

# Problem-based Learning: Impact and Implementation in a Workshop Setting

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*In this paper we report on two successful teaching workshops held before and after the meeting of the Federation of Asian and Oceanian Physiological Societies (FAOPS) in Kuala Lumpur in September 2002. The paper is structured to reflect the sequence of sessions during the workshops and expands information on the topics raised. Overall, the sessions modelled the processes of problem-based learning (PBL) approaches. Participating teachers were diverse. They reflected differences in national backgrounds, experiences of teaching workshops generally, and familiarity with concepts of PBL in particular. Two thirds of the participating teachers had some prior experience teaching in small group settings. Most of them came from regional medical schools that are using or plan to implement some elements of PBL in their curricula. Consequently, the interchange of ideas was particularly rich and varied. Workshop evaluations were very positive; those present indicated that they particularly valued the lively interactions amongst themselves and with the leaders. Here we raise issues relating to PBL, and include examples with relevant references. Each section is built around a specific session, although time was limited and some aspects could not be covered in great depth. As the workshops followed a problem-based approach, each group's discussion was unique.*

**Key words: problem-based learning, workshops  
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## WHAT IS PBL?

Problem-based learning is an approach or a concept introduced about 30 years ago at McMaster University in Canada<sup>[1,2]</sup> and now widely implemented. A problem (usually clinical) serves as a trigger to initiate the students' exploration and learning.

Students in facilitated small group discussion identify relevant issues for consideration and pursue

them in self-directed study in order to acquire new knowledge or skills, or to resolve the problem. Tutors do not teach content knowledge in a didactic manner. One key to the success and durability of this approach lies in the open and supportive nature of the tutorials. The role of the facilitator is crucial in helping students to manage the discussion productively and collaboratively. Consequently, group sizes must be kept manageable - nine or fewer students per group - for effective interaction and learning.

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An important strength of PBL is that student-directed learning and teamwork are encouraged and supported. This emphasis does not imply a handing over of responsibility from staff to students. Rather, it is preparing students for professional collaborative practice and highlights the need for them to identify areas of ignorance or uncertainty in order to seek out relevant information<sup>[3,4]</sup>.

For the students' learning to be productive and appropriate in PBL skills in critical thinking, reasoning and appraisal, the elements leading to problem-solving, must be developed. An effective tutor encourages students to challenge and test ideas, work logically through mechanisms and review the implications of suggestions and hypotheses. Such activities generate and support understanding, not rote learning.

Integration, a core characteristic of PBL at its initial introduction, encourages students to seek understanding and apply their knowledge across a range of traditional scientific disciplines. In addition, they consider issues from other common themes or domains of medical programs (eg community aspects, the needs of patients and families, professional and ethical concerns). Such integration makes for efficient learning when topics common across disciplines are studied simultaneously, in a consistent framework. Some institutions have, however, introduced "single subject" PBL, for example within physiology<sup>[5,6]</sup> or pharmacology<sup>[7]</sup>. While some of these more constrained programs have been well received, they lack the integrative learning across disciplines, which is so powerful and effective. One key issue is often the disjunction between the active learning of PBL and the passive absorption of knowledge in parallel didactic courses.

Good quality medical programs have goals and/or outputs defined. In some cases the overall expectations are driven by national bodies<sup>[8,9]</sup>, in others by accreditation or local issues<sup>[10]</sup>. PBL is powerful in emphasising broad goals in establishing critical thinking, life-long learning, integration, clinical rele-

vance, professional conduct and the application of knowledge. Thus the method and philosophy have been applied in many medical schools in different countries eg.<sup>[11-16]</sup>. More recently, similar strategies have been applied in many other areas of learning outside of medicine, including dentistry<sup>[17,18]</sup>, other health sciences, education, law and social work<sup>[19]</sup>.

As was apparent in the introduction<sup>[20]</sup> and in the discussion at the Round Table at the FAOPS conference (see the preceding paper), there is no universally agreed definition of PBL<sup>[21]</sup> and there may also be a gap between understanding and practice<sup>[7,22]</sup>. Harden and Davis<sup>[23]</sup>, see a continuum in PBL practice. Many teachers use the term to refer to any teaching activities, however didactic, if they start with the token introduction of a problem or clinical case.

To be consistent and to ensure mutual understanding, there is a need to develop definitions and use commonly agreed terms.

## WHY USE PBL?

Simply, PBL is used because it works to the satisfaction of students and staff in many institutions.

