

# Problem Based Learning: A Review of Experiences of Medical Students

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## Abstract

The constructs for teaching Problem Based Learning are very different from traditional classroom or lecture teaching and often requires more preparation time and resources to support small group learning. This review is to assess the experiences of medical students about Problem Based Learning. This review is also to explore the experiences of medical students regarding their concerns and challenges about Problem Based Learning; assess medical students' perceived advantages and disadvantages about Problem Based Learning and explore medical students' knowledge and skills gained through Problem Based Learning. A thorough search of peer reviewed and grey literature from 1987 to 2016 yielded 76 publications that were synthesised and analysed. This review found out that Problem Based Learning could develop the flexible knowledge base of medical students; develop medical students' effective problem solving skills; develop medical students' self-directed lifelong learning skills. This review therefore concludes that the Problem Based Learning curriculum appears to be more effective in teaching medical courses as compared to other experiential approaches. More research is needed to identify more effective and efficient ways of improving the teaching of Problem Based Learning in Medical Schools.

**Keywords:** Problem Based Learning, Review, Experiences, Medical Students, Methodology

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## 1.0 Introduction

Problem Based Learning (PBL) is a student-centered pedagogy in which students learn about a subject through the experience of solving an open ended problem found in trigger material. The PBL process does not focus on problem solving with a defined solution, but it allows for the development of other desirable skills and attributes. This includes knowledge acquisition, enhanced group collaboration and communication. The PBL process was developed for medical education and has since been broadened in applications for other programmes of learning. The process allows for learners to develop skills used for their future practice. It enhances critical appraisal, literature retrieval and encourages ongoing learning within a team environment.

The PBL tutorial process involves working in small groups of learners. Each student takes on a role within the group that may be formal or informal and the role often alternates. It is focused on the student's reflection and reasoning to construct their own learning. The Maastricht seven-jump process involves clarifying terms, defining problems, brainstorming, structuring and hypothesis, learning objectives, independent study and synthesis (Schmidt, Rotgans & Yew, 2011). In short, it is identifying what they already know, what they need to know, and how and where to access new information that may lead to the resolution of the problem.

A review of PBL is timely because issues of flexible thinking and life-long learning have come to the fore in discussions of classroom reform (Bransford et al., 2000; Greeno et al., 1996). PBL is of increasing interest to medical educators as demonstrated by widespread publication of books written about PBL (Duch et al., 2001).

A search of literature from 1987 to 2016 revealed published studies on PBL in the areas of the effects of PBL during medical education and postgraduate studies (Albanese & Mitchel, 1993; Colliver, 2002; Hallinger & Bridges, 2016; Nandi, Chan & Chan, 2000;) and preference of PBL over traditional methods by students and educators (Berkson, 1993; Newman, 2003; Vermont & Blake, 1993).

So far, experiences about how PBL can develop the flexible knowledge base of medical students; develop medical students' effective problem solving skills; develop medical students' self-directed lifelong learning skills; how PBL could develop medical students' effective collaboration skills and intrinsic motivation of medical students seems insignificantly investigated which this review paper sought to address.

## 2.0 Methods and Materials

A systematic search of the national, regional and international literature was undertaken from peer reviewed databases from 1987-2016. Other databases include the MEDLINE, CINAHL and PubMed. The key words used for the search included: problem based learning, methodology, experiences, medical students and university. The search was augmented by reviewing the literature from books, local newspapers, magazines and reference lists of articles thought to be relevant.

### 3.0 Findings

A great deal of knowledge emerged from this review of evidence which is presented in headings as the concerns and challenges about PBL, the advantages and disadvantages of PBL and the knowledge gained by medical students through PBL.

#### 3.1 Concerns and Challenges of Problem Based Learning

With reference to the experiences of medical students regarding their concerns and challenges about PBL, a qualitative case study by Ju, Choi, Rhee and Tae-Lee (2016), explored challenges Korean Medical Students and tutors experienced during their PBL sessions from a cultural perspective using Hofstede's cultural dimensions. Twelve preclinical medical students and nine tutors from a large Korean Medical School participated in interviews. The interview data were analyzed using the constant comparative method and classified according to Hofstede's cultural dimensions.

