

Is Problem-Based Learning a Quality Approach to Education in Health Sciences?

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Abstract

The Faculty of Health Sciences at McMaster University has pioneered, experimented and finally excelled in the application of problem-based learning (PBL) as an entire medical curriculum for the past 35 years. However, the general practice of PBL by other medical schools around the globe has progressed slowly. In theory, PBL as an educational philosophy has long been considered as a quality cognitive concept and was adopted by many medical schools via curriculum reform to improve students' learning attitude. In practice, what is the experimental evidence for PBL meeting the expectation of a quality education in health sciences? How do we differentiate problems associated with PBL philosophy per se from those associated with the ways PBL are handled and implemented? I will address these questions from the perspective of the assessment of performance of students, graduates and practising physicians from the PBL track compared to those from the conventional track based on literature information. Ample evidence suggests that PBL is superior in producing more compassionate physicians and graduates with lifelong learning and leadership quality. But, some educators and administrators are still skeptical that the benefits from PBL may be too marginal to justify the resources required in sustaining it. In this presentation, the assessment of PBL, in both theoretical and practical terms, will be discussed using McMaster PBL as a convenient example because of its relatively long history in practising PBL in medical education.

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Evolution of PBL in Medical Education

Since the pioneering adoption of problem-based learning (PBL) by McMaster University in medical education more than three decades ago,^{1,2} increasingly more medical schools around the globe have been undergoing curriculum restructuring by incorporating some forms of PBL philosophy into their new curriculum.³ Some schools have believed and trusted in the McMaster PBL philosophy by adopting PBL as the major educational instruction in their medical curriculum and converted to PBL in a very short period. A representative example is the School of Medicine at the University of Hawaii, which converted to PBL in 15 months starting from an incoming class of 56 students in 1989.⁴ An equivalent example in the Asia Pacific area is the Tokyo Women's Medical College, which established PBL during the inception of the college in 1992.⁵ Some have adopted a cautious and elaborative approach in developing a medical education pathway differentiating itself from the McMaster PBL model, but still maintaining the principal elements of the PBL concept. A typical example in this type of PBL medical schools is the establishment in Harvard

Medical School of a pilot experimental track of PBL-based curriculum in parallel with the traditional track in 1985.⁶ After a few years of experimentation, it evolved into the so-called "new pathway" hybrid curriculum, in which the traditional teacher-centred lectures, best known for its efficiency in disseminating knowledge, still play an important part to complement the student-centred, self-directed PBL.⁷ An equivalent example in the Asia Pacific region of this group is the College of Medicine of the National Taiwan University, which initiated a hybrid PBL in 1992,⁸ and in 1997, the University of Hong Kong.⁹

There are still many schools, particularly those with a heavy historical burden, who are skeptical about the pedagogic value of PBL and fear the uncertainties that might give rise to adverse results from such a major curriculum change. They have hesitated for years before the reality of curriculum change became inevitable. One of the most commonly asked questions by a medical school in transition or ready for curriculum reform is: *How can we be sure that the PBL curriculum works better than the traditional curriculum?* Obviously, there is no model

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answer, thus standardised solution, to this question with a high level of complexity. However, one can learn from the evidence emerging from the experimentation with PBL by others and make an intelligent analysis and assessment. *Quality assurance of PBL relies on a quality control process, which is based on well-defined assessment criteria compatible with the competencies required of the products of PBL, namely, the students, graduates and the resulting physicians.*

Quality Assurance: What Quality and Which PBL Model?

For a traditional medical school newly engaged in implementing PBL in curriculum reform, a hybrid model is conceivably more attractive.^{6,10} In this model, preservation of a majority of didactic lectures makes the teachers feel more comfortable and thus less resistant to change. However, the need to handle both the new and old aspects of the modified curriculum would increase the working load for both students and teachers. Furthermore, the conflicting pedagogic principles in the assessment of competence in learning in the new and old approaches^{11,12} may send confusing messages to students and teachers.

In the absence of adequate experimental evidence from controlled studies, the effectiveness in the practise of PBL in the medical education remained largely elusive. The intrinsic difficulty in fact arose from the definition of PBL itself. For example, medical schools adopting the hybrid curriculum may assign a certain percentage of the student contact hours for “PBL activities”, either in the form of a discipline-based course, or as a more integrative course module.^{13,14} Alternatively, problem-based, self-directed modular courses in small group format may be used as a model to test the feasibility of conversion to PBL curriculum.¹⁵ Teacher-centred didactic lectures, generally regarded as *the best of old for its efficient delivery of knowledge by experts*,^{5,10} are provided, in as interactive and integrative manner as possible, either before or after student-centred PBL sessions, on the same day or in the same week. If the planning of the hybrid system is not properly balanced, the PBL component (*intended for enhancing the personal learning qualities, such as self-motivation, active learning, lifelong learning, critical thinking, professional behaviour, effective communication and collaborative team-work spirit of the students via the assessment on the process of group learning*) would be awkwardly buried in the traditional lecture-based curriculum, which is notoriously known to cultivate passive and competitive rote learning and may render PBL ineffective and insignificant. Thus, confusion potentially embodied in such a hybrid model makes an objective assessment of its pedagogic effectiveness highly difficult, if not impossible. To avoid misleading interpretations, the discussions here are primarily based on

studies at McMaster, which represents the major pedagogic approach over the entire medical curriculum and has been subjected to the test of time for 3 decades.

