Original Articles

Description of a Canadian PBL Programme in Pharmacology

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Introduction

McMaster University (Canada) brought problem-based learning (PBL) to the forefront of education in 1969 and has played a critical leading role in the promotion and development of PBL since then. The medical schools at Harvard, the University of Limburg at Maastricht (Netherlands), the University of Newcastle (Australia), and the University of New Mexico (U.S.) have developed influential programmes as well. Subsequently, variations of the McMaster model have been adopted by a number of schools in the U.S., including New Mexico, Michigan State, Tufts, Harvard and Southern Illinois. Some of the educators from McMaster University have played a facilitative role in the early planning process of new curricula in some of these universities such as the University of Hawaii and Harvard.[1]

In recent years, there have been numerous discussions, conferences and workshops on PBL as a teaching format in Pakistani medical colleges and universities. Experts in medical education from different parts of the world have been inducted to facilitate the shift from lecture-based to problem-based learning in the Pakistani context. I studied pharmacology at McMaster University, Hamilton, Canada (Graduate of the class of 2002) in PBL format, as part of the undergraduate Biology and Pharmacology Co-op programme (Bio/Pharm programme), which has been extensively described.[2-4] The purpose of this communication is to describe the programme and its main strengths, for the benefit of those who are involved in planning such programmes/ courses in Pakistan, and for students who are going through the process.

Description of PBL-based Pharmacology Courses at McMaster University

The biology courses of the Bio/Pharm programme are taught in lecture format, while the pharmacology courses are taught in problem-based, self-directed tutorial format. Each tutorial group consists of no more than 6-8 students, with a facilitator, who is a senior faculty member. The pharmacology courses are facilitated by faculty members from various departments (e.g., Medicine, Obstetrics and Gynaecology, Pharmacology), with substantial interest in pharmacology.

Problems for each course are carefully constructed such that the main objectives of the course are met through in depth study of the problems. Four to six problems are handed out to students at the beginning of the course, along with a list of the course objectives and the expected knowledge base the student should have at the end of the course. Approximately three to five weeks are spent on each problem. The duration of each course is four months, and the tutorial sessions are held once a week for three hours.

The order of problems is determined by the facilitator, based on the course objectives covered in each problem. Alternatively, students also have the choice to pick from among problems at random. When a new problem is given to students, they get a fair amount of time to read the problem in class. This is followed by a 'brainstorming' session, where students raise issues from the problem presented. All these issues are written on the blackboard, regardless of how odd, narrow or broad they may be.

The next step is refining the issues raised into learning objectives. This may be a difficult task and the facilitator may help focus the group. The learning objectives for the first week are usually broadly focused, allowing students to understand the 'bigger picture' before getting to specifics. After a suitable number of learning objectives are framed, a reasonable number (approximately five to eight) are selected for the first week and students disperse, to individually collect information, read it critically, and discuss it in depth with the group the following week. Critical reading and critical thinking is strongly emphasized in the programme. Students are encouraged to challenge information, explain apparent contradictions, look for discrepancies, and present differing viewpoints on a subject where possible.

Students seek information from textbooks, review articles and primary literature. As students mature in their learning abilities, there is a shift from textbooks to published literature as primary information sources. Sufficient information is collected, critically analyzed and learnt by students (self-directed learning) to the best of their ability. Information and questions are brought to the tutorial the following week.

Tutorials are run in a discussion, rather than presentation format. Students 'talk about' what they have learnt, thus sharing with the group and teaching each other. The use of visual aids (e.g., diagrams on the blackboard,

Table 1. Structure of a PBL course in undergraduate pharmacology at McMaster University, Canada.

