-directed initiation of the problem.

Task 2: Students identify and clarify the unfamiliar terms

Task 3: Students suggest interim solutions/conclusions

The important facilitation support provided by the PBL tutor in the face-to-face environment is creating a sense of ease and equality such that each student will identify the concepts or terms within the case trigger with which they are unfamiliar. The danger in moving this task online – particularly when students engage asynchronously – is the potential for the less confident or motivated students to delay their response or not respond at all. Implementations of collaborative task-based online learning have provided students with a structure to input initial responses to the task prior to engaging in group discussion and collaboration [13]. Thus, for the medical PBL environment students can individually complete a form that scaffolds their identification of unfamiliar terms and initial suggestions for a solution to the problem of the case. Individual responses can be collected on a separate page for all group members to view prior to discussion.

Task 4: Students define learning goals

The definition of learning goals helps direct students for their independent inquiry. Thus, the support of group interaction through a structured discussion space carries the benefit of collaboration from the face-to-face environment online when students are not co-located.

The question for practice in any particular context is whether this task can be facilitated by the group alone or if a tutor is necessary to support the direction toward definition of learning goals. In the particular context of UOW’s online PBL implementation, students will have...
previously engaged in two years of face-to-face experience with goal-setting. Thus, it is plausible to expect online PBL groups to be self-facilitating. What will be important is for students within the groups to continue to carry out necessary PBL ‘roles’—that is, group elected ‘chair’ and ‘scribe’ [4]. In self-facilitated online PBL interactions. To support the group moving toward conclusion of the discussion on goal setting the online environment could have scaffold within which the scribe can input the agreed learning goals. This sets a guide and a point of reference for students to engage in their self-directed inquiry.

**Task 5: Student engages in independent inquiry**

Web delivered resources aide students’ immersion in the self-directed inquiry task. Some medical schools leave this stage of the process completely to the individual student’s discretion to search, access, evaluate and incorporate the resources and literature relevant to their defined learning objectives. Others provide students with more direction with links to specific websites, journal articles, and/or textbook chapters organised per curriculum module or per case. Regardless the particular school’s approach, within the face-to-face learning environment, students often use the PBL tutorial session (and/or informal on-campus study meetings) to share and discuss the appropriateness of the resources they identify and use during this task. To support distance study, the online environment can include a support tool that provides a place for students to input links to the sources they have identified. Such a tool needs to provide a structure that guides students to annotate these links such that they can adequately describe the source to their group mates and thus link the relevance to the particular case and/or aspect of the curriculum in general. The tool then acts as a group-defined repository of resources.

**Task 6: Students share and apply learning to this and other scenarios**

As students re-convene their groups to share their independent findings a structured discussion tool can again be of support. At this stage we can replicate the interaction mechanisms and tools used in the goal-setting stage. Importantly the scaffold for the scribe to summarise the group findings will provide closure to the particular PBL activity.

4. Conclusion

The learning design framework of tasks, resources and supports provides a method of describing the PBL learning process in general and helps to design how the pedagogical model might be enhanced through technology tools.

In the context of the University of Wollongong’s medical school, the complement of technology tools will be progressively introduced to facilitate the PBL process during face-to-face sessions and as students move to rural and remote clinical placements. The focus will not be to attempt to reduce face-to-face collaboration when students are co-located but to investigate how the technologies can enhance the PBL process in both environments.

Within this medical education research context, as the academic debate regarding the efficacy of PBL continues, it will be critical to document the learning outcomes realised for students engaged in the pedagogical strategy within all contexts.

**References**


