



What is Problem-Based Learning (PBL)?

It is magic, myth and mindset

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So, What is PBL?

PBL is becoming an increasingly popular pedagogic jargon. "What does PBL stand for?" your students may ask. Whether PBL stands for Problem-Based Learning, or Partnership and Bonding in Learning (cited from the 'PBL Student User's Guide' by the PBL committee of NUS's Faculty of Medicine), it makes no difference to some students who do not care as long as this is not a question in the examination. There are those who care and are curious; they want to know not only what PBL stands for, but also how PBL works. I am sure that this holds true for teachers as well.

According to the citation used in the PBL student User's Guide of the Faculty of Medicine here: "Problem-based learning (PBL) is grounded in the belief that learning is most effective when students are actively involved and learn in the context in which knowledge is to be used". This was indeed the philosophy that McMaster University based upon in the inception of its medical education more than 30 years ago. Therefore, PBL is active learning with particular relevance to the learning objectives (as opposed to the traditional passive spoon-feeding rote learning based on teacher-designed didactic lectures and instructions). 'Active' implies dynamic interactions among the learners and

'learning' signifies the focus on the process used by the learners rather than the process imposed by the teachers. Life is too short and knowledge is too broad. Learning must be relevant to learners' objectives in order to be effective and efficient. In medical education, the learners' knowledge and skills will ultimately be applied within the context of biomedicine and healthcare. Then their learning would be most effective using scenarios of clinical situations as the triggers for learning. The scenarios then become the trigger problems in PBL (which are often referred to as 'Health Care Problems' or 'HCPs' in medicine) as a means to trigger the learning process. The primary aim is not to solve the clinical problems. Therefore, PBL should not be mixed up with problem solving, although problem-solving skills usually result as a benefit of PBL. This is also distinctly different from the traditional clinical case study, either in tutorial format (sometimes called 'small-group conference teaching') or the bedside format during the clinical years of the students. In both conventional tutorials and bedside teaching, the teacher remains as the centre of students' learning, and problem solving is usually the bottom line.

From the above, you may realise that PBL is not a monopoly for medical education, it applies widely to learning in most professional schools and disciplines, including Nursing, Dentistry, Art, Music, Architecture, Archaeology, Engineering, Law, etc. In fact, PBL was first applied in business schools.

In PBL, students learn using carefully designed scenarios from which the issues are identified and the objectives developed. Students learn whatever relevant to their learning objectives. They learn what they need and when they have to know.

PBL: Magic or Myth?

In the traditional curriculum, preclinical disciplines, such as anatomy, biochemistry, physiology and pharmacology are prerequisite for proceeding to paraclinical subjects and clinical specialties. They are mainly knowledge-based and usually taught didactically by experts in given disciplinary areas, often as large group classes in lecture theatres. In contrast, in the PBL curriculum, HCPs are designed as a guide for learning from an integrative

perspective. Knowledge in anatomy, physiology, pharmacology, microbiology, biochemistry, community medicine, etc. will all come into place as long as they are of significant relevance to achieving the learning objectives of a given HCP as defined by the students. Students usually manage the learning pace and strategy in PBL with maximal flexibility within the boundaries clearly defined as the study road map listed in the students' handbook. This is called 'self-directed learning', a distinct characteristic of PBL. One should not mix it up with 'self-indulgent study' or 'self-willed learning' in the traditional system

In traditional education, teaching is generally overdone and learning is underserved. Students have little or no time to digest, comprehend and integrate the imposed materials.

where students were left alone to cram for the examinations. Teachers serving as tutors are not knowledge-providers as in the case of spoon-feeding; they serve to facilitate the learning process. Instructions are carried out via discussions among students in small-group tutorial format, where all members (including tutors) know each other by the first names. This small-group learning should not be mistaken as small-group teaching as in conventional tutorials and bedside teaching noted above.

The traditional curriculum still entails the education principles based on didactic teaching generally practised in the secondary schools, while the PBL curriculum represents scenarios analogous to adult learning imprinted with maturity and professionalism. Therefore, PBL represents a learning behaviour, which differentiates tertiary/higher education from the secondary school education. Most teachers carry the mentality that medical students must be well equipped with as much basic science knowledge as possible in case they need to apply it in clinical years 2–3 years down the road. This is the so-called 'in case' approach in teaching. In PBL, students learn as the issues are identified and developed, be it basic science or clinical skills, anatomy or physiology. They learn whatever is relevant to their learning objectives as identified in the HCP. They learn what they need, when they need to know it. This is called an 'in time' approach to learning.

