

Problem-based Learning in Medical Education: The Singapore Hybrid[†]

M C E Gwee,*^{BPharm, PhD, MEd}, C H Tan,**^{MBBS, M Med (Psych Med), PhD}

Abstract

Introduction: Problem-based learning (PBL) is an innovative educational strategy to enhance student-centred, interactive and integrated learning through intensive small group tutorials. PBL is problem-first learning in which a commonly encountered medical problem serves as the primary focus of and stimulus for learning. Several adaptations have evolved since its implementation at McMaster University in 1969. In 1999, the Singapore medical school implemented PBL as a key feature within its new hybrid curriculum. **Methods:** The review will focus on the educational implications and impact of the present curriculum reform with emphasis on the implementation of PBL within the new hybrid medical curriculum. **Results:** Our early experience in implementing PBL resembles those of several other “traditional” medical schools, namely, a generally favourable and positive response from staff and students mixed with varying degree of anxiety to change. **Conclusion:** Appropriate training and changing the mindsets of staff and students, strong leadership from the Dean and a deep commitment by all concerned are essential to ensure the successful implementation of PBL within a “traditional” medical school. PBL will enhance the quality of medical education and the educational preparation of our students to meet the challenges of future medical practice.

Ann Acad Med Singapore 2001; 30:356-62

Key words: Curriculum reform, Problem-first learning, Self-directed learning, Shifting educational paradigm, Value-added education

Introduction

In 1969, the McMaster University Faculty of Health Sciences established a new medical school with a major difference from “traditional” medical schools in its overall educational philosophy that underpinned the design of its entire course curriculum. The medical educators in McMaster were critical of what they perceived as many of the shortcomings of the highly lecture-based discipline-oriented traditional medical curriculum, namely, the information overload endured by students who resort to rote learning, the inability of students to integrate and apply knowledge of the basic medical sciences to clinical problems, and insufficient preparation of students in problem-solving skills essential for lifelong learning. The McMaster initiative established a new and radical trend in medical education with the implementation of problem-based learning (PBL) as its innovative educational pathway. Over the past three decades or so, various adaptations, including hybrids, of the McMaster PBL curriculum model have been implemented in many medical schools worldwide.^{1,2}

What is Problem-Based Learning?

“Problem-based learning is the learning that results from the process of working toward the understanding or resolution of a problem”³

“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 the knowledge is to be used”⁴

Essentially, PBL is problem-first learning with a commonly encountered medical problem serving as the focus of and stimulus for learning. The key elements in PBL relate to the learning that occurs: before the acquisition of new knowledge (e.g. before exposure to lectures in a specific discipline) and from the integration and application of knowledge in the basic sciences and clinical disciplines toward understanding of or solving a problem; through the social interaction of students in small learning groups, and from independent self-study periods, the critical use of resource in the search for information and also from

* Professor

** Associate Professor

Department of Pharmacology

Faculty of Medicine

National University of Singapore

Address for Reprints: Dr M C E Gwee, Department of Pharmacology, Faculty of Medicine, National University of Singapore, 10 Kent Ridge Crescent, Singapore 119260.

[†] This review is based on a Symposium Lecture (Why PBL?) delivered by MCE Gwee at the 1st ASEAN Conference on Problem-Based Learning in Health Sciences, 20-22 November, 2000, Faculty of Medicine, National University of Singapore, Singapore.

facilitation and nurturing of the learning process by the teacher (tutor). Thus, PBL differs, in concept, educational philosophy and practice, from the highly teacher-centred, lecture-based and discipline-oriented traditional medical curriculum.⁵

The PBL Process

The main instructional strategy used in PBL is the small group tutorial in which students are required to take greater initiative and responsibility in the teaching-learning process. Although group size is usually limited to 6 to 10 students to optimise group dynamics, adaptations with group sizes of greater than 20 students have also been used.⁶ The teacher takes on the role of a tutor who facilitates or guides the learning process. In PBL, each problem case is usually studied over two sessions of 1 to 2 hours each. Each tutorial session has its specific intended process, goals and outcomes.⁵

