

Problem-Based Learning: New Road to Learning at Hamamatsu University, School of Medicine

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English

Abstract: This paper seeks to give an overview of the classroom methodology called Problem-Based Learning (PBL) that is the foundation for the new approach being adopted for implementation at the Hamamatsu University School of Medicine. Here I will briefly examine the rationale for implementing PBL, describe the basic theory of how PBL works, highlight some of the problems that need to be overcome in implementing it, and report some of the progress being made in our institution. Although the change to PBL is not an easy road to travel initially, it does have the greatest potential to produce the new breed of doctors needed to modernize Japan's current medical system, create a more patient-friendly environment and foster more satisfying career paths for our graduate medical practitioners.

Key words: problem-based learning, medical students, classroom methodology

The beginning of change

University education in Japan is currently facing many challenges and medical schools are no exception. Japan's university system has had to adapt rather quickly to a growing market orientation in higher education spurred on by the University Deregulation Law of 1991 and subsequent incorporation of public universities in April 2004. These changes have impacted on public expectations of universities for improved performance and necessitated the modernization of practices in research, teaching, and management. One of the most significant changes implemented in 2003 at the Hamamatsu University School of Medicine was the introduction of a Problem-Based Learning (PBL) program for third-year medical students.

Why has PBL been added to our medical curriculum? Firstly, the curriculums of most medical schools aim to provide a wide range of learning experiences and objectives ranging from formal lectures, laboratory practice, demonstrations, written assignments, small group tutorials, one-on-one interactions with faculty members, and bedside teaching in an inpatient environment to prepare their students for their future careers. PBL has proven to be an even more valuable tool in educating new doctors and is well suited for medical education; in fact, the PBL approach was first established in the early 1970's at the medical school of McMaster University in Canada. Its superior utility to traditional teaching methods has enabled it to spread rapidly and now PBL flourishes in medical schools around the globe as well as being increasingly adopted for use in other disciplines and professional schools. In addition, as it has spread it

has also been further developed and has evolved to produce numerous variations to suit different needs and purposes of each educational institution adopting it; this is also the case in Hamamatsu.

Secondly, PBL has highlighted the shortcomings of traditional education. One of the basic assumptions regarding traditional learning in educational institutions generally appears to be that learners with the requisite amount of intelligence, as determined by entrance examination success, taught by teachers with professional knowledge and skills results in learning. However, in reality not all students succeed in acquiring all the knowledge and skills required by their courses of studies but they can still receive a passing grade (O'Dowd 2003). Research into learning over the past two decades has shown the former assumption about learning success is rather naive, as cited by Bridges (1992):

1. Students retain little of what they learn when taught in the traditional lecture format.
2. Students often do not appropriately use the knowledge they have learned.
3. Since students forget much of what is taught by the time they graduate, these gaps in their knowledge may adversely affect their future professional performance and practice.
4. Their acquired knowledge has not been anchored to realistic contexts, therefore they lack the ability to elaborate on new information and think broadly when confronted with problems.

This then leads to the question of the relevance of traditional examinations. Many students are successful under the traditional lecture/exam system because of their ability to cram for a test; however, memorizing information just for an examination doesn't mean that they are successful learners (O'Dowd 1996, 2003). And many students continue this very poor study habit throughout their medical studies because it has delivered "success" in the past, even though cramming does not produce real learning. In particular, such students will not develop the deep understanding of the vast amount of medical knowledge needed as the basis for their future career in medicine. PBL, on the other hand, aims to anchor learning through experience tackling realistic problems and helps students develop a deeper understanding of knowledge through discussion, research and application.

And thirdly, PBL has the greatest potential to produce the new breed of doctors needed to modernize Japan's current medical system and make it more efficient, patient-friendly and more satisfying for medical practitioners. In recent years, the mass media has increasingly reported and exposed the failings of Japan's medical practitioners leading to vocal calls for change and more openness along the lines of foreign medical practices, for example, informed consent, second opinions, a greater degree of discussion regarding options for treatment, and more patient-friendly manners. One way to achieve these changes is to adopt some of the training methods used in foreign medical schools that have proved successful, such as PBL. Thus, PBL has been chosen as one of the main vehicles for reform in Japanese medical schools.

What is PBL?