PBL: A Change of Mindset

To increase the competitive edge, politically or academically, an increasing number of traditional professional and educational institutions are adapting PBL as an operating strategy with variable degrees of understanding of the underlying philosophy and the readiness for implementation. I have encountered places and situations where PBL was superficially treated as a teaching methodology or a course (i.e. PBL was claimed to be in practice, but with little evidence of PBL spirit). It is also not uncommon to observe that traditional didactic lectures are used to complement or enhance learning in PBL in a so-called 'hybrid system'. This system may have a chance to succeed if the

lectures are kept to a minimum and remain interactive as well as integrative. Theoretically, it would be very unusual to come across a hybrid system where PBL is used as a complementary strategy to enhance the effect of the traditional didactic lectures. This is like using the slide-rule to aid computer calculation. However, the reason for the appearance of various forms of PBL is simple: there are major differences in the mindset as a result of the historical burden chronically carried by an established traditional institution. For instance, your builders will tell you that it is much easier and cheaper to build a new house than to renovate an old house; and your car mechanic will also advise you to put in a new engine rather than to repair an old functionally defective one.

Students are young and flexible enough to learn to be tolerant and adaptable to new ways of learning. It is a common observation that persistent resistance, despite the evidence of many successful examples, comes largely from teachers. The sentiment of resistance generally reflects ignorance, insecurity and fear. In the traditional system, teachers are used to being in full control of the learning activities (because they are knowledge-providers); in PBL, they may no longer enjoy such power in the group. In the traditional system, teachers are perceived as experts on the subject they teach; in PBL, they become non-expert tutors and feel so insecure and frustrated about being unable to answer questions that are not within their expertise area. Besides, handling the group dynamics amongst students is new and uncomfortable for the traditional teachers, who have never received training in this area. The fear of the unknown and the unfamiliar causes high anxiety in teachers. High anxiety leads to avoidance, and therefore, resistance and rejection. Furthermore, teachers favour didactic teaching in the traditional system because they need to justify being paid to lecture as teachers. It is natural and more comfortable for these teachers to follow the same way their teachers taught them. So, the vicious cycle perpetuates and the mindset reinforces itself and becomes too deep-rooted to accept revolutionary alternatives. At best, they may accept some evolutionary changes by decorating their teaching with some PBL-like activities. This is indeed how various forms of PBL get cloned and confuses many newcomers.

The resistance against PBL is usually not due to the mindset of students, but the mindset of teachers.

So, how should the mindset of the teachers be changed to put PBL in the proper perspective? The anxiety and fear in teachers should be removed by leading them to understand the true spirit of PBL, by training them to be effective facilitators (as tutors) and teachers (as resource persons), by providing feedback and guidance to their performance in facilitating learning and handling group dynamics, and by giving them attractive incentives and rewards. This topic is a broad but also very important subject of PBL in its own right. It may deserve a separate future discussion involving administrative strategies. □

Can Asians Do PBL?

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Author's Note

The original title of this paper was 'Is the Asian Culture an Inhibitory Factor in PBL?' As I thought about it, I realised that by borrowing the title from Kishore Mahbubani's thought-provoking book 'Can Asians Think?', it would be easier to approach this issue.

Can Asians do PBL? Adopting the same approach as Mahbubani in his book *Can Asians Think?*, the answer is "No", "Yes" and "Maybe". Before I explain this ambiguous answer, PBL needs to be defined as it is generally accepted. Recently, PBL has been recognised as an innovative educational approach although it has been practised for more than 30 years in medical education at McMaster University. It has been shown to have the potential to enhance the educational process and its outcomes. The basic principle is that learning can be initiated by starting with a problem that the student wants to solve. In trying to solve the problem, the student generates hypotheses and then identifies learning issues for which he needs more information. Generally, it is practised as a small-group tutorial where the students are actively involved and take responsibility for their own learning and the teacher (tutor) facilitates the learning process. Thus, PBL is a student-centred approach in which content learning occurs in a context where knowledge acquired is applied to understanding or solving problems commonly encountered in practice. Thus, PBL is problem-first learning.

No, Asian students cannot do PBL. Why? In Asia, the student-teacher relationship tends to be stiff and formal. The teacher is seen as a distant figure. While students may tend to have blind respect for their teachers, this could be a result of teachers expecting to be respected without necessarily earning that respect. In our schools in Singapore, there is a subject called 'Moral Education' where respect for elders (including teachers) is emphasised. Our students do not ask questions in class. They are shy, lack self-esteem, and may be extremely polite. We may also have teachers who put down students who dare to ask questions and view such students as rude. Our Asian culture values loyalty and deference toward the teacher. Our teachers may

be authoritarian and expect the students to have a quiescent attitude. Asian society also tends to be intolerant of mistakes and thus students will not be more active in class for fear of being wrong. To make PBL successful, the students need to be constantly asking questions and seeking answers by themselves. The student-teacher relationship has to be more open and liberal. Students can be freely critical of their teachers and should feel free to make mistakes and learn from them. Thus, our Asian traits both on the part of the students as well as the teachers would appear to prevent the behaviour that is necessary for the successful implementation of PBL.

