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21st Century Teaching For Students Of Medical Laboratory Technology: A Problem-Based Learning Approach

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Abstract

Introduction: The expected knowledge base required for newly qualified laboratory technicians in practice setting is immense. However it is almost impossible to include all the information required at entry into professional practice into the teaching curricula. Problem based learning (PBL) is intended to develop lifelong and self-directed learning. The aim of this study was to analyze students' opinion about a new model of PBL and to evaluate its effect on the students' conceptual understanding.

Methods: We developed a teaching and learning *quality improvement (QI) model* for final year medical laboratory technology (MLT) students based on PBL. After finishing an introductory teaching module, students were given a pre-test assessing both reasoning skills and facts at beginning of next class. Students were then randomly divided into four groups in the next session. This was followed by small group PBL discussions on pre-test questions. A similar surprise post-test was then conducted after 2 weeks and each student's view on PBL was assessed.

Results: A total of three PBL sessions were conducted. The overall mean post-test scores were significantly higher than the mean pre-test scores (p value<0.05). The PBL model was rated as 'an excellent way in understanding concepts' by majority of the students and 86.7% of students gave overall positive remarks.

Conclusion: The QI model based on PBL sessions improved the students' conceptual understanding of the topic. This model may lead to the development of self-directed learning skills and enhance student-centered learning outcomes beyond knowledge acquisition.

Introduction

The expected knowledge base required of newly qualified laboratory technicians for the practice setting is immense. However it is almost impossible to include all the information required at entry into professional practice into the teaching curricula. Also many medical and para-medical graduates were unable to apply the content learned in their classes to clinical practice [1]. Hence we need to develop students into lifelong learners and self-directed laboratory practitioners.

Problem based learning (PBL) is a strategy that uses a problematic stimulus for students to develop and acquire knowledge. Students are presented with a problem to solve rather than a lecture to absorb. Students, working in small groups in a classroom setting, are challenged to apply previously learned information to the problem and identify the knowledge and skills they lack to accurately solve the problem [2]. PBL has been implemented as a main teaching strategy in nursing courses by the Department of Health in UK [3,4]. Similarly many universities have also observed enormous usefulness of PBL strategy for undergraduate medical students. However there is no information available in the literature that addresses the question of usefulness PBL learning methods in laboratory technology courses.

Three types of approaches to PBL have been identified in the literature: (1) completely integrated PBL, curricula, (2) transitional curricula, and (3) a single-course approach [5]. We planned to implement PBL in one or more courses of the medical laboratory technology (MLT) curriculum as a *trial process* in an attempt to gain some of the proposed benefits of PBL. However in high school the learning is passive and focused on factual knowledge. Hence the students' rapid transition from passive learning to a PBL curriculum where learning is independent and focused on cognitive skills, might be difficult for many students, particularly in the early phases of a PBL program [6]. Hence it has been suggested that a module or short course can be designed to include mixed teaching methods (including PBL) to achieve the learning outcomes. Also small number of lectures may be desirable to introduce topics or provide an overview of subject material in conjunction with the PBL scenarios [7].

As no suitable PBL model was found in the medical

education literature for medical laboratory technology (MLT) students; we developed a simple model where introductory teaching sessions are followed by PBL discussion sessions. The aim of this study was to evaluate the effect of this mode of teaching and learning on the students' conceptual understanding of the topic and the retention of the gain in knowledge after three weeks of introductory class.

Methods

Introduction of PBL for medical laboratory technology in JIPMER, Pondicherry, India

We developed a teaching and learning *quality improvement (QI) model* for final year undergraduate MLT students based on PBL models. The new MLT program combined traditional and PBL curriculum features. These features included integration of PBL into regular curriculum, where introductory classroom lectures were followed by PBL discussions with integrated objectives. A problem-solving approach was used with small-group learning in the subsequent session. The goals of these sessions were to foster the development of clinical reasoning and responsibility for learning and to create a forum for students to address laboratory patient care issues.

Study Unit Design

The final year undergraduate MLT students (n=18) have weekly biochemistry theory classes in their curriculum. An introductory teaching session from the topic 'lipid metabolism' was first conducted. After finishing an introductory teaching module, students were given 10 multiple choice questions (MCQ) of one mark each assessing both reasoning skills and isolated facts at the beginning of next class (pre-test). Students were then randomly divided into four groups, each group consisting of 6–8 students. This was followed by small group PBL discussions on pre-test questions in the presence of a faculty member. Attendance was mandatory for PBL sessions. Students met once a week for 2 to 2.5 hours per session and worked through health care scenarios that were designed to address study unit objectives. Students were challenged to apply previously learned information to the problem and identify the knowledge and skills they lack in accurately solving the problem. A surprise post-test of a total of 10 marks was then conducted after two weeks. At the end of all the sessions, each student's opinion on PBL was assessed by asking them to tick choices on an anonymous questionnaire. The learning effects of this group discussion were evaluated by comparing the performance of students in pre-test *versus* post-test using paired student's-t-test by SPSS 13 software.