Sorting out PBL Amongst Misnomers and Misconceptions

With the above premise in mind, I regard PBL as an active attitude toward learning in an integrative curriculum relevant to clinical practice; it is not merely a teaching method.^{2,16} PBL can be simply defined in the following way according to the McMaster philosophy.¹ **PBL is an “active learning”** with particular **relevance to the learning objectives** (as opposed to the passive, rote learning based on teacher-designed didactic lectures and instructions, typical of the traditional curriculum). **“Active”** implies dynamic interactions, self-motivation and self-management among the learners and **“learning”** signifies a focus on the process used by the learners rather than the process imposed by the teachers. Learning must be **“relevant”** to the objectives perceived by the learners 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. Thus, the scenarios become the **trigger-problems in PBL**. At McMaster University, they are referred to as Health Care Problems as a means to trigger the events in the self-directed learning process (in the following order of events: brain-storming learning issues, formulating and prioritising learning objectives, acquiring learning resources, seeking and synthesizing information, sharing and exchanging learned knowledge and skills and providing feedback for improvement). The primary aim is not to solve the clinical problems. *Therefore, one should not mix up PBL with problem-solving*, although problem-solving skills usually result as a benefit of PBL. PBL tutorial is also distinctly different from the traditional *“clinical case study”*, either in tutorial format or with the use of real patients during the “clinical” years (typically, **bed-side teaching**). In both conventional tutorial and bedside teaching, the teacher remains as the centre of students’ learning, and problem-solving is usually the bottom-line. Therefore, *“problem-based learning”* practised by students should not be mixed up with *“case-based teaching”* practised by teachers.

In the conventional curriculum, teachers usually think that medical students must be well equipped with as much basic science knowledge as possible *in case* they need to apply it in the clinical years 2 to 3 years down the road. This is an **“in case”** approach in teaching. In the PBL curriculum, students learn as the issues are identified and developed, be it basic science or clinical skills, be it anatomy or physiology, be it biological or social/behavioural. They learn whatever

is relevant to their learning objectives as identified in the trigger problem. They learn what they need, when they need to know it. This is an “**in time**” approach in learning.

Self-directed learning in PBL should not be mixed up with *self-indulged study* as widely adopted by students in the traditional curriculum. Self-directed learning is a form of adult learning, in which self-management (including time, process and content), self-discipline and cooperative learning occur as a collective responsibility of students not only as individuals but also as a group, even in the presence of facilitators. Self-indulged study, on the other hand, implies studies in isolation, frequently associated with a competitive environment.

The learning behaviour of students in different geographical regions has often been linked to cultural issues, including socio-economic-political factors in very much the same way as cultural issues influence the health care delivery and medical educational system. Also, the extent and relevance of cultural issues covered in a medical curriculum may also be misinterpreted because of the inadequacy of methodological considerations in assessment.¹⁷ Having dual ethnic background in education, I have visited many medical schools in the Asia Pacific region for the past 10 years and developed a personal interest in examining the use of PBL in medical education in that region. I notice that local teachers in many Asian countries hold the opinion that Asian students are not capable of doing self-directed learning in PBL environment. However, this perception, which is probably due to the education philosophy embraced by the Asian socio-political culture and considered not to be conducive for creative and critical thinking, falls short of strong supportive evidence and does not take into consideration the profound influence of the attitudes of teachers and educators on students' learning behaviour.¹⁸

Assessment Dictates Students' Learning Behaviour

In a recent article,¹⁹ I described my own experience with the learning attitudes of students typically observed in traditional institutes in Asia and North America, where I had studied and taught in the early 70s and early 90s, respectively. In both continents, I observed the common phenomena: passive class-participation, lack of intrinsic motivation and inquisition and surface learning, which represent typical findings in didactic, non-interactive, teacher-centred teaching. Furthermore, regurgitation of learned knowledge, a competitive/threatening learning atmosphere, short knowledge-retention time and frequent class-skipping, which are typically associated with traditional examinations as the major assessment method. Such characteristics observed in University education were partly inherited from the secondary school education. In

general, students in the Asia Pacific region, especially new graduates from secondary schools, are admitted to the medical schools based on their examination scores, which measure primarily the retention of learned factual knowledge, not the students' ability to acquire and understand them.

