

# Problem-Based Learning as an Instructional Method

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## ABSTRACT

Problem-based learning (PBL) methods have revolutionized the field of medical education, since its introduction almost 40 years ago. However, there are many un-answered questions on the benefits and effectiveness of PBL. The supporters and critics of PBL continue to dispute the merits of cognitive foundation of PBL based approach. This paper performs a literature review of the different systemic reviews and meta-analysis which have addressed the effectiveness of PBL. Evidence presented in these reviews show that PBL does not impact knowledge acquisition, but impacts application of knowledge. There is no unequivocal evidence in favour of PBL that it enhance learning. More work is needed to identify appropriate outcome measures in-order to analyze the effectiveness of PBL.

**Key words:** *Problem-based learning. Medical education. Effectiveness. Cognition. Application.*

## INTRODUCTION

McMaster University was the pioneer to adopt the Problem-based learning (PBL) based curriculum in 1969. Over the next 20 years, 50 medical schools adopted the PBL based format of the curriculum. This was a revolution in the medical curriculum despite the fact that pioneers of this curriculum format did not have any philosophical or cognitive basis for this change.<sup>1</sup> Barrows and colleagues described the rationale for PBL based curriculum as being interesting for medical students to learn clinical problems in small groups and this will make medical education more relevant".<sup>1</sup> This format of instruction surprisingly got widespread adoption and recognition including endorsements by Association of Medical Colleges and the World federation of Medical education without any concrete evidence.<sup>2,3</sup>

Over the next 40 years there were a number of studies including systemic reviews and meta-analysis on effectiveness of PBL's between 1993 and 2010. It is very challenging to analyze the effects of PBLs using an outcome-based approach as PBL educators have taken different definitions for what constitutes a PBL based curriculum.

This paper summarizes the recent body of knowledge on three aspects of PBL effectiveness. These include the cognitive basis of PBL, knowledge acquisition through PBL and effects of PBL on clinical competencies.

Cognitive Basis of PBL: In-order to understand the cognitive basis of this mode of instruction the basic

objectives behind introduction of PBL method must be revisited. The main objectives as described by Burrows were to deliver knowledge in clinical context, use clinical reasoning skills, use self-directed learning skills and excite intrinsic motivation and enquiry.<sup>4</sup> It seems that the pioneers of PBL based method thought that this type of instructional method would help the students to develop problem solving skills. However, the work by Norman and Schmidt and later Elstein *et al.* showed that there was no evidence that any one type of curriculum can enhance problem solving skills.<sup>5,6</sup> However, it was shown that PBL contributes significantly to some cognitive attributes.<sup>6,7</sup> Knowledge which is acquired in relevant context is easy to remember. Knowledge acquired by using clinical examples helps in pattern recognition. Use of prior knowledge in PBLs helps in processing new information. Elaboration of knowledge at the time of learning as concepts are discussed at length in PBLs. Similarity between the context in which the knowledge is acquired and applied, helps in recall.<sup>6,7</sup>

Krischner *et al.* however, refuted the claims that there is elaboration of knowledge at the time of learning in PBLs; they suggested that problem solving approach places a heavy load on the working memory.<sup>8</sup> Mayer *et al.* in review on instructional methods also concluded that the tutor guided approach would be more beneficial for learning.<sup>9</sup>

Finally, to wrap-up this debate between proponents and detractors of PBLs, the main arguments of detractors against the PBL is that the problem solving approach in the PBLs causes heavy load on the working memory and thus limits learning. However, it must be realized that working on a case in PBL environment goes far beyond just problem solving. This process includes clarifying definition and terms, brain storming and making hypothesis, identifying learning needs, researching these learning objectives and discussing explanation of a phenomenon.

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Knowledge Acquisition and Clinical Competency Through PBL: Since the introduction of PBL, a number of narratives and systematic reviews have been written on the effectiveness of PBL comparing it with traditional didactic approaches. Schmidt *et al.* were the first one to compare PBLs with traditional mode of instruction.<sup>10</sup> They concluded that PBL method encourages students to take up inquisitive style of learning and directs them towards self directed learning. However, they noted that students from traditional curriculum tend to perform slightly better on academic achievement tests.<sup>10</sup> Berkson published an overview of 12 studies in 1993;<sup>11</sup> she noted that there was no evidence that PBL enhances problem solving skills and enhances knowledge acquisition. In addition she argued that PBL was costly and demanding on faculty and students. The first-two systematic reviews were also published in 1993. The authors found that students from traditional schools performed better on National Board Exams.<sup>12,13</sup> They also demonstrated that there was no difference between PBL students and traditional school students in terms of factual and clinical knowledge.<sup>12,13</sup> However, they concluded that PBL was superior to traditional methods based on students and faculty attitudes, better clinical performance, benefits to academic process and more humane approach to patients among the PBL students.<sup>12,13</sup> Although the authors reviewed the literature comprehensively but there were major methodological flaws in those reviews.

Kalain *et al.* published a systematic review of 6 studies in 1999. They compared the effects of PBL on performance in National Board of Medical Examination (NBME) and concluded that the PBL students performed better on clinical component of the exam, however, they performed poorly in basic science component.<sup>14</sup> In the year 2000, Collivier published a review on eight studies including randomized trials.<sup>15</sup> Although his work has many methodological flaws but he concluded that three of the randomized trials showed no benefit of PBL on NBME performance. However, one randomized trial demonstrated moderately better interpersonal skills among PBL students.<sup>15</sup>

Newman conducted a systematic review of 15 studies to analyze the effectiveness of PBL. He concluded that the PBL resulted in more positive attitude towards clinical practice while non-PBL students resulted in better consultation skills.<sup>10</sup> He also concluded that there were limited high quality studies to analyze the effectiveness of different types of PBL's in different contexts.<sup>10</sup>

Hoffman *et al.* compared the performance in USMLE Step-1 and Step-2 examination of classes matriculating from both traditional versus PBL curriculum at University of Missouri-Columbia School of Medicine (UMCSOM).<sup>16</sup> The results showed that the mean scores of UMCSOM PBL students was significantly higher in 6 of the 10

comparisons for USMLE Step-1 and 6 of 9 comparisons for USMLE Step-2 from first-time examinees nationally.<sup>16</sup>

So far the most comprehensive and methodologically correct systematic review was conducted by Koh *et al.*<sup>17</sup> They analyzed the effect of PBL on the outcome of 37 clinical competencies of a physician.<sup>17</sup> Their results indicated that PBL had a positive effect on 7 of these 37 clinical competencies. The competencies where a strong effect was seen fell within social and cognitive domain.

In a recent workshop in UK,<sup>18</sup> 10 UK based PBL medical school, one dental school and one veterinary school discussed the implementation, strengths and weaknesses of their PBL based medical curricula, there was a general agreement among the groups that if PBL is conducted well than it is an effective instructional tool.

Although a number of reviews have been conducted on effectiveness of PBL highlighting strengths and weaknesses of PBL method, there is still a strong derive in medical education towards curriculum reforms and integration of PBL and other teaching/learning strategies in the undergraduate medical curriculum. The evidence presented in this literature review shows that there are merits in introducing PBL as an instructional method. However, more comprehensive and methodologically rigorous studies needed to be carried out in-order to identify the outcomes and clinical competencies on which PBL based instruction method has a positive effect.

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