Interviewing the students

The second part was concerned with interviewing the students who were exposed to PBL for the first time to explore their opinion on this QI model of PBL. This was analyzed by the content analysis of the questionnaire form filled by the students at the end of all the sessions. The anonymous questionnaire survey (see Appendix-1) sought opinions on (i) rating of PBL model as a tool in understanding concepts' compared with regular teaching model, (ii) the association between the 'PBL tool' and 'development of your skills of critical thinking' and (iii) overall remarks. The association between the 'PBL tool' and 'development of skills of critical thinking' was assessed by asking the students to tick on a 0-10 cm visual analogue scale (VAS), where '0' referred to no association and '10' referred to maximum association. The first section of the survey form (questions 1–2) dealt with the demographics of the student. The second section dealt with the students' opinions on QI model of PBL (questions 3–5).

Results

Three regular teaching modules were required to complete the topic lipid metabolism. Hence a total of three PBL sessions and three pretests-posttests were conducted.

(i) Effect of small group PBL discussion on the students' conceptual understanding of the topic and the retention of the gain

The overall mean post-test (post discussion) scores were significantly higher than the mean pre-test (pre discussion) scores, mean±SD: 8.2±1.8 versus 6.2±2.0, mean difference=1.96 (n: 18x3=54 and 95% confidence intervals=2.7, 1.2), p value< 0.001. Hence the gain from the discussion exercise was retained after three weeks of introductory teaching session.

(ii) Content analysis of the questionnaire form seeking students' opinion on PBL model

Of the 15 students who answered the questionnaire, 73.3% were males and 26.7% were females. All the students were between 19-24 years of age. The PBL model was rated as 'an excellent way in understanding concepts' compared with regular teaching model by 66.7% of the students (Fig 1A). None of the students rated PBL model as poor compared with regular teaching model. The association between the 'PBL tool' and 'development of skills of critical thinking' on a

0-10 cm visual analogue scale (VAS) was rated as ’10 cm’ by 33.3% students, ‘9 cm’ by 13.3% students and ‘8 cm’ by 26.7% of students (Fig 1B). None of the students rated the association as less than 5 cm. About 86.7% of students gave overall positive remarks (Fig 1C). The general *verbatim* remarks of students are presented in Table 1.

Discussion

Generally in a teacher-directed (teacher-centered) instructional paradigm, students are mainly passive recipients of abundant content knowledge and are not actively involved in the teaching learning process. Consequently the regular classroom based lectures do not nurture enough the students to build a firm foundation for the development of lifelong continuing self-education which is so critical for competent medical practice in the 21st century [8]. Educational systems are accused of being too clumsy, producing bad instruction, and of being out of touch with today’s training needs. There is more emphasis on the process involved in developing instruction and less importance is given to basic learning principles. Insufficient quality in education is likely to result in an inferior product [9].

In the mid-1960s, McMaster University gave birth to a medical school so different it sent ripples of astonishment throughout the educational world. Problem based learning was developed by Harold Barrows at McMaster university medical school in response to student dissatisfaction with the lecture format [10]. It is recognized that there may also be interactions between multiple learners, teachers and others. The PBL model focuses on the interaction between learner and teacher, engaging respectively in learning and teaching activities and simplifies complex interactions into transactions between pairs of individuals [11]. In practice, PBL is usually part of an integrated curriculum using a systems based approach, with nonclinical material delivered in the context of clinical practice [7].

We found that the PBL discussions on pre-test questions after an introductory teaching module improved the students’ conceptual understanding of the topic and the academic gain from the exercise was retained after three weeks of introductory class. Participants found this model of learning and teaching helpful. They also felt that it adequately represented the teaching activities within the wider context of undergraduate medical laboratory technology education. The structure of the PBL sessions allowed students to think critically and they felt that the discussing problems are a powerful tool for understanding concepts.

Our study however has few limitations. Although two weeks following the end of the PBL sessions a good predictor of short term retention however this time period is insufficient to assess long term retention of knowledge. Also not all students answered the questionnaire. The small group sessions were also not purely PBL sessions and were rather based on a mixed approach. Nevertheless the overall response of the students was very encouraging and we definitely intend to expand upon these findings in the future and include QI model in the curriculum of the under-graduate MLT students.

Conclusion(s)

We finally conclude that the QI model of PBL may help in developing a professional climate that allows the evolution of students’ from a laboratory technologist being perceived as primarily a technician to being perceived as a professional making decisions regarding diagnosis.