Session 1 begins with the presentation of the problem case (a paper case, video clip, audio recording, etc.) followed by a period of analysis, brainstorming and generation of hypotheses about the possible underlying causes of the problem. This session ends with group members identifying and formulating learning issues and assigning learning tasks for follow-up action. Over the next 3 to 5 days group members undertake a period of *independent self-study*, searching for and gathering information related to their assigned tasks. Students are encouraged to use multiple resources in their search, including the library, Internet and teachers with the relevant expertise. The emphasis is on efficiency and in being critical in the use of resource. In Session 2 students reconvene in their respective groups and share with one another their newly acquired information. Students then re-analyse the problem, critique and refine their initial hypotheses, and then attempt to integrate and apply their newly acquired knowledge toward understanding or resolving the problem.

In our practice, a Session 3 is convened with all students in the lecture theatre immediately after Session 2 is completed. The case writer (the expert) conducts the session, beginning with a presentation of the “findings” by one group of students with opportunities for members from other groups to contribute any additional information. The case writer then systematically reviews the problem with the students through an interactive session to probe student understanding of the problem case. Session 3 is intended to provide all students with the opportunity to meet with the case writer for clarification and to obtain a better perspective of the scope of the learning outcomes expected.

At the end of each tutorial, group members and their tutor give and receive *feedback* to and from each other. Both positive and negative factors that affected individual and

group performance in achieving the group goals are reviewed. This helps students to increase their self-awareness and their sensitivity to the needs of others in a small learning group.

The Singapore Medical School Curriculum: From Tradition To Innovation

“Medical education, with its intensive pattern of basic science lectures followed by an equally exhausting clinical programme, was rapidly becoming an ineffective and inhumane way to prepare students, given the explosion in medical information and new technology and the rapidly changing demands of future practice”⁴

In 1999, a major educational milestone was recorded in the history of medical education in Singapore with the implementation of a new undergraduate hybrid medical curriculum incorporating PBL as a key feature. Our new curriculum reflects a significant shift in educational paradigm, from the highly teacher-centred, lecture-based and discipline-oriented curriculum to a more student-centred, integrated, interactive and faculty-directed pedagogical structure, with the intended aim of enhancing the learning environment and the quality of medical education for our students. Thus, in implementing the new hybrid curriculum, our medical school has moved from tradition to innovation in designing our educational strategies to better prepare our students to meet the challenges of their future medical practice.⁷ Several compelling events led to the extensive curriculum reform undertaken by our medical school.

The Great Entrapment: Over 90 Years of Tradition

The undergraduate curriculum in our medical school, as in many medical schools in the world, has been deeply entrenched in tradition with the highly discipline-based traditional lecture as the main instructional mode. The major curriculum design remained essentially the same over the years, although several curriculum reviews have been undertaken. However, our medical graduates have served the nation well in many of the medical specialties. Our medical degree continues to receive wide international recognition and our health care delivery system is of high international standard and quality. There seemed little need, therefore, to re-design our curriculum or to re-appraise the desired attributes required of our medical graduates for future medical practice in a rapidly changing world.

The Inevitable Awakening: Global Forces of Change

“It has been widely observed that there is an information explosion and that the student is at ground zero; he cannot learn all there is to know or even a substantial

part of the knowledge in one field"⁸

We live in the digital age of massive information explosion and phenomenal advances in the sciences and technology which pose many new challenges with increasingly more complex demands in the work environment (including medical practice) and in our daily living. It is thus inevitable that educational priorities and strategies must change to ensure that today's education will better prepare students to cope with the new challenges and demands of tomorrow. Changing trends in medical education that focused on the urgent need for curriculum reforms have been well documented in two main official publications in the UK (*Tomorrow's Doctors Recommendations on Undergraduate Medical Education*⁹) and in the USA (*GPEP Report*¹⁰). Criticisms of the traditional medical curriculum from within the medical profession also stimulated the need for curriculum reforms: "What emerges are physicians without enquiring minds, physicians who bring to the bedside not curiosity and a desire to understand, but a set of reflexes that allows them to earn a handsome living".¹¹