In practice, however, many students and tutors have encountered various challenges, such as inactive participation in student-led discussions (de Grave, Dolmans, & van der Vleuten, 2001; Kindler, Grant, Kulla, Poole, & Godolphin, 2009), students' concerns about their perceived lack of knowledge (Glew, 2003; Kindler et al., 2009), and tutors' lack of understanding about the roles of tutors (Azer, 2001; Moust, van Berkel, & Schmidt, 2005; Ward & Lee, 2002) during their PBL experiences. In addition, PBL often generates conflicts with the traditional approach to teaching and conventional expectations, such as "long-term effects versus immediate learning outcomes," "depth versus breadth of the curriculum," and "higher order thinking versus factual knowledge acquisition" (Hung, Bailey, & Jonassen, 2003, p. 13).

While suffering mixed perceptions and results in practice, PBL has been introduced in a number of medical schools in several Asian countries, including South Korea (Kim et al., 2004), Hong Kong, Taiwan, Singapore, and Japan (Servant, 2013), with the hope that PBL would enhance the quality of students' learning experiences. As expected, the medical students and tutors in Asian countries have experienced challenges (Chang et al., 2001; Hussain, Mamat, Salleh, Saat, & Harland, 2002; Tsou et al., 2009) similar to those reported in the American context (Hung, 2011).

However, several studies (e.g., Khoo, 2003) indicated that different challenges might be experienced by Asian medical students and tutors during their PBL sessions, such as a lack of collaboration and discussion among students and a passive attitude toward PBL, which may jeopardise the PBL curriculum.

The overarching goals of medical education are to produce doctors capable of (1) evaluating and managing patients with medical problems in an effective, efficient, and humane manner; and (2) evaluating their own abilities, determining when new knowledge and/or skills are needed, and continuing learning throughout their professional lives (Barrows, 1985, 1994; Barrows & Tamblyn, 1980). PBL has been known as one of the most effective methods for achieving these goals, supposedly by empowering medical students to actively engage in real world problem solving, self-directed learning, and collaborative learning (Barrows, 1985, 1996; Barrows & Tamblyn, 1980).

#### 3.2 Advantages and Disadvantages of Problem Based Learning

In assessing medical students' perceived advantages and disadvantages, Manisha, Harsh, Shalini and Geeta (2016) revealed that Problem-based learning (PBL) is an innovative educational approach in which the students determine what they need to learn. The present study was done to review the pros and cons of PBL, with the aim to introduce reforms in the traditional teaching methodology.

A total of 200 medical students participated in the study. Six PBL exercises were allotted to the students and after their completion, they were asked to fill the questionnaire regarding their perceptions about PBL on a 5-point Likert scale, as well as open ended questions to elicit two reasons each for liking and disliking PBL.

For the student, problem-based learning emphasises the application of knowledge and skills to the solution of problems rather than the recall of facts (Bligh, 1995). The present study showed that the PBL improved the presentation skills, communication skills and proficiency with computer and IT among students. Similar finding was observed in a study by Nahar, Salam, Nuzhat, Alakrash and Dipro (2014) among medical students in Saudi Arabia in which 77.1% students agreed that PBL improved presentation skills.

A study carried out by Koh, Khoo, Wong and Koh (2008) based on systematic review of 15 studies on problem based learning showed that PBL improved presentation and communication skills of the students. Another study carried out by Thirunavukkarasu, Latha and Nalini (2012) among the medical students of Chennai also found that PBL improved the communication skills in 80% students. The present study also showed that PBL motivated the students for self-directed learning and led to better understanding of the concepts which is also well supported by the systematic review carried out by Koh, Khoo, Wong and Koh (2008).

Another study carried out by AlHaqwi et al., (2015) in a medical school of Saudi Arabia also reported that PBL helps in improving the understanding of the subject. Their study showed that PBL improved critical thinking among students. Similar are the findings of the study carried out by Nahar, Salam, Nuzhat, Alakrash and Dipro (2014) among Saudi medical students in which 81.4% students perceived that PBL improved critical thinking.

Contrary to this, are the findings of the systematic review by Koh, Khoo, Wong and Koh (2008) which showed very little impact of PBL on critical thinking. In the present study, it was found that PBL encouraged the students to gather academic information beyond the textbooks. Similar are the findings of the study conducted by Nanda and Manjunatha (2013) among the medical students of Karnataka in which information gathering was observed to be significantly better with PBL than the traditional method.