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Illustrations

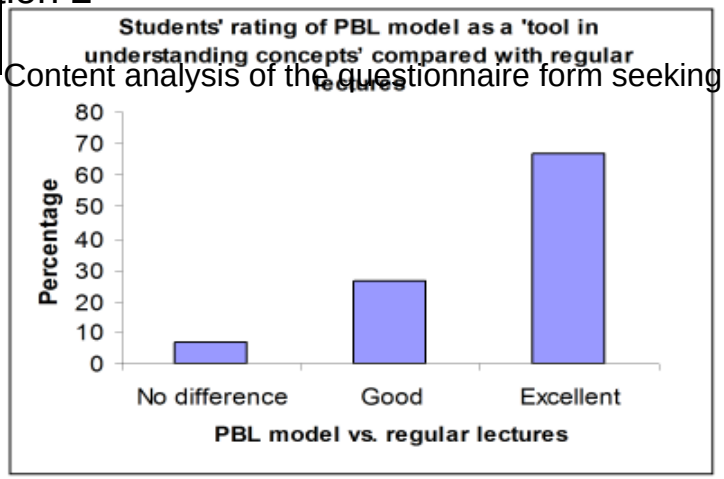
Illustration 1

Table 1 General verbatim remarks about PBL model of students

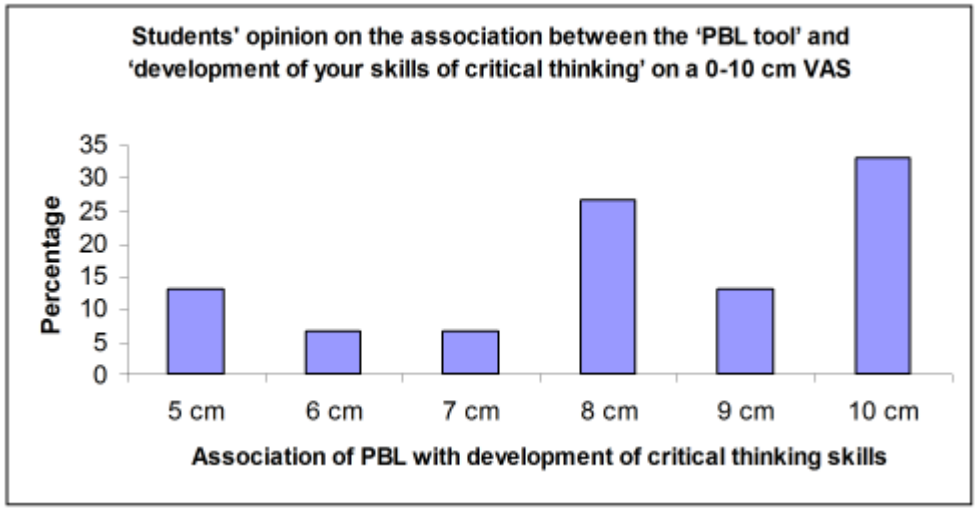
Verbatim remarks	Overall category
"This is my first (and best) experience. It will be helpful for us during preparation for higher studies. Please continue this forever"	Positive
"This model is good"	Positive
"This model is good"	Positive
"The concept is fresh and gives chance for the students to relate themselves with classes. After the discussion, a Xerox copy of the correct answers with explanation can be circulated to the students"	Positive
"This PBL model is working excellent for me"	Positive
"This model will help while facing problem based questions"	Positive
"It is a nice model with nice concepts"	Positive
"PBL model of teaching is better than usual methods"	Positive
"This model will be very useful for future entrance exams also"	Positive
"This PBL model is good and with every discussion I acquired useful skills"	Positive
"This PBL model is good. It develops the individual skills and dealing capacity"	Positive
"This PBL model is excellent in improving our knowledge and skills"	Positive
"I feel very glad about this PBL model. I would prefer this type of learning. Thank you"	Positive
"This model takes more time"	*Negative*
"In between the discussion class, give some break, it becomes very tiring"	*Negative*

Illustration 2

A



B



C

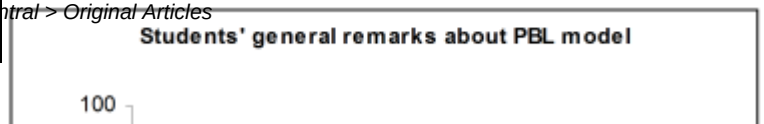


Figure 1 Content analysis of the questionnaire form seeking students' opinion on PBL model

Illustration 3

Appendix-1

Questionnaire survey

We appreciate your honest opinions
The responses will be treated anonymously and confidentially

The first set of questions relate to your demographic information

1. What is your age?
2. Gender? Female Male

The remaining questions relate to your opinions on problem based learning (PBL)

3. How would you rate PBL model as a tool in **understanding concepts'** compared with regular teaching model?
    a) Poor
    b) No difference
    c) Good
    d) Excellent

4. Do you think PBL model can be useful in **developing your skills of critical thinking**?

Please rate the association between the 'PBL tool' and 'development of your skills of critical thinking' of each by placing a cross anywhere on the space provided.

5. Please give your remarks about this model of PBL. Also mention your suggestions for improvement of this model.

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