Strong evidence demonstrates that PBL students learn as many "facts" as in conventional programs and perform as well on national examinations<sup>[24-26]</sup>, although<sup>[27]</sup> drew the opposite conclusion from those published data. In addition, it is anticipated that students should also acquire other long-term skills which are harder to assess, including problem-solving, teamwork professional conduct, critical appraisal and peer communication, the application of textbook knowledge to clinical situations, an ongoing commitment to professional learning, but see<sup>[28-30, 31,32]</sup>. Students early in PBL courses are less likely to resort to rote learning<sup>[33]</sup>.

The adoption of PBL is increasing, but why is it not more widely applied? Conservatism of staff is common: any change is opposed on principle and academic territories may be threatened. In addition, some opposition lies in myths that critical-thinking

academics ought not to accept readily. Costs are sometimes seen as an impediment and some authors assume that PBL is of necessity more expensive<sup>[29]</sup>. It is, however, possible to calculate the staff costs for PBL tutorials and to organise other learning activities so as to remain within the budget available<sup>[34]</sup>, rather than the reverse approach<sup>[27]</sup>. Additional activities and resources to support PBL can be reviewed and selected because they are affordable, based on local circumstances<sup>[35]</sup>.

### **DEVELOPING APPROPRIATE PROBLEMS**

The development of appropriate trigger problems is an early step in implementing PBL. Problems may be acquired from other schools or from published materials. These may be free or inexpensive through partnerships, but acquiring an institution's intellectual property is usually costly. Cases developed elsewhere, however, seldom exactly meet local needs in terms of the specific goals, the demographics of disease, community issues, local subject expertise, curriculum design and the expectations or prior educational experiences of the students. Nevertheless, a number of PBL schools will accept short-term visitors and observers and workshops or seminars are increasingly available. A collaboration between three Australian medical schools<sup>[36]</sup> offers a powerful model when several institutions within a country or region are planning PBL simultaneously.

Generally, the early problems emphasise common or important clinical issues or variations in normal function and stimulate an understanding of basic mechanisms. Good problems provide enough information to generate discussion on basic and clinical sciences, as well as social, community and professional issues. Local situations determine the choice of appropriate problems and detailed learning strategies<sup>[35]</sup>.

In planning the progressive development of learning in a PBL curriculum, the problems and ma-

for associated learning issues must be identified and mapped. Gaps and unnecessary duplication can be avoided by reviewing the learning from a range of perspectives. Curriculum maps need only be simple and inexpensive to be effective and valuable<sup>[37]</sup>. Optimally, a small group is responsible for overseeing the entire curriculum to ensure consistency, although some schools retain departmental control of clusters of related problems.

Triggers initiate the discussion. They vary between institutions and may be presented in writing, or, to encourage observation, as an image: a photograph, video, or computer screen or the use of a simulated patient. Triggers may be quite brief (a common Australian pattern), stimulating the students to generate hypotheses broadly on the basis of limited initial information. In other schools (eg. in North America), the first presentation often provides rather more detail<sup>[38]</sup>. Students then react to the information and tease out learning issues. The differences may in part reflect styles of medical practice. Additional triggers or further information may be provided as the discussion proceeds, designed to advance, not subvert, the discussion.

The information provided is crucial in highlighting the issues and - at times - setting some boundaries. Unless guidance is provided, students may totally misinterpret the intentions, as happened in one of the recent workshops, or be unfocused in their explorations. Deviations from the intended "coverage" or "depth" are not significant for a single problem, but major goals may not be achieved if guidance is consistently ineffective.

A well-planned problem will stimulate interest and provide enough hints for the students to direct their learning activities appropriately. Thus problems for beginners would normally encourage the critical understanding of fundamental concepts on disease and illness using common clinical scenarios as triggers of learning, not dwelling on clinical detail. (Students generally need no encouragement to find the detail!) Later, the emphasis may well be

more on resolution of clinical mechanisms and become more problem-solving diagnosis, effective treatment and disease/patient management. In order to establish whether the trigger is effective and the guidance appropriate, it is useful to trial problems with colleagues or students. Some schools use an explicit cognitive map as a framework for the progress of the tutorials<sup>[39]</sup>.

Having identified key issues, staff must ensure that students have access to learning resources (texts, references, images, data, learning programs) that will provide good quality information at an appropriate depth and level. Increasingly the internet or intranets deliver these resources, often along with formative assessment<sup>[40]</sup>. Providing that the overall process is not circumvented, a few relevant classes may also be offered, including seminars or lectures; skills are developed in practicals, evidence-based medicine exercises and clinical work.