Other reasons for liking PBL as a teaching methodology in our study were that PBL makes learning more interesting, inculcates the habit of teamwork and improves the problem solving skills among the students. A study conducted by Al-Naggar and Bobryshev (2012) among the Malaysian medical students also highlighted the fact that PBL holds the interest of the students and promotes their problem solving skills. Nanda and Munjunatha (2013) also observed that PBL enhanced the teamwork and interpersonal relationships among the students. Though majority of the students in the present study favoured the PBL teaching methodology but PBL needs to be improvised as many students perceived few problems with this methodology.

The major reasons for disliking the PBL methodology were reported as that preparation for PBL requires more time as compared to the conventional teaching methods; few students reported that group discussion was inadequate. Few students also found the briefing to be inadequate and some of the students also perceived the group size to be large. The study by Al-Naggar and Bobryshev (2012) among Malaysian medical students also found the PBL to be more time taking than conventional method. Student contact hours are four times greater for educators in a problem-based learning curriculum than for educators in a traditional curriculum. As a consequence, the economic viability of problem-based learning becomes a major concern.

Another limitation of problem based learning as reported by Koh, Khoo, Wong and Koh (2008) was that PBL does not improve the possession of medical knowledge, though the application of knowledge was enhanced through this process.

The present study revealed that PBL is a self-learning strategy that empowers students to engage in problem solving and collaborative learning and improves confidence, presentation and communication skills and critical thinking. It has been found to be an interesting teaching methodology that leads to better understanding and long lasting learning. Students generally favor this strategy as it enhances their ability to handle and solve real-life problems. However, few of the challenges are also accompanied with PBL methodology which should be looked into to improvise it. Moreover, it is recommended that further studies should be carried out among medical students of India and abroad to review the strengths and pitfalls of PBL which would provide useful data towards the integration of PBL in future Indian medical curriculum.

### **3.3 Knowledge and Skills gained through Problem Based Learning**

In exploring medical students' knowledge and skills gained through PBL, Meo, (2013) assessed knowledge and skills in a respiratory physiology course in traditional versus problem-based learning (PBL) groups in two different medical schools. Two different undergraduate medical schools were selected for this study. The first medical school followed the traditional Lecture-based Learning (LBL) curriculum, and the second medical school followed the PBL curriculum. Sixty first-year male medical students (30 students from each medical school) volunteered; they were apparently healthy and of the same age, sex, nationality, and regional and cultural background. Students were taught respiratory physiology according to their curriculum for a period of 2 weeks.

This is one of the few studies that shows a positive effect of PBL on learning in basic medical science. Shahabudin (1987) demonstrated that PBL students showed better factual recall than traditionally educated students. Interestingly, Kaufman et al. (1989) reported that PBL students scored higher on the National Board of Medical Examiners *part 2* clinical science examination. Concurrently, Burford et al. (1990) directed a randomised multicenter study in pharmacology using PBL and traditional curricula and demonstrated higher scores on knowledge testing for the former PBL approach.

Our data, as well as those of the other authors referenced here, support our hypothesis that medical knowledge is certainly better retained if originally learned using PBL compared with traditional lecture methods.

The findings of the present study are in contrast to studies that reported that undergraduate students in a PBL group had lower knowledge acquisition compared with those who received the lecture method (Andrew & Jones, 1996; Frost, 1996; Kim, Kang, Kim, Nam & Park, 2000). The literature shows that PBL produced no statistically significant differences in knowledge acquisition compared with the traditional lecture-based method for graduate nursing students (Miller, 2003).

Furthermore, Rideout et al. (2007) found that undergraduate students taught by the PBL method had no statistically significant differences in theoretical knowledge in pathophysiology and professional knowledge compared with students taught by the lecture method. The most probable reason for this contradiction is the difference in research methodology, as their study was based on a self-reporting questionnaire. However, in the present study, we assessed knowledge based on single best Multiple Choice Questions (MCQs). MCQs were based on both lower level as well as higher order of Bloom's taxonomy, including recalling, comprehension, application, analysis, synthesis, and evaluation.