PBL is a cutting-edge instructional method that has gained a lot of attention and interest in recent years in many educational settings, not just medical schools, as a replacement for traditional lecture-style teaching. Indeed, David and Harden (1999) refer to PBL as the reverse of the traditional approach to teaching

and learning. In this new approach, the starting point is a case-problem given to students who then work through it to derive the general principles, concepts and knowledge needed for their course of study. More to the point, PBL aims to stimulate learning by presenting students with realistic problems to solve in a cooperative group environment guided by a tutor who facilitates the entire process. Through the PBL process, students not only acquire the necessary knowledge for their course of study but also learn critical thinking skills, communication skills, problem solving skills and life-long learning skills.

Even so, no one involved with implementing PBL thinks it's easier than regular teaching or takes less time. In addition, as with almost every other modern innovation in teaching, both students and teachers are sometimes uncomfortable, at least initially, with the process. Why, then, have medical schools and other institutions embraced PBL so enthusiastically? The main reason is PBL produces a better product, that is, students who have a better understanding of the materials they have studied and the opportunity to practice higher-level learning skills. As opposed to regular lecture-style teaching where students sit, often passively, through many long hours of lectures to collect facts to be memorized for the purposes of passing some abstract form of test, with PBL students learn via contextualized problem sets and realistic situations and apply a variety of learning skills to develop higher-order thinking and understanding. And combined with the dynamics of small group work and independent investigation, they can achieve higher levels of comprehension and develop better learning and knowledge-forming skills in addition to better social skills. This exciting approach to teaching and learning brings new knowledge into play more rapidly than traditional methods and fosters the acquisition of knowledge that can adapt quickly to new situations.

How PBL works

Rather than the traditional approach of spoon-feeding students content through lectures, PBL challenges students to “learn to learn” by working cooperatively in small groups to explore solutions to similar problems they would meet after graduation. PBL is based on the idea that a study program should primarily develop students learning and thinking abilities in order for them to gain a deeper understanding of course materials and be better prepared to face real world challenges after graduation.

Here is a basic outline:

- The course content is divided into modules. Sets of problems are developed for each module that will lead students through all the necessary course work to be covered.
- Each class is divided into small tutorial groups of approximately five students each.
The groups' membership generally remains constant throughout the semester although the teachers/tutors may change.
- Students are presented with a series of tailored problems, based on realistic cases that reflect course materials and goals, to engage the students' interest and stimulate learning of the target subject matter.
- Students then pool their current knowledge of the topic and list it under the heading “What do we know?”

- Discussion and analysis then enables them to construct a problem statement. This is merely a starting point and may be revised as assumptions are questioned and new information is added.
- The group then identifies the “learning issues” they believe each new problem presents; under the heading “What do we need to know?” students develop questions that must be answered to address missing knowledge or to illuminate the problem.
- Under a third heading, “What should we do,” students decide how to divide their labors to resolve these questions and record matters such as what specific actions must be performed by the next tutorial. Students then gather information from all available sources; the school’s library, internet, and from experts on the subject.
- As new information is collected, it is analyzed within the group for its application to the problem statement and usefulness in refining their initial working hypotheses.
- This process continues until the target topics have been covered.
- In the final stage, students reflect on the process they have carried out and on the content knowledge they have now studied through the module’s problem.
- The module ends with an assessment of student achievement of the learning goals. This assessment may vary according to the tutor or institutional requirements.

Through this process, PBL prepares students to start thinking critically and analytically, and to find and use appropriate learning resources. The goal of PBL is not to find the solution to each problem but for students to learn primary concepts and develop critical thinking and communication skills. PBL places the responsibility for learning squarely on the students while teachers/tutors move from being providers of content to facilitators of learning.

Critical Issues

Before integrating an innovative PBL program into the regular curriculum, a number of critical issues need to be considered. In particular, it needs to be recognized before implementation that PBL is a significant departure from the traditional teaching system that administrators, teachers and students have previously experienced; it is different and therefore requires some preparation and understanding of its major features in order to fulfill the great expectations placed on it.