The Glorious Enlightenment: Curriculum Reform

*"—the NUS Faculty of Medicine needs to respond decisively and appropriately to the rapid changes in medicine and medical education, to ensure that the graduates are well equipped to meet the challenges of medical practice in the years ahead"*⁷

*"In determining the direction and substance of the curriculum reform, the Faculty of Medicine was guided by the vision of the type of graduate which it aspired to train"*⁷

In 1997, our then newly appointed Dean, Professor Tan Chor Chuan, initiated the curriculum reforms in our medical school with the clear recognition that medical education in NUS must now rise to the challenge to better prepare our medical students of today to become the competent doctors of tomorrow. Clear statements on the desired attributes (i.e. desired end-product quality) of future NUS medical graduates have been well documented in the "*Educational Objectives of the New Medical Curriculum*", and these relate to five broad categories: Basic science foundation for clinical practice; Clinical competence; Communication; Appropriate attitudes; Professional development.⁷ This has been one of the most extensive and insightful revisions in the undergraduate medical curriculum that has been undertaken by our Faculty of Medicine since its founding in 1905.

The New Hybrid Medical Curriculum: Shifting the Educational Paradigm

"After examining a number of curriculum models and taking into account local conditions, the Faculty elected

*to adopt an integrated systems-based approach supplemented by problem-based learning methodologies"*⁷

Our new medical curriculum is, essentially, a *hybrid* curriculum reflecting a fundamental shift in the educational paradigm, from the highly teacher-centred, discipline-based teaching (lecturing) in a passive learning environment, to a more student-centred, faculty-directed and active learning environment. Thus, the core pedagogical principle of student-centred, integrated and interactive learning underpins the overall organisation and delivery of our new hybrid curriculum. Our pedagogical structure therefore consists of the following principal components: lectures (with greater emphasis on an interactive approach); problem-based-learning (PBL, to promote active learning); special study modules (SSM, an enrichment elective within and beyond the confines of medical education); undergraduate research opportunities programme (UROP, providing opportunities for early research experience); physician-development programme (PDP, early exposure to patients, doctors and other members of the medical team in Year I); clinical skills foundation course (an extension of PDP in Year II, designed to equip students with basic clinical skills for on-going development of future clinical competencies); medical education on the Net (MEDNet, providing customised IT instruction and a comprehensive medical education IT support system).

Another key feature of the new curriculum is the inclusion of "*Faculty-directed integrated examinations ensuring emphasis on core knowledge and principles, and conceptual understanding*".⁷

Our Hybrid Curriculum: Providing a More Balanced Learning Environment

*"The New Pathway aims to innovate without sacrificing the best of the old, to stimulate initiative without inefficiency, and to balance the latest developments in medical science with the age-old values of healing"*¹²

The question may be asked, in undertaking our curriculum reform, why did we not take the opportunity to adopt a complete PBL curriculum as exemplified by the McMaster model? Firstly, from a practical standpoint, this would have been a most daunting task requiring considerable logistics support for its effective implementation in an environment so deeply entrenched and entrapped in traditional education. Moreover, the design of our pedagogical structure includes several other student-centred educational strategies that will complement the educational aims of PBL.