Tutor guides are invaluable aids to staff. The best are short (fewer than about 5-6 pages) and easy for tutors to use for preparation; they provide assistance (without excessive detail) within the tutorial and indicate the natural "flow" of the session. Topics of importance and relevance may be indicated, but the aim is not to dictate the scope of knowledge or to direct the discussion. Overall, they enhance the systematic working through the problem and provide comfort, especially to new tutors. An excessively detailed and highly structured tutor guide (often requested by non-expert tutors as a safeguard) tends to be misused inflexibly and may even inhibit students from raising or pursuing issues not listed in the guide, thus dampening the spirit of self-directed learning central to PBL.

## THE FINE ART OF FACILITATING

Facilitation of a group is the obverse of didactic teaching<sup>[41]</sup>. Students make the running, generating and owning the discussion<sup>[42]</sup>. The possible number of interactions within a group is very large (rising

factorially with the size of the group), so the tutor must manage them<sup>[43]</sup>. A relaxed approach and some humour help. Staff development is essential<sup>[42,44]</sup> and a guide for students is helpful<sup>[45]</sup>. Case studies of issues arising in PBL are provided in<sup>[46]</sup>.

A good tutor shepherds the discussion gently, encouraging the active processes of enquiry and reasoning. Myths about PBL suggest that the tutor is silent or simply sits and says "hmmm" every so often. Good tutors do engage actively with groups, although they neither lead, nor instruct. They need to be familiar with issues/principles raised by the problem, ideally supported by a good tutor guide. There is a fine line between merging, to become just another participating group member, and being sufficiently detached to observe and offer subtle guidance and appropriate feedback.

Being an effective and skilful facilitator in maintaining good dynamics in group-learning, a good PBL tutor should be very observant and sensitive to the needs of individual students that are often expressed non-verbally<sup>[47]</sup>. It would not be an exaggeration to state that a tutor's working relationship with the group may hinge upon the sitting arrangement for the tutorial session. A tutor most effectively sits with the group members who that he/she is accepted by the group as a member and it is possible to make eye-contact with all members. If the tutor sits outside the group, he/she sets up a boundary, intentionally or unknowingly, separating him/herself from the group. It then becomes difficult to have face-to-face interactions with all members. This latter is also an important reasons for ensuring that the group size is not too large for effective PBL sessions.

Are expert or non-expert tutors most effective?

Everyone is most comfortable with topics in areas of personal expertise, but there is a temptation to short-circuit discussion and offer "the answers". Some tutors cannot resist any opportunity to give a mini-lecture, an inappropriate behaviour. Other tutors intervene too little, failing to encourage students to think critically and rigorously. Yet others intervene too fre-

quently and prematurely, not allowing students to experiment with establishing their own group dynamics. The best tutors are well prepared for each tutorial, actively maintain and observe the process, recognise and respect difference, offer constructive and frequent feedback and are "student-friendly".

They may have some relevant clinical or scientific knowledge, or they may have backgrounds (eg in education or psychology) which prepare them well for observing and managing the interactions. Groups accept and value different styles of tutor and tutors learn to use different strategies depending on the group.

The value of feedback cannot be overestimated: to students on their contributions to the process, and from students on the tutor's role. While most good PBL schools provide time for such feedback, usually in the form of formative evaluation (see later discussion) at the end of the week or even at the end of each PBL session, it may be necessary to intervene at other times. Giving feedback to individuals is generally uncomfortable, whether for staff or students.

There are, however, different styles of interaction and degrees of skill in providing and receiving more personal comments. To some extent that is a result of individual and national characteristics.

A well-functioning group is active, happy, learning enthusiastically and even noisy at times; a non-functioning group is a set of discordant, acutely miserable or even warring individuals. Some typical examples of non-functioning PBL tutorials due to a lack of understanding of the roles of the tutor or a lack of effective tutor training have recently been described<sup>[47]</sup>.

### **SUPPORTING PBL WITH LEARNING RESOURCES AND ACTIVITIES**

If students are to direct their own learning, they need access to libraries, textbooks and other resources, including those on computers. Librarians are in-

valuable contributors because of their strengths in developing students' skills in information literacy and in the provision of materials. Since students have different learning styles, a variety of resources is needed since not all are equally popular or useful. Of course, such resources are not universally available or affordable and institutions have to make decisions on priorities.