My experience in medical education in the Asia Pacific region strongly indicates that three elements collectively hold the key to success in influencing students' learning attitudes in PBL. They are: effective assessment system consistent with the pedagogic concept of the curriculum (which dictates students' learning attitude), consistency in leadership support (that provides the driving force to sustain teachers' as well as students' attitude towards innovative change) and the motivation of teachers (which influences students' learning behaviour). Assessment has a powerful dual steering effect on shaping students' learning strategy and setting their mode of inquiry. Irrespective of the nature of the curriculum, PBL or non-PBL, as long as the factual content-based traditional examinations/tests stay as the major assessment method, the students' learning attitudes and mode of inquiries will remain largely unchanged. One may ask whether the assessment of the competencies expected of a medical student in a PBL environment are actually part of the curriculum in a medical school that claims to have adopted a PBL approach in students' learning. These competences, to name a few in addition to knowledge acquisition and retention, include: *skills in conducting self-directed learning, inter-personal skills to achieve the objective of group-learning, skills in effective communication, professionalism and self-awareness, skills in critical appraisal, ability in creative thinking and logical reasoning, skills in hypothesis generation and formulation of learning objectives, and potential of lifelong learning.* When a medical school adopts a hybrid PBL curriculum, in which the traditional examination is retained as the major assessment method without carefully considering and implementing alternative assessment strategies, it will defeat the spirit of PBL making it particularly vulnerable to failure in changing students' learning attitude.

It can be argued that McMaster medical students or students from PBL schools are selectively chosen (via admission *assessment*) for PBL learning environment, therefore they are naturally better suited for PBL curriculum. This argument may justify the observed difference between medical students at McMaster and at traditional schools; i.e., McMaster students were more receptive to collaborative learning and self-directed learning in a small group environment (see discussions later). Indeed, McMaster Health Sciences Faculty are truly selective in admitting students such that it places relatively more emphasis on the

students' attitude, personality and potential for innovative learning over their specific knowledge base for problem-solving, which students can effectively acquire later in the PBL environment. Thus, it is not uncommon for McMaster's medical programme to admit students with minimal biological background from non-health science disciplines as long as the students have the personal qualities for self-directed learning.

How do Students from PBL Schools Fare Compared to Their Traditional Counterparts?

A number of evaluative studies, including some meta-analysis research,^{12,20-23} have addressed the question whether a PBL curriculum is superior to the traditional curriculum in improving students' attitudes toward learning. Vernon and Blake²⁰ commented "... no sample was found in which students' attitude did not favour PBL to some degree". The PBL environment is generally perceived in a positive light. PBL helps inquiry-based learning skills and allows more time to do self-initiated learning. PBL students use a wider range of resources, tend to do more group activities and study longer. PBL is more enjoyable and satisfying. This result was reported not only for the medical schools using PBL as the major pedagogic approach, but also in schools putting individual specialised basic sciences course and clinical skills to the test.²⁴⁻²⁶ For example, Finch²⁴ reported that the performance of the students studying paediatric medicine on the written Provincial Registration Examinations of Ontario showed that no significant difference existed between student cohorts with respect to factual biomedical knowledge, but that the PBL students performed significantly better in tests of deeper understanding and the cognitive skills related to patient management. Collivier²³ has questioned the association between the research observations and the PBL theory. Although there was a slight advantage in favour of the PBL students, the difference was considered by Collivier not to be significant enough to justify the level of resources required to sustain the PBL activities, using examinations required for graduation or licensure. It has been a persistent concern for some educators, who are skeptical about PBL not being able to sufficiently equip the medical students with the factual biomedical knowledge, as does the teaching by expert teachers. They worry that change to PBL curriculum may disadvantage their students in Medical Qualification Examinations. In this connection, Berkson²² did not find significant difference in students' academic performance between PBL and non-PBL schools. A recent comparative study²⁷ of the student achievements in the Qualifying Examination in Canada between the PBL and non-PBL medical schools showed that these students performed similarly, except in psychiatry and preventive medicine and community health. In the latter two subjects,

PBL graduates scored higher indicating that the PBL cohort of students was more knowledgeable than, and possessed superior patient management skills, to their traditional counterparts. A similar finding was also obtained in a recent report on the analysis of the United States Medical Licensing Examination in students of the University of Missouri-Columbia School of Medicine before and after implementation of a PBL curriculum,²⁸ which showed that major PBL revisions of the curriculum did not compromise the performances of medical students on the licensing examinations; in fact, they may have contributed to higher scores. A similar conclusion was also obtained when students of the PBL-track and the conventional track in the same medical school were compared.^{7,27,29}

Kaufman and Mann²⁹ have made an observation on students' attitude toward their learning environment, cultural issues in medicine and their curriculum during the year before (1995) and the year after (1996) the transition from a conventional curriculum to a largely PBL curriculum (1996) in Dalhousie University, Canada. In this case, the admission variables were equivalent. The authors found that PBL students have significantly more positive attitudes toward their learning environment and their curriculum. They concluded that PBL curriculum is more superior regarding students' attitude toward learning. Interestingly, the response rate for PBL students was 87% (73/84) and 68% (57/84) for students in the conventional curriculum, suggesting that PBL students expressed more interest and sense of responsibility in participating in such a survey pertaining to their curriculum and their learning attitude.