There are also now several examples of medical schools which have successfully incorporated PBL as only an integral component of an overall hybrid curriculum. The hybrid model ("New Pathway") of the Harvard Medical

School (HMS) implemented in 1985 is a clear example of a successful hybrid curriculum that has influenced the more traditional schools contemplating to implement PBL.¹² In 1991, the College of Human Medicine, Michigan State University, implemented a hybrid curriculum consisting of a traditional lecture-based discipline-oriented programme in the first year and PBL in the second year. It was concluded that “*the children of this curricular marriage are vigorous*”!¹³ Furthermore, it has also been pointed out that “*PBL is not a panacea for all the current ills in medical education*”^{14,15} and that “*— PBL and traditional curricula are far from incompatible— the two will gradually merge*”.^{14,16}

In adopting our hybrid curriculum, we also considered it important to accommodate the diversity of learning styles among students. Our hybrid curriculum will provide a more balanced learning environment that would benefit our students through their exposure to a variety of student-centred instructional strategies. The retention of lectures within our hybrid curriculum is to continue to provide our teachers with opportunities for expression of their individual excellence in teaching (lecturing) in their discipline expertise, albeit in a more interactive approach. After all, a dedicated teacher with passion for his subject matter can deliver an enjoyable, highly captivating and intellectually stimulating lecture that stirs the mind to think deeply and critically. More importantly, such a lecture can be highly inspirational and motivate student learning! In discussing the HMS hybrid curriculum, Armstrong had also added the caveat: “*Replacing all lectures with discussion groups or tutorials would merely substitute one lopsided system for another*”.¹²

Implementation of PBL in Our Hybrid Curriculum

*“Successful implementation of PBL does not come easily. All our strengths and skills as teachers will be required. Our behaviour and beliefs will be challenged. Complex difficulties may arise, and we will need the ability to explore options and generate creative solutions in cooperative contexts. Commitment, determination and teamwork are essential, and above all we need self-knowledge and considerable understanding of the learning process”*¹⁷

Problem-based learning forms an integral component of our new medical curriculum occupying 20% of the overall curriculum time. However, PBL is a key educational strategy that will impact strongly on our overall curriculum, student learning and the changing role of the teacher. PBL was implemented in the Year I course curriculum in 1999 and then in Year II in 2000. In each year of study, 8 problem cases (units) are selected for delivering the curriculum through PBL (Table I).

TABLE I: (A) PROBLEM-BASED LEARNING (PBL) CASE TOPICS AND (B) PBL CASE SCENARIOS

(A) PBL Case Topics

Year I	Year II
Semester I	Semester I
1. Lower limb and gait	1. Tissue damage and repair
2. Hyperlipidaemia	2. Immunodeficiencies and consequences
3. Breathlessness and oedema	3. Cancer
4. Chronic breathlessness and cough	4. Cardiovascular disorders
Semester II	Semester II
5. Ascites and gastrointestinal bleeding	5. Respiratory disorders
6. Oliguria and oedema	6. Gastrointestinal disorders
7. Growth defect	7. Genetics
8. Glucose intolerance and large baby	8. Neurological disorders

(B) Typical Examples of PBL Case Scenarios

Year I

Freddie Lim, a 69-year-old man, was referred to the orthopaedic clinic for a painful hip and inability to walk after a fall in the bathroom (Case 1).

Year II

Mr Song, a 38-year-old man, presented to the A & E department with severe epigastric pain (Case 6)

Planning for Change: Logistics Support and Mindset Change

PBL involves intensive learning in small groups and its implementation requires considerable logistics support, including the training and development of teachers as competent PBL tutors, conducting PBL workshops yearly for new cohorts of students, ensuring the availability of enthusiastic case writers with the desired expertise and on-going monitoring of teacher and student morale, as well as of any unforeseen problems occurring that might disrupt a conducive PBL environment. Other important requirements include ensuring the availability of quality library resource facilities and adequate number (20 in our present case) of and suitably designed tutorial rooms. A Faculty PBL Committee, consisting initially of 5 (now 8) teachers from clinical and non-clinical disciplines, was first formed in late 1998 to co-ordinate the logistics support required for the implementation of PBL within our faculty.