Tutorial Session:	Evaluation
Study problems distributed of students ↓ Problem 1 ↓ Brainstorming session ↓ Form learning objectives ↓ Select learning objectives for first week ↓ Discuss information collected (week 2). Form objectives for the following week ↓ End of problem: verbally summarize the information gathered ↓ Submit brief write-up two weeks after the end of the problem	Tutorial evaluations: Evaluation of facilitator and students based on the following categories: responsibility, information gathering, communication, critical sense and self assessment **Mid-term evaluation:** Based on previous tutorial evaluations Final evaluation Based on mid-term evaluation and tutorial evaluation after mid-term **The triple jumps:** Phase I: Formulate hypotheses Phase II: Design experiment Phase III: (Additional information given) Reassess hypotheses and experiment

transparencies, handouts prepared by the students, etc.) is strongly encouraged. Such a discussion results in a better understanding of the concepts by the entire group, and the identification of more learning objectives for the following week. In subsequent weeks, learning objectives are identified from issues raised by group discussions, and reference to the list of objectives framed when the problem was first handed out.

At the end of each problem, the group summarizes the information in a verbal discussion. Students are expected to submit a brief write-up two weeks after the end of the problem. The purpose of this exercise is to provide students with an opportunity to summarize their learning, ensure that all concepts are thoroughly understood, and provide them with a reference record of the content component of the course. Additionally, this exercise helps the tutor assess what the students have learned, and identify factual or conceptual errors.

The final exam is appropriately called the 'triple jump' or 'tri-partite' exercise, or 'tripsi' for short. In the first phase, students are presented with a problem, and given 20 minutes to write one to three possible explanations for the observations made. In the second phase, students are given 20 minutes to choose one of their explanations and design an experiment to test or verify their explanations. In the third phase, students are given additional information and asked to re-assess their explanations and experimental tests in light of the new information. Students have two hours to complete the third phase. Each phase is evaluated separately.

The purpose of this exercise is to provide students with an opportunity to apply information, learning skills and analytical abilities acquired from the problem based tutorials.The triple jump allows students to critically analyze information, identify gaps, ask relevant questions and design experiments to find answers, thus following the theory of the scientific research process into practicality. A summary of the structure of pharmacology PBL courses is shown in Table 1.

Evaluation is one of the main components of the

programme. The five categories for evaluation of performance (student and tutor) are: responsibility, information gathering, communication, critical sense (creative thinking and student's evaluative ability) and self-assessment. After every tutorial session, students evaluate their own performance, each other's performance, the tutor's performance, the problem itself, and the course of the tutorial. The tutor evaluates his/her own performance, the students' performances, the problem itself, and also the course of the tutorial. During mid-semester, one tutorial session is set aside for holistic view of each student's performance in the two-month period. Final evaluations are held in the last tutorial session before the exam. In this session, the mid-course evaluations are used as a basis and the student is evaluated based on a visible improvement or regression in any category. Each student evaluates him/ her-self, along with the tutor and the rest of the group. Based on the comments made by the whole group, the tutor assigns a mark according to a grading scale shown in Table 2. Additionally, students evaluate the course and the tutor.

Table 2. Grading scale for PBL tutorial sessions.

90-100	Outstanding performance	70-72	Average performance
85-89	Excellent performance	67-69	Satisfactory, but below average performance
80-84	Very good performance	63-66	Marginal performance
77-79	Good performance	<63	Fail
73-76	Above average performance		

The final mark achieved by the student is based on mid-course and final evaluations, summary reports for problems, mid-term assignments and the triple jump. The mid-term assignments allow students to research an area of interest in the context of the course objectives. Students submit a written report and may be asked to present their work.

Comments

On a personal note, the PBL experience in learning pharmacology concepts was an unforgettable one. I hope that more students can experience the pleasure of learning as I have. The main skill that I acquired as a result of PBL was how to learn. It allowed me to explore the areas that most interested me. The course structures allowed for independent and group work, and for learning as well as teaching opportunities. The programme promoted the refining of evaluation skills-strengthening the ability to evaluate and to be evaluated.

The small class size allowed for the personal and academic development of each student on an individual basis. There were always opportunities for faculty and student interaction, and out of class discussions on academic and personal matters. The limited number of students in the programme and students per tutorial allowed for close contact between students, both in and out of class. This worked to promote positive group dynamics during each tutorial session, and fostered a personal appreciation for fellow colleagues.

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