New thinking

At the outset, it is important for both teachers/tutors and students to adopt new thinking, approaches and frameworks for learning in the PBL class environment. For example, rather than teachers lecturing and spoon-feeding facts to the students, the vehicle for learning is a problem given to the students “cold”. In the tutorial time, students discuss the elements of the problem, generate hypotheses to test, identify relevant facts, and propose learning issues. Unlike standard classes, students generate the learning issues or objectives based on their analysis of the problem and guided by their tutor. If prerequisite knowledge necessary for a problem’s resolution is missing, then students are responsible for obtaining it and sharing it with their group members.

Case problems

As its label implies, PBL is based on learning through problems that guide students to knowledge. And as mentioned earlier, these problems should reflect real world scenarios that raise the concepts and principles relevant to the topic area. One of the most critical issues in PBL is the creation or selection of problem scenarios for each module of the program. Indeed, one of the perceived problems of PBL is the paucity of suitable case problems; if good problems aren't given to students, the process will not unfold as it should and so won't be as effective. Problem design has therefore received a lot of attention in PBL literature and led to the identification of seven main elements (Dolmans et al 1997, cited in Davis and Harden) that can be summarized as follows:

1. Learning outcomes: faculty learning objectives should be reflected in the learning issues likely to be identified by students.
2. Phase of the curriculum: problems should reflect the phase of the curriculum and allow students to build on prior knowledge and advance their understanding and learning.
3. Relevance and motivation: problems should be interesting and relevant to the students future practice, thus encouraging them to spend more time on self-study.
4. Integration: basic concepts and knowledge need to be integrated into the scenario.
5. Cues: cues are needed to guide students and stimulate their discussions and elaborations.
6. Open problem: problems should not be so complete that only one answer is possible. Instead, they should be "ill-structured" or incomplete to enable open discussion and research options.
7. Student activity: all students need to be involved in the process of acquiring the necessary knowledge, and not allowed to coast along on the labor of others. Students should be motivated to carry out detailed investigations of multiple research areas to fully achieve the multiple goals of each set problem.

Higher level learning

PBL problems should also strive to induce students to higher-level learning and critical thinking skills. Traditional classroom learning usually centers on low-level skills like remembering facts, terms and definitions so many students lack the motivation or incentive to go beyond the superficial acquisition of facts to a deeper understanding of subject material. In his seminal work, *Taxonomy of Educational Objectives* (1956), Bloom organized cognitive levels from simple to complex and illustrated these with parallel student activities, highlighting the need to break the traditional learning mold by arranging learning materials and activities at the higher levels where students apply principles, analyze, synthesize and evaluate.

Bloom's Cognitive Level Student Activity

Evaluation: Making a judgment based on a pre-established set of criteria

Synthesis: Producing something new or original from component parts

*Analysis: Breaking material down into its component parts to see
interrelationships / hierarchy of ideas*

Application: Using a concept or principle to solve a problem

Comprehension: Explaining/interpreting the meaning of material

Knowledge: Remembering facts, terms, concepts, definitions, principles

This is also the aim of PBL.

It has been observed that one of the reasons that students have difficulty adjusting to PBL is that they do not possess these higher level learning skills. If they do not possess such skills and are unable to develop them while studying at the university level, how are they expected to acquire them by the time their graduation? How can they be an effective doctor without such skills? Thus one of the challenges confronting tutors is how to help students develop the needed variety of learning strategies and critical thinking skills while at the same time trying to acquire the knowledge necessary for their course of study.

Role of the tutors

Another critical issue concerns the perceived role of the teacher/tutor. Past cases in implementing classroom innovations, such as PBL programs, have shown that many teachers harbored serious concerns about the “radical” departure from traditional teacher-centered methods and experienced acute anxiety over their perceived loss of control of the learning environment (O’Dowd 1995, 1998). This natural reaction to innovation highlights the importance of first preparing staff for change with a targeted faculty development program in PBL. At his September 2004 lecture on PBL at the Hamamatsu University School of Medicine, Professor Gordon Greene of the University of Hawaii’s John A Burns School of Medicine told the assembled staff members of the importance of having PBL tutors actually experience learning through PBL for themselves before they undertake directing such learning for their students. To paraphrase Professor Greene, the best way for tutors to understand PBL is to do it and discover for themselves how engaging the process can be and how exciting the final results. He also emphasized that tutors are still an integral part of the PBL process and should not fear the process becoming more student-orientated as it is the students who need the process more than the tutors.