The answer can be "Yes". Despite the gloomy picture I have painted above, I have reasons to be optimistic. A survey of Korean medical students who had participated in a 4-week posting at some Canadian teaching hospitals with their Canadian counterparts showed that the environment can change student behaviour and expectations. To the Korean students, the Canadian students' learning by active and open dialogue with their teachers was very impressive. After their first week of anxiety and depression, the Korean students became more comfortable and relaxed. The Canadian teachers found the students to be extremely keen to learn. Bearing in mind that the Korean students had language difficulties, they did become more active in the more favourable learning environment in Canada. Thus, even students who have been taught in a traditional way can show favourable behavioural traits in a different educational setting.

Our own experience in NUS encourages us to answer "Maybe". Up till 1999, the Faculty of Medicine has followed a traditional British-style curriculum where the first year is devoted to learning the basic sciences such as Anatomy, Biochemistry, and Physiology and the second year to para-clinical subjects such as Microbiology, Pharmacology, Pathology, and Family Medicine. The next three years are spent in the clinical departments learning the necessary clinical skills. Such a system has worked well for many years. The method of delivery of the content has evolved over the years from being predominantly lecture-based to the introduction of more small-group learning activities. However, the main complaint about this curriculum has been that in the first two years, the amount of content is overwhelming and much of the material that is taught seems remote from the practice of medicine. Thus, a more integrated curriculum for the first two years with 20% of curriculum time spent on PBL was introduced in July 1999.

After the first semester of this new curriculum, the medical students responded to a survey on their reactions to the new teaching/learning style of PBL. Many of the students' concerns were linked to their unfamiliarity with their new role of looking for information themselves and seeking clarification from experts other than their PBL tutors. In general however, most of the comments were highly positive. Many felt that the PBL sessions were fun and enjoyed the increased interaction among the students and tutors. They thought that PBL encouraged thinking and active integration of

information and had improved their research skills. The PBL trigger problems also helped to reinforce their knowledge of basic science and its relevance to clinical practice. The tutors indicated that they were pleasantly surprised at the students' willingness to participate actively in the PBL sessions. This observation confirmed the report on the Korean students that even students who have followed a traditional curriculum for most of their lives are able to change their behaviour when placed in a different educational setting.

Of course, one semester's positive experience does not necessarily mean success for the PBL experiment in NUS. So

ask us the same question in a few years' time after we have gained more experience with PBL. After our students and staff have become accustomed to a more open system of teaching/learning that emphasises more student-centred and self-directed educational activities, **maybe** the answer will be "Yes". □

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Is PBL Suitable Only for the Health Sciences Curricula?

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Consider the solving of this problem from a Criminology course:

Detective K needs to identify exactly where the 1.7 m suspect, Bozo, was standing when a shot was fired. The bullet was located in a telephone pole at an angle of 60° with an apparent dent in a metal stop sign 2.3 m above the street. Bozo claims that he was standing facing the stop sign but 50 m away. The bullet hole was 3.2 m off the ground. The telephone pole is 10 m away.

The Subject-Based Learning Approach

In subject-based learning, students start their learning by being told what they need to know. For example, for the criminology course in reference, students will need to learn Geometry, Physics, Criminology, Psychology, Ballistics and Materials, etc. And at the end of learning all these, they will be given the problem to solve. However, by then, they would have learnt too much and lost sight of the relevance of all the individual subjects and their integration.

The Problem-Based Learning Approach

In problem-based learning, the problem is given at the beginning of the course. Being confronted by the problems, students would realise that they need to acquire enough Geometry, Physics, Criminology, Psychology, Ballistics and

Materials, etc. in order to solve the problem. Hence, lateral integration takes place right from the start and there is progressive layering as they move on to solve further problems. As seen here, PBL is suitable for the teaching of Criminology.

PBL in Non-Health-Science Disciplines

PBL has been implemented either partially or fully in the curricula of these non-health-science disciplines by various educational institutions in Australia, Canada, and the United States of America:

1. Economics and Business
2. Architecture
3. Engineering
 - a) Mechanical Engineering
 - b) Chemical Engineering
4. Social Studies (renamed as 'Issue-Based Learning', in New South Wales, Australia)
5. Legal Studies (PBL has been used in law for a long time)
6. History and the Arts
7. Science
 - a) Mathematics
 - b) Chemistry
 - c) Biochemistry
 - d) Physics
 - e) Biology
 - f) Computing

8. High School Education (PBL advocates in Dentistry and Medicine have provided training to high school teachers to apply PBL to secondary education.)