Implementing PBL within our revised curriculum has been one of the most challenging, daunting and unenviable tasks ever to be undertaken by a Faculty Committee in our medical school. The PBL Committee had only about 10 months of preparation time. One important task was changing the mindsets of teachers and students to be more

receptive to the shift in the educational paradigm, which would impact strongly on teaching practices, and student learning. Change of mindsets is essential to overcome potential barriers to educational change. It is pertinent to note the experience of the Harvard Medical School as expressed by Moore:

*“The use of problem-based learning, while supported by a small group of faculty, was by no means universally acclaimed by the faculty. Considerable resistance, skepticism and outright hostility emerged during the planning process”*¹⁸

However, with strong leadership and support from the Dean, the PBL Committee remained steadfast and totally committed to the task. Excellent team spirit prevailed and, together, members of the Committee planned, organised and conducted several workshops for teachers and students, to explain and to provide hands-on experience of the PBL philosophy and process as well as the role of tutors and students in the PBL tutorial setting.

Our Early Experience: Positive but Cautious

Our early experience showed that, with appropriate and adequate training, teachers and students adapt quickly to the PBL tutorial process. Regular feedback to and from tutors and students in the first year of our implementation indicates a positive acceptance of PBL as a useful educational pathway to enhance the learning environment in the education of our medical students. Of course we also had our fair share of “sceptics and resistance”, especially in the initial implementation phase.^{19,20} There is also still a need to optimise group dynamics and to boost tutor effectiveness, confidence and enthusiasm.

In a survey concluded just recently, the preliminary data suggest that Year I tutors are now much more supportive and are more convinced of the value of PBL as a learning strategy. Our early experience with Year II tutors suggests a similar early phase response to PBL, with many teachers still undergoing adjustments to their new role as PBL tutors. Anxiety displayed by tutors in the early phase can be attributed mainly to teachers having to move away from the usual comfort zone of the rituals of lectures to a more student-centred discussion-based learning environment. Teachers have also raised some concerns about the educational benefits that can be derived from the heavy investment in time on PBL.

Although we have achieved reasonable success in the implementation of PBL in our faculty, we need to tread with caution and with continued vigilance to guard against the pitfall of the *Hawthorne effect* in which “success” is the result of a short-term gain arising from the enthusiasm of participating in something new and novel which then wanes thereafter.

Expected Returns on Investment in PBL: Providing a More Holistic and Value-Added Education

*“Faculty members work with alert, motivated, turned-on minds in a collegial manner that has no equal”*²

Implementing PBL within a medical curriculum is indeed a heavy educational investment requiring considerable logistics support as discussed earlier. What then are the expected returns on our heavy investment, especially in time, in PBL? In the context of our hybrid curriculum, PBL can be expected to provide value-added education which will contribute significantly to the overall quality of medical education in NUS that goes beyond simply acquiring content knowledge and rote-learning.

Laying the Foundations for a Lifetime of Continuing Education

PBL is more than just a method of teaching. PBL is a way of learning through an innovative learning paradigm that actively involves students in the learning process, i.e. PBL is highly student-centred learning in which students, with some guidance from the tutor (facilitator), play a major part in deciding what to learn and from what resources in their search for information to resolve a medical problem. PBL therefore strongly fosters the development of self-directed learning skills. Thus, PBL is specifically designed to encourage and empower students to take greater initiative and responsibility to direct and to manage their own learning; a unique educational experience that will contribute to laying the foundations for a lifetime of continuing education.

Learning Beyond the Biomedical Sciences

Implementing PBL from the first year of the medical course helps students to have an early appreciation of the relevance of the basic sciences to clinical practice, since students learn in the context of integrating and applying knowledge in the basic sciences to resolving or enhancing their understanding of a medical problem. In addition to learning the life sciences, problem cases also incorporate learning that relates to and impact on various aspects of population health, community and behavioural issues, thus enhancing student perspectives of medical problems beyond just the bio-medical sciences.