Albano et al. (1996) conducted a study on differences in knowledge acquisition in medical colleges using a variety of instructional strategies, including PBL and LBL; they concluded that the differing strategies seem to have only limited influence on the level of knowledge of the graduates. However, in the present study, we assessed knowledge based on marks obtained in the MCQ examination in respiratory physiology among undergraduate medical students in LBL versus PBL curricula and found that students who belonged to PBL curriculum obtained higher scores in the MCQ examination compared with those who belonged to the LBL curriculum. We believe that the most probable reason for this contradiction is that Albano et al. (1996) used the Maastricht progress test. The Maastricht progress test is a written test consisting of true/false item questions, and this test may not be suitable to solve the problem of assessment of knowledge of individual students; however, it may be helpful in identifying corresponding cognitive levels. Moreover, in true/false examinations, students have a relatively high probability of guessing the answer Albano et al. (1996).

Login et al. (1997) conducted a study to determine academic performance on a standardized oral comprehensive exam in students taught basic science in a PBL curriculum and a LBL curriculum. The oral comprehensive exam was administered to the graduating classes of 1991–1994, 6 months after the completion of their basic science courses. The class of 1991 was taught by LBL, and the classes of 1993 and 1994 were taught by PBL. The science and medical knowledge component score was significantly better for the PBL class of 1994 than for the LBL class of 1991. Similarly, in the present study, we found that students who belonged to the PBL curriculum obtained higher scores in the MCQ examination compared with students who belonged to the traditional curriculum.

Smits et al. (2002) reported that there was no consistent evidence showing that PBL in continuing medical education is superior to other educational strategies in increasing a physician's knowledge but there was moderate evidence showing that it led to higher satisfaction. Smits et al. (2003) also investigated the effectiveness of PBL compared with LBL in a postgraduate medical training program concerning the management of mental health problems for occupational health physicians. They observed that, in both groups, knowledge increased equally directly after the program and decreased equally after the follow up. They also suggested that both forms of postgraduate medical training are effective. The gain in knowledge remained positive, and the performance indicator scores also increased in both groups, but they increased significantly more in the PBL group. Although in the present project we did not follow up the study findings, our results favor the PBL group, where the gain in knowledge was significantly more compared with the LBL group of students.

Monica et al. (2004) reported that a PBL curriculum resulted in significantly better examination performance than did the traditional teaching curriculum, both for MCQs and the viva examination. Students were significantly more successful in the examinations if they had experienced the PBL style of curriculum.

Rich et al. (2005) determined the efficacy of PBL pedagogy in preclinical and clinical teaching. Test scores of undergraduate dental students from conventionally taught classes were compared with scores of dental students from PBL classes. Their scores revealed that PBL students performed significantly better than traditional students on midterm and final examinations.

Gurpinar et al. (2005) conducted a cross-sectional study among fifth- and sixth-year medical students in Turkey. They prepared 25 MCQs, and the examination was conducted to compare the knowledge of medical students in PBL and traditional curricula on public health topics. The results showed that PBL group scores were significantly higher than those in the traditional group. Similarly, we found that students who belonged to the PBL curriculum obtained higher scores in the MCQ examination compared with students who belonged to the traditional curriculum.

Hwang and Kim (2006) studied the effects of PBL with the traditional method on learning in a cardiorespiratory nursing course. They found that the level of knowledge in the PBL group was significantly higher than that of students in the lecture group. The results of the present study are in agreement with those of Hwang and Kim (2006).

Koh et al. (2007) observed that PBL during medical school has positive effects on physician competencies, especially in cognitive dimensions. Dehkordi and Heydarnejad (2008) conducted a study aimed to compare the effect of education through PBL or LBL on knowledge in nursing students. Students underwent a one-semester course using the two methods of education, and Dehkordi and Heydarnejad (2008) found that the level of knowledge in the PBL group was significantly higher than that of students in the lecture group.

Callis et al. (2010) conducted a study to determine knowledge and skills in a hybrid PBL curriculum compared with a traditional LBL curriculum. They found that students who belonged to the hybrid PBL group were better at applying basic science knowledge to a clinical case and demonstrated greater skills in the areas of hypothesis generation and communication. Similarly, in the present study, PBL students achieved better scores in the MCQ examination and OSPE compared with those who belong to the LBL curriculum.

Szogedi et al. (2010) conducted a study using a cardiopulmonary resuscitation (CPR) examination and collected data on final CPR exam grades both from PBL and traditionally trained students. Students who attended PBL classes had better CPR examination grades and demonstrated better resuscitation skills when their their

knowledge and skills were assessed compared with their traditionally trained peers.

Similarly, in the present study, we found that students who belonged to the PBL group demonstrated better knowledge in respiratory physiology and lung function skills compared with their counterparts.