In one study designed to test the hypothesis that PBL students do better in recall/retention of learned knowledge,³⁰ physiotherapy students were randomly assigned to PBL in a muscle physiology course. Their scores on MCQ were compared to those who remained in the traditional stream soon after the course and 6 months after the course. PBL students did have slightly, but significantly lower scores on MCQ test after the course. This may be a result of the conventional assessment method (MCQ), which is based on the factual knowledge content, being in favour of students from the traditional stream. However, it was remarkable to observe that PBL students did 5 times better on the core concepts in a free recall situation 6 months after the course. While PBL students may acquire slightly less knowledge content, they do retain that learned knowledge for a considerably longer period than the non-PBL students in the same course from the same institute.

Do PBL Graduates and Physicians do Better in Professional Satisfaction and Lifelong Learning?

In an ACMC Medical Resources Conference held in Vancouver in 1994, Woodward et al³¹ compared the survey

on the opinions of 320 young family physicians (certified by College of Family Physicians of Canada during 1989-1991) practising in Ontario about the relative importance of undergraduate and postgraduate education to their practice decision and attitudes. More physicians from PBL schools showed professional satisfaction (66%) than the physicians from the non-PBL traditional schools (40%), whereas dissatisfaction of family physicians showed the opposite trend; i.e., 10% for physicians who graduated from PBL schools and 26% for physicians from non-PBL schools.

In 1991, there were two conflicting reports on the comparison of McMaster graduates or practising physicians on their attitudes toward lifelong learning. Tolnai³² compared the level of participation of continuing education activities between graduates from the University of Ottawa and McMaster University. They found no difference. The interpretation of the findings is a rather intriguing one. A positive result would support the anticipated hypothesis that PBL graduates can do better lifelong learning in the form of continuing educational activities. On the other hand, a negative finding may indicate either that the PBL graduates are not concerned with the conventionally structured continuing educational activities since they have been trained to learn on their own pace and need, or that the continuing educational activities are not a reliable measure of lifelong learning.

In another study, Shin et al³³ reported that the primary-care physicians who graduated from McMaster University (2 to 10 years after graduation) were more updated than those from the University of Toronto with new development of the management of hypertension. Although it can be argued that the study may be biased because McMaster has a strong basis in cardiovascular research, the more prevalent use of PBL in graduate research training courses at McMaster appears to be in line with the PBL approach being conducive for lifelong, self-directed learning, in education as well as in research (which is truly self-directed and problem-based).

A Take-home Checklist for Quality Assurance

To conclude from the preceding discussion, quality assurance of PBL as a quality education requires a clear set of quality control strategy. A partial checklist for assessing the effectiveness of institutional PBL contributing to the quality control of the PBL curriculum is listed below to facilitate interested teachers, educators and administrators to exercise some self-directed learning.

- Do your educators, teachers and students really understand what PBL is all about?
- Have you clearly defined your product competences and let your students know?
- Should you be selective in admitting students to medical

school?

- Are your student assessment tools in favour of fostering the anticipated competence?
- Are you offering sufficient support for student guidance and faculty development?
- Do you have a core leadership group/unit to sustain, monitor and advance PBL?
- Does your administrative structure support the concept/practice of PBL?
- Will you encourage/reward faculty engaging in improvement of education via research?

PBL is now a worldwide popular pedagogic jargon, but it has often been, and is still misconceived, misinterpreted and misused. PBL is an alternative concept of learning, not just another way of teaching. PBL in medical education is more effective when learning is based on clinical scenarios in a small group setting, but clinically-driven problem-solving is not the sole purpose of the PBL approach, especially in the early years of medical education. PBL represents a consequence of the current trend in medical education reform in response to the rapidly changing social context under economic, political and technological influence, which the traditional medical education no longer can accommodate. Available data collectively suggest that PBL is indeed a quality approach to education in Health Sciences, but assurance of its quality rests on a proper understanding of PBL by students and teachers and its effective implementation by educators and administrators. PBL is not a rigid concept; it may change again in future with changes in the socio-economic structure and technological developments and health care systems continue to evolve.

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