Responsibilities of students

Finally, it is essential that each student take responsibility for and ownership of the process for it to achieve its goals. If they do not, they will waste their time waiting for the tutor to do more for them or trying to figure out what the tutor really wants. It is up to tutors to make it clear that students themselves are the ones who must be responsible for doing the work; cooperating and contributing to group discussions, sharing the workload of finding information and developing solutions to problems that do not have one “right answer.”

In addition, students more adept at “book learning”, cramming and memorizing may feel uncomfortable in PBL roles that require them to discuss and analyze problems, conduct research in a timely manner, coordinate with other group members, and generate alternatives and solutions. Fortunately, with time, stimulation and guidance, most students will develop and grow with PBL and will not only acquire the necessary knowledge for their course of study but also learn critical thinking skills, communication skills, problem solving skills and life-long learning skills.

Problems in Implementing PBL

Implementing any innovation is always fraught with difficulties and PBL is no exception. Many teachers as well as students used to traditional forms of instruction have experienced some “shocks”, from the lack of rigid class structure to the uncertainty of what they should actually be doing. Making it work to its full potential takes time, patience and a willingness to accept a degree of risk and uncertainty with this type of classroom methodology.

Passive students may at first be ill prepared for the active demands that will be made on them with PBL. Studies on student motivation and their use of learning strategies (O’Dowd 1996, 1999, 2003) have shown a strong dependence on a relatively small number of strategies and low-level cognitive skills and a general lack of motivation to stretch themselves intellectually by not engaging in much more than the minimum requirements. For example, in the first year of PBL in Hamamatsu, tutors have experienced cases of students being more concerned about what they have to do to “get their grade” than in adapting to the new PBL format. Therefore students who are used to having the lesson objectives, assignments and solutions to problems handed to them will most likely be very reluctant to take risks on their own without some form of guidance initially. In such cases, tutors may need to take on the role of metacognitive coaches by serving as models and demonstrating what is required, that is, thinking aloud with students in discussions, prompting students to contribute and formulate questions, and suggesting different types learning strategies they want students to try. Over time, as students become more comfortable as self-directed learners, the tutors can fade into the background and resume their real role as facilitators of the process.

There also exists a lack of understanding about the purpose of learning through problems. It takes a lot of effort to convince students that PBL is about a learning process for them and not about a correct answer to the problems set for them. Due to the initial “novelty” of the PBL process, tutors new to this process have been tempted to give students key variables, too much information, too much direction, or simplistic problems as a way of helping students; this serves only to short-circuit the system and confuse the students as the various groups compare their experiences in PBL sessions.

Progress leads to success

As part of my research on this topic, oral interviews were conducted with several third year students currently engaged in PBL and they report that good progress is being made. Some of the successes of PBL reported by students include:

- * Students enjoy working together in the small group tutorial environment.
- * PBL allows students more personal communication with tutors.
- * Students are losing their fear of speaking out in the group discussions.
- * PBL is generally considered a better style of learning.
- * Students have found it easier to understand terms, ideas and topic content.
- * PBL’s assessment format is favored over the normal one-big-final-test format.

Of course, further development, improvement and refinement of core elements of our PBL system is still

needed but the outlook is positive if student acceptance can be taken as a guide. Even so, it needs to be remembered that the adoption of PBL is a constructive and evolutionary process rather than a revolutionary one. Change and improvement should be seen as part of a continuum of development of student abilities that should be embraced and encouraged by students, tutors and the institutional administration.

Conclusion

Although innovation and change are necessary for educational reform, the adoption of untraditional instructional models may initially appear risky, frightening, and create uncertainty amongst teachers, students and educational administrators. This is especially the case when implementation does not go as smoothly as expected or produce immediate good results. This can be said of PBL when students new to the PBL processes may actually learn less at first because it is unfamiliar to them. Fortunately, as with almost every other innovative reform in teaching, these problems can be overcome; the successful PBL programs in the USA, Europe & Australia are testament to this fact.

It must be recognized that becoming comfortable with PBL will take time, and will consume more of the tutor's time and energy as they work to keep their tutorial groups on course. The good news is that the problem-based learning environment is exhilarating, meaningful, and rewarding not only in the short term but in the long term as well. It may turn out to be one of the most exciting things both students and tutors will experience in their time together at the medical school.

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