

## Medical undergraduates in a teaching hospital in North India: learning the problem based way

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### Abstract

**Objectives:** Problem-based learning (PBL) has been discussed and deliberated at various levels in health professions education in the last few decades. This study was undertaken to compare traditional lecture based learning with problem based learning (PBL) methodology in medical curriculum.

**Methods:** A cross sectional comparative study was carried out among 133 students enrolled in 3rd year of MBBS in Jawaharlal Nehru Medical College (JNMC), Aligarh as the students of this class had been taught both by lectures and PBL sessions. They were enrolled by convenience sampling. The study was performed for a period of 60 days from 20<sup>th</sup> November 2014 to 20<sup>th</sup> January, 2015. Data was collected by means of structured questionnaire.

**Results:** Of the total 133 students, 56 (42.1%) were girls while 77 (57.9%) students were boys. Majority of these 94 (70.7%) were hostelites. 78 (58.6%) students liked only PBL followed by both LBL and PBL by 93(69.9%) students. 51(38.3%) students claimed that PBL has led to better understanding of subject while 57(42.9%) respondents favored both LBL and PBL. 87(65.4%) respondents admitted that PBL has led to more clarification of their concepts while 94(70.7%) students appreciated both LBL and PBL. Coverage of sufficient syllabus through PBL and both (LBL & PBL) was claimed by 82(61.7%) and 98(73.7%) students respectively. Majority 75(56.4%) was satisfied with training of the teacher for traditional teaching while 82(61.7%) were satisfied with training of facilitator for PBL. 58(43.6%) students were satisfied with availability of resources for PBL, 74(55.6%) for LBL while 63(47.4%) were for both methods combined together. 75(56.4%) respondents preferred present scenario (LBL parallel with PBL) in JNMC.

**Conclusion:** Lecture Based Learning must be in symbiosis with Problem Based Learning for better analytical approach and clarification of concepts among medical students. There is need to improve the information resources for PBL and enhancement of practical knowledge of students.

**Keywords:** Problem based learning, lecture, facilitator, syllabus

### Introduction

Problem-based learning (PBL) is a student-centered pedagogy in which students learn

through the experience of resolving meaningful problems. In contrast to the traditional lectures, PBL is conducted with

small groups of students working together to achieve understanding. The main objective of PBL has been to develop adult learning skills through self-direction, collaborative problem-solving, nurturing clinical reasoning and communication skills. These skill sets promote lifelong learning and better prepare students for their professional careers. [1]

PBL was pioneered in the medical school program at McMaster University in Hamilton, Ontario, Canada in the late 1960s by Howard Barrows and his colleagues for undergraduate medical students.[2] Traditional medical education disenchanted students, who perceived the vast amount of material presented in the first three years of medical school as having little relevance to the practice of medicine and clinically based medicine.[3] The PBL curriculum was developed in order to stimulate the learners, assist the learners in seeing the relevance of learning to future roles, maintain a higher level of motivation towards learning, and to show the learners the importance of responsible, professional attitudes.<sup>2</sup> It has since been implemented globally in many health professional courses including medicine, dentistry, nursing, and pharmacy. [4],[5],[6] Some universities such as Maastricht have adopted a pure PBL curriculum with few post-PBL lectures; some like McMaster University developed a PBL curriculum with few lectures, [5] whereas some others like Harvard Medical School implemented a hybrid PBL curriculum that provides more structured didactic learning supported by PBL sessions. [5] In some schools, there is a PBL approach running at the whole curriculum level such as the faculty of odontology in Malmo (Sweden) and the faculty of dentistry at the University of Hong Kong (SAR) whereas in others, PBL is presented at a single course level within a lecture-based curriculum.

A study carried out among 1st year students at Nelson Mandela school of Medicine

showed that majority of the students benefited from input of other students in PBL tutorials as they were conducted in small groups.[7] Another study showed that knowledge and power of interpretation was quite improved among students on reaching the 3rd year but their interest in the process of PBL conduction was lost and they developed short cuts to solve the problem.[8] Sweller et al proposed the concept of cognitive load which stated that active problem solving early in the learning process is a less effective instructional strategy than studying worked examples.[9] However evaluation of the effects of PBL learning in comparison to traditional instructional learning has proved to be a challenge. Various factors can influence the implementation of PBL: extent of PBL incorporation into curriculum, group dynamics, nature of problems used, facilitator influence on group, and the motivation of the learners. Additional studies are needed to investigate all the variables [2] and technological scaffolds [10] that may impact the efficacy of PBL.