Learning Through Social Interaction: Promoting Collaborative Learning

PBL also provides an educational experience in which “*All teach All learn*” through peer teaching and learning. Thus, learning is achieved through social interaction, so that students need to understand and learn to abide by the rules of engagement (code of social behaviour) in learning in small groups. In particular, students learn the importance

of individual and group accountability working as team members in a collaborative/co-operative learning environment. PBL therefore creates opportunities for building strong '*Partnerships and Bonding in Learning*'.

Promoting Critical Thinking and Problem-Solving Skills

PBL is highly student-centred and discussion-based learning: students generate hypotheses, discuss and critically analyse ideas, issues and diverse viewpoints and draw their own conclusions in the course of trying to understand or resolve a medical problem. Students also have the opportunity to reflect on their own learning. PBL therefore fosters the development of creative and critical thinking skills, problem-solving skills and communication skills.

The PBL Tutor: Going Beyond a Talent for Lectures

*"An academic who only presents facts is not a teacher; a teacher is one who nurtures the learning process and thereby modifies behavior and patterns of thinking for a lifetime"*²¹

The PBL tutor clearly reflects the changing role of the medical teacher from the traditional "*sage in centre stage*" to the *facilitator* with the important role "*— to expedite the intellectual and interpersonal process for the group*".²² The effective tutoring skills of a PBL tutor will strongly influence student enthusiasm, attitudes and motivation in learning. The close interaction over a whole semester with the same group of students also creates opportunities for the PBL tutor to become mentor, guardian, and role model to the group members. Thus, PBL provides excellent opportunities for teachers to nurture the learning process and build strong partnerships and bonding in learning with their students that go beyond a talent for lectures.

Sharing of Common Educational Goals and Building Learning Communities

PBL also provides opportunities for building learning communities amongst teachers in our faculty. Case writers meet with all tutors before each PBL problem case is finalised. Each meeting provides a conducive forum for teachers from various disciplines to share their concerns over a common educational goal: tutors seek clarification from the case writer on any perceived ambiguities and provide suggestions for improvements from a multidisciplinary perspective. Education of tutors through such cross-talks has been found to be very useful and valuable by all concerned, especially for tutors from basic science disciplines who are able to broaden their educational perspectives beyond their own basic disciplines.

Summary

"Unless we take what steps we can to improve the learning environment for our students, their potential

*will only be partly realized, our standing in our own eyes and in the eyes of society will be diminished and, ultimately, society itself will be the poorer"*²³

Our medical school had recently undertaken extensive curriculum reform and implemented a new hybrid curriculum. The primary aim of the reform is to enhance the learning environment and the quality of medical education for our students. Although PBL occupies only 20% of the overall curriculum time, yet considerable logistics support had to be mobilised with the expectation of achieving the beneficial educational outcomes of the PBL strategy. The question then is, is it worth all the effort? The answer is, it is imperative that we must now enhance the education and potential of our students beyond just the acquisition of knowledge and the memorisation, recall and regurgitation of facts in examinations.

Implementation of our new hybrid curriculum, with PBL as a key feature, is a major step undertaken by our faculty to ensure that our medical students will graduate, not only with sound knowledge and comprehension, but also with the ability to critically apply, analyse, integrate and evaluate knowledge and information for the ultimate benefit of their patients. Teachers in our faculty of medicine can take pride in the fact that they have embarked on a bold educational initiative that will impact strongly, not only on the end-product quality of medical education in NUS, but also on the health and well-being of our society.

Acknowledgements

We would like to express our deep appreciation and gratitude to all of the following for their firm and continued support in working together towards our common educational goal: our past Dean (Professor Tan Chorh Chuan) and present Dean (Professor Lee Eng Hin), Associate Professor Koh Dow Rhoon (Vice-Dean Curriculum), members of our PBL Committee, all teachers and heads of departments, our students and last, but certainly not least, Mrs Gn Soon Lay (secretary to the PBL Committee).

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