Abou-Elhamd et al. (2011) introduced PBL techniques into the ear-nose-throat (ENT) course taught to fifth-year medical students, and conventional methods were used to teach audiology and ENT radiology. They concluded that the application of PBL to ENT teaching resulted in a substantial increase in students' knowledge and skills. Similarly, in the present study, we found that students who belonged to the PBL group achieved higher scores when knowledge was tested based on the MCQ examination and skills in the lung function test were tested based on the OSPE.

Schwartz et al. (1992) demonstrated that PBL students scored significantly better on the formulation of differential diagnoses and interpretation of clinical data, demonstrated a strong trend to perform better on ordering of appropriate laboratory and diagnostic studies, and scored significantly better on the National Board of Medical Examiners-II subtest. Similarly, in the present study, we found that students who belonged to the PBL group achieved better scores in the OSPE when skills were assessed in performing and interpreting spirometry/lung function test data. Rich et al. (2005) reported that a preclinical and clinical program using PBL methodology resulted in student performance of nonsurgical periodontic skills at a level equal to or greater than that of a conventional approach.

In correlation with the results of the present study, Smits et al. (2002) reported that there is evidence showing that PBL increases a physician's skills. Similarly, Dochy et al. (2003) suggested a strong positive effect of PBL on skills of students. Moreover, Bader and Syed (2009) reported that the PBL system helps in developing student skills, particularly problem-solving and analytic skills. Thomas et al. (2009) compared the performance of obstetrics and gynecology residents who were trained using a PBL curriculum during medical school with those who were trained in a traditional curriculum. They found that there was a significant difference between the mean scores of the two study groups for United States Medical Licensing Examination *step 2*. In the present study, our data, as well as those of the other authors referenced here, support the concept that skill in medical students is certainly better retained if students learn in a PBL style of teaching and learning.

#### 4.0 Limitations

This review had some limitations. The literature on the researcher's interest is limited. Some resources are old enough that teaching methodologies like PBL may have changed or undergone innovations since they were written; also the researcher did not assess the quality and methodological validity of reviewed sources. Therefore certain assertions that the researcher makes in the review are based on only one or two studies, sometimes from grey literature, and cannot be substantiated, validated, or generalized. And yet the compelling story the literature presents is consistent, suggesting that it is a true representation of the experiences of medical students about Problem-Based Learning.

#### 5.0 Discussion

It is a general believe that PBL students used the problems to seek, synthesize, reason and integrate the information and also to better understand, process, and retrieve the information.

Moreover, the PBL tool of teaching and learning enhances students' basic knowledge and problem-solving skills, and PBL students also have more chances of group discussion. This pedagogy alters the students' learning strategies. Therefore, in this present review, students' knowledge and skills were better in PBL compared with LBL.

The results of the present review show that students who belonged to a PBL curriculum obtained significantly higher knowledge and skills scores compared with students who belonged to traditional styles of medical school. This review contributes to the understanding of the relationship between different educational approaches and student outcomes. Although, it was generally noted that the results of the present review were based on certain medical specialties such as respiratory, physiology and a lung function laboratory may provide some evidence in the selection of an appropriate method for teaching and learning, we need multicenter, large-scale, longer time period studies on multiple body systems to obtain more valid and reliable conclusions needed to support decision making about curriculum changes.

The issues that emerged from this critical review are that, whilst PBL is both innovative and challenging, PBL also improves presentation, communication and ICT skills. Another revelation from the review is PBL motivates students for self-directed learning and also improves the understanding of the subject. The review also revealed that PBL leads to academic innovation and enhances team work. PBL could also have very little impact on the critical thinking of students and PBL is time consuming as compared to the conventional teaching methods.

PBL does not improve the possession of medical knowledge. PBL enables students to construct extreme and flexible knowledge. PBL enable students to become effective collaborators. This goal is however less researched and needs further attention. PBL enable students to become intrinsically motivated. This aspect is also less researched

and needs attention.

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## 6.0 Conclusion

Problem Based Learning proved to be a more effective methodology in training medical students. This review focused on the experiences of medical students about Problem Based Learning and confirmed that students' experiences about Problem Based Learning could improve the self-learning skills of medical students and further make medical students independent in their chosen carriers. Medical curricula designed to improve knowledge and skills must first involve the views of the students and tutors for effective and efficient implementation of that curriculum.

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