It has been reported that instead of didactic communication in lecture hall, active participation of students in PBL had a bigger role to play in continuing medical education.[11]

### **Learning principles**

The four key learning principles on which PBL is based are constructive, collaborative, contextual and self-directed learning. [12] The constructive principle implies that learning is an active process in which students actively construct or reconstruct knowledge networks. In other words, learners in a PBL tutorial are actively involved in the process and the elaboration of facts and ideas during their interactions helps in stimulating prior knowledge. This helps learners to relate new information to existing knowledge and thus achieve deeper and richer learning experience. [12] The collaborative principle of learning is

based on social structure in which two or more individuals interact during certain circumstances that have a positive effect. The interactions in the tutorial group include elaboration, co-construction, mutual support; constructive criticism and social interaction that have a positive effect on learning. Collaborative learning in PBL takes place when participants have the same goal, share responsibilities, are mutually dependent and need to reach an agreement through open interaction. [12] The principle of contextual learning states that all learning is situated that is, always learning takes place in the context. The situation in which knowledge is acquired determines the use of this knowledge. [12] In the case of PBL, learners are exposed to authentic, complex problems or cases which are professionally relevant and developed in the context of future clinical practice. This facilitates the transfer of knowledge by anchoring learning in meaningful contexts. [12] Self-directed learning implies that learners play an active role in planning monitoring and evaluating the learning process. [12] The emphasis on self-directed learning is an important distinguishing feature of PBL. [13] In a PBL process, learners discuss and plan approaches to tackle their gaps in knowledge, while reflecting on their progress, as well as the progress of their group. This makes them aware of their prior knowledge and motivates them to take charge of their learning process, which is an important skill to become a lifelong learner. The current study was aimed to compare the perception of 2<sup>nd</sup> year MBBS students regarding the two teaching methodologies of LBL and PBL in Jawaharlal Nehru Medical College, Aligarh.

### Materials and methods

A cross sectional comparative study was conducted among 133 MBBS 2<sup>nd</sup> year students of Jawaharlal Nehru Medical College (JNMC), Aligarh. As only current 3rd year MBBS students of JNMC were

taught both by lectures and PBL sessions, only these were enrolled in the study by convenience sampling. Duration of the study was 60 days (20<sup>th</sup> November-20<sup>th</sup> January, 2015). In this study, LBL was a teaching methodology characterized by delivery of lectures i.e., knowledge was imparted by teachers whereas in PBL, problem based scenarios were given to the students divided in small groups instead of delivering lectures and students were supposed to solve those problems themselves by means of books, internet and journals.

### The problem-based learning tutorial process

An essential component of a PBL tutorial is a small group of students approximately 8-10 in number and a facilitator. The students elect a chairman who will lead the discussion and a scribe or clerk who will help the group in charting the progress. The learning cycle in PBL begins in the first tutorial by presenting minimal information about a complex problem and ends with student reflection. [14] While working with the problem in the first tutorial, students use white boards to record their evolving ideas. The whiteboard serves as a focus for interaction and as a forum for the group to co-construct knowledge. It also helps externalize and provide a systematic approach to problem solving. [14] The board is divided into three records keeping columns by the scribe to facilitate problem solving. The *facts* column holds information that students gather from the problem statement such as what the problem is and where did it occur. The *ideas* column keeps track of the brainstorming/analyzing process for the facts identified. This is followed by elaboration and clustering of ideas to identify knowledge gaps. The knowledge gaps identified are placed in the *learning issues* column. Thereafter, each member of the group is encouraged to work self-directed on all the learning issues identified. The time for SDL is

predetermined based on the depth and difficulty of the problem that could be between 3 and 7 days. In the second tutorial, the group re-discusses the problem, shares and applies the new knowledge to integrate and solve the problem. The tutorial ends with an evaluation process wherein each member is encouraged to reflect on their performance and the group's performance. This helps students to identify gaps in their thinking and transfer their problem-solving strategies, self-directed learning strategies and knowledge. Critical reflection can give students a basis for improvement. [14]

### **Data collection**

Data was collected by means of structured questionnaire (Annexure). Moreover, feedback was taken from the students about their contentment with resources available for PBL sessions and their satisfaction with present scenario where PBL is running parallel to lectures.

### **Validity assessment**

Three experts (2 professors and one associate professor) determined the validity of each question as well as the entire questionnaire. Two indices (relevancy and clarity) were assessed for each question, and four indices (relevancy, clarity, inter-rater agreement, and comprehensiveness) were calculated for the entire questionnaire. For each question and the entire questionnaire, the experts scored each of the above mentioned indices from 1 to 4, with 1, 2, 3, and 4 corresponding to poor, fair, good, and excellent, respectively. Once scoring was complete, the following indices were calculated: 1) item content validity index, which shows validity for each question; 2) scale validity index, which shows validity for the entire questionnaire; 3) inter-rater agreement, which shows how well experts agree on the validity of the questionnaire; and 4) comprehensiveness score, which shows what percentage of experts agree that the questionnaire is comprehensive. To

calculate the item validity index, the scores were dichotomized into two groups: good or excellent vs. fair or poor. The item validity index for each question (for both clarity and relevancy) was calculated as the percentage of experts who rated the question as good or excellent. For each index, a cutoff point of 0.80 was considered as acceptable validity. For questions with validity indices less than 0.80, the question was revised or excluded. The scale validity index was calculated using the average item level method, [15] in which the average of clarity or relevancy score from all questions is calculated. The inter-rater agreement was calculated as the percentage of questions considered excellent or good by all experts. The scale comprehensiveness score was defined as the percentage of experts who considered the comprehensiveness of the questionnaire as good or excellent, rather than poor or fair. Therefore, it was calculated as the number of experts who rated the questionnaire as good or excellent divided by the number of all experts.