Many programs provide some formal classes - lectures, seminars, clinical or practical work - to supplement the PBL tutorials. They were described as "hybrid" by<sup>[48]</sup> and may now represent the majority of so-called PBL programs. When classes are small, students can interact directly with staff, and seek specific help as needed. In large schools, timetabling is inflexible; classes must be scheduled and rooms booked months or years in advance. When additional sessions offer insights into broad issues regularly raised by the groups, or develop specific skills, there need be no conflict with the principles of PBL. In some institutions, however, didactic lectures are given before PBL sessions so that the PBL provides more "clinical relevance". In others, didactic classes explicitly "solve" the problem following the initial PBL session. In those cases, the groups' enquiry processes are subverted and learning is not self-directed.

Increasingly, access to learning resources is offered on Webster. At the University of Sydney, the medical site is designed to mirror and support the PBL process<sup>[49]</sup>, see <http://www.gmp.usyd.edu.au>; a similar approach is used on the Sydney dental website. A trigger, such as photograph(s) and brief text initiates the first tutorial and engages attention. After discussion, students may access a range of online articles and reviews, evidence-based medicine resources, specially prepared summaries of relevant topics, recommended websites and formative assessment (see below). During and after the second tutorial some relevant results are available (eg laboratory data, diagnostic images) if the group justifies a reason for accessing the information, and at the end

of the third tutorial a short summary of the features of the case is made available.

In medical, dental and other health care professional programs, clinical skills relevant to the weekly learning are often introduced and practised. It is a very effective strategy. Students particularly benefit from exposure to patients with problems related to the weekly learning.

### **ISSUES IN ASSESSMENT**

Assessment in PBL programs poses many philosophical and practical issues; it remains a significant challenge. Biggs<sup>[49]</sup> emphasises the need for aligning the goals with the strategies both for learning and assessment. PBL, that encourages students to think broadly and follow up issues of interest, is not well matched with a set of closed examination questions that demand only recall. Further, the award of competitive grades or marks on examinations based on PBL tutorials can influence negatively the sharing and cooperation within groups.

Self-directed learning in PBL is well supported with a system of formative assessments that do not count towards progression. Students can evaluate their knowledge as they go, and gain confidence in the appropriateness of the depth and breadth of their understanding. Formative assessments can be in the form of quizzes and may include for practice question formats that will be used summatively. They can be made available on-line.

It is a challenge to assess summatively (for progression or graduation) in ways that are consistent with the PBL process. An examination requiring no more than factual recall is not appropriate. Most large schools find it necessary, though, to use some multiple-choice questions. While such questions can be set into a framework of problems, they usually only test recall. Modified essay questions, consistent with PBL, allow students to reason through a problem, providing short answers at each step. They require careful setting, close supervision

during the examination and matching responses to prepared model answers. Related practical and clinical skills can be tested using Objective Structured Clinical Examinations (OSCEs) or OSPEs (Objective Structured Practical Examinations). The triple-jump exercise ("exercise" is used in place of examination to remove the undesirable suggestion that it is a traditional summative examination) was originally developed at McMaster<sup>[50,51]</sup> and mirrors well the PBL process. It is labour-intensive and has low reliability for summative purposes. It is therefore used formatively to reflect the student's familiarity with the PBL process, especially in the first 6 months when students are adapting to the new and unfamiliar learning process.

As noted, essential weekly components of formative assessment in PBL include the provision of feedback to students in the group, and students have the opportunity to comment on their tutor's contribution. Such discussion occurs at the level of the whole group, but it is also common for tutors to interview students individually. Some schools use an external tutor to monitor and evaluate each group. Such tutors' comments on the contributions and interactions are ideally formative. In some schools, however, summative marks or grades are awarded for each student's performance in the tutorials although concerns have been expressed that the competitive element may interfere with the group process.

### **EVALUATING PROGRAMS AND WORKSHOPS**

Evaluation of the effectiveness of a PBL program is critical to ensure that the program meets its own goals, and that it meets the students' needs. A rigorous scrutiny of the results of well-structured examinations can provide useful information about student's strengths and weaknesses, whether in content knowledge and understanding or skills in reasoning and integrating information. As noted earlier,

comparisons with students in conventional programs have been undertaken<sup>[24-26]</sup>. They are usually of limited value, being restricted to the domain of recalled knowledge. Other potential issues for evaluation include for example the capacity of students to apply knowledge, solve clinical problems, think critically, and work effectively in a team. One simple measure, that of enjoyment of the program, is usually higher for PBL<sup>[18-20]</sup>, and Albanese<sup>[52]</sup> argues that perhaps collegiality and teamwork are the attributes of greatest value in PBL

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