Some actual studies of PBL in use are discussed below:

Issue-Based Learning (IBL) in Social Studies at University of New South Wales, Australia

In the first year, students of Social Studies are introduced to IBL to provide them with a broad introduction to social work issues, collaborative learning, the opportunity to question their knowledge and values, and increased responsibility for their own learning. The IBL process begins with a trigger case, video and news clippings, and two small-group tutorials, followed by one large-group presentation the week after. There is also a specific reading list that guides the students to the appropriate references.

The conclusion from this IBL experience is that IBL is resource-intensive in terms of physical arrangement and manpower. The state of preparedness of students also poses a problem. However, it is found that in IBL, there is an increased integration of knowledge, skills and values and an increased competence and confidence in social work amongst students. The implementation of IBL in Social Studies in University of New South Wales is so successful that the other universities of New South Wales have also adopted IBL for their Social Studies curriculum.

PBL in Engineering (Australia and Canada)

Other actual experiences include those of Australian and Canadian universities' implementations of PBL in their Engineering curricula. Both groups found that students enjoyed the course more and the time spent on their studies in both PBL and traditional approaches was the same. However in PBL, the range of final marks is small as there is less motivation to excel, because students share their workload. Comparatively in PBL, the coverage of material is less, yet topics covered are dealt with more depth. There are also positive responses from the industry. In McMaster University's case, the industry liked its Chemical Engineering graduates so much that it has pressurised other Canadian universities to introduce PBL in their Engineering curricula.

PBL in Architecture (University of Newcastle, Australia)

In University of Newcastle, Australia, the Department of Architecture found that their structured lectures and design studio session were lacking in integration. 100% PBL was then implemented for their entire 5-year programme. In Year 1, a series of problems lasting four weeks each are given to students. In Years 2–4, students deal with one major problem lasting the whole year and shorter problems of varying length. In Year 5, students get to select their own problem and deal with it the whole year.

Throughout the 5-year programme, seminars and short lectures are held between problems. These seminars and short lectures are driven by the problems. With a learning issue

on hand, each student would want to learn more about the various subjects in order to solve the problems. Hence, students are found to be more attentive and motivated to learn.

Variations to PBL

There are variations of PBL. For example, in implementing PBL in large classes, multiple small groups are formed with a faculty member as a 'roving facilitator' who may or may not be a content-expert. Sometimes owing to a shortage of staff, this 'roving facilitator' may be an experienced senior undergraduate, with senior students taking to lead groups. And instead of large time-consuming problems, those used are short structured ones.

Instead of presentations of solutions in small groups, there are also large-group presentations. Another variation is the presence of a reading list to guide students' search for information. Another hybrid is a mixture of PBL tutorials, lectures, and seminars. Or instead of PBL for the whole course, it is only implemented in research projects where students define their own problem and research it and solve it.

PBL vs. the Traditional Method

As the medical sciences introduced PBL into their curricula earlier than the non-health sciences, many of the survey and research findings available are based on PBL in the medical sciences. In summary, the findings are as follows:

1. Mastery of content is equivalent to that in traditional courses in short term studies (Aspy et al., 1993).
2. PBL students scored higher in clinically-oriented exams (Mennin et al., 1993; Vernon & Blake, 1993).
3. Better clinical performance in residency programmes (Mennin et al., 1993).
4. PBL students scored higher in problem solving, self evaluation, and data gathering in behavioural science (Albanese & Mitchell, 1993; Gallagher et al., 1992).
5. Standardised tests favour traditional teaching (Vernon & Blake, 1993).
6. Content knowledge of students in PBL is not as good as those in the traditional method (Albanese & Mitchell, 1993; Vernon, 1995).
7. Knowledge gaps in PBL-trained peers (Albanese & Mitchell, 1993).
8. PBL students fare better in long-term retention (Farnsworth, 1994).
9. Improved attitudes (Bridges & Halliger, 1991; Pincus, 1995).
10. Friendlier educational climate (Schmidt et al., 1992).

Is PBL Suitable Only for the Health Sciences Curricula?

Finally, the question of whether PBL is only suitable for the health sciences curricula has to be answered. However, I believe that the reader would be in a better position to answer this question, for you would know your curriculum and subject better. A word of caution, however, is that coming from a 'do' discipline myself, our faculty decided that we should not implement PBL fully for all our courses lest

we produce a dentist who knows a patient's problem and how it can be treated theoretically, but who does not have the necessary skills to treat the patient. So in 'do' disciplines like Architecture, Dentistry, and Engineering, you will find that you still need technical and laboratory classes to train the students. Otherwise, you will have good thinkers, but not good practitioners and doers. □

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