### **Reliability assessment**

The test-retest method was used to evaluate reliability. We administered the questionnaire to 133 case subjects and 50 control subjects twice, with a 2 or 3-week interval between the administrations. Inter-Class correlation coefficients (ICC) and kappa statistics were used to determine reliability. For each of these statistics, a cutoff point of 0.70 was considered as denoting acceptable reliability. After calculating the index, in consultation with experts, questions with reliability values of less than 0.70 were revised or excluded.

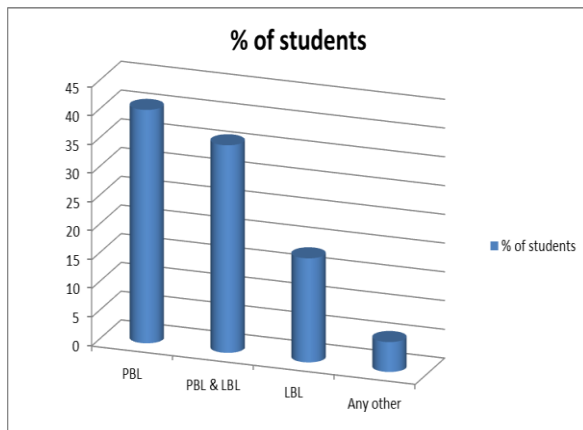
### **Statistical analysis**

Statistical analyses were conducted using SPSS, version 19. The indices calculated included item validity index for clarity, item validity index for relevancy, scale validity index for clarity, scale validity index for relevancy, inter-rater agreement, scale

comprehensiveness scale, ICC for quantitative variables, and kappa statistics for categorical variables, as noted above.

**Results**

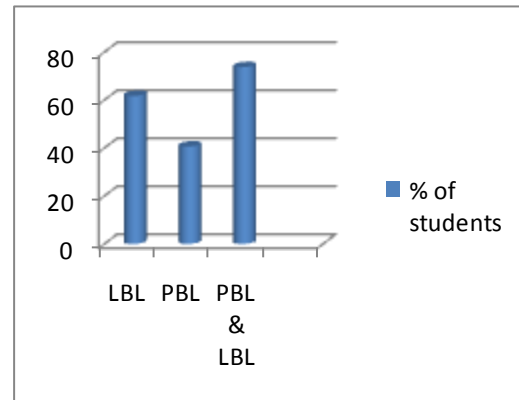
Of the total 133 students, 39 respondents were day scholars while 93 students were hostelites. Male to female ratio was 77:56 (1.38). Fifty four respondents liked only PBL, 48 liked both LBL and PBL and 24 appreciated only LBL as shown in Fig 1.



**Fig. 1: Student appraisal of various teaching methods.**

Approach of the study participants pertaining to the attribute of different teaching methods in imparting better analytical approach, long term learning of

subject, more conceptualization with different teaching and methodologies and benefit in integration of all subjects is reflected in 82(61.7%) respondents expressed that sufficient syllabus was covered by traditional teaching /lecture based learning, 54(40.6%) by PBL only whereas 98(73.7%) students reported adequate coverage of syllabus by both methods combined together as shown in Fig 2.



**Fig. 2: Coverage of sufficient syllabus by PBL.**

Competency of both PBL facilitator as well as lecturer indulged in traditional teaching as perceived by the students of JNMC is shown in Table 2.

**Table 1. Attribute of various teaching methods.**

Better analytical approach imparted various teaching methods			
PBL	PBL & LBL	LBL	Any other
108 (81.2%)	112 (84.2%)	37 (27.9%)	
More clarification of concepts in medical studies imparted by teaching methods			
PBL	PBL & LBL	LBL	Any other
87 (65.4%)	94(70.7%)	28 (21.1%)	
Significance of subjects' integration in concepts of the students			
Yes	No	Don't know	
103(77.4%)	21 (15.8 %)	9 (6.8%)	

**Table 2. Training of facilitator/Lecturer for respective teaching methodologies.**

<b>Training of facilitator for PBL sessions in JNMC</b>		
Well trained	Not trained	Don't know
82(61.7%)	<b>39</b> (29.3%)	12(9%)
<b>Training of lectures for traditional teaching / lectures in JNMC</b>		
Well trained	Not trained	Don't know
<b>75</b> (56.4%)	41(30.9%)	17(12.8%)

58(43.6%) students were satisfied with the availability of resources for PBL, 74(55.6%) for LBL while 63(47.4%) students were satisfied for both methods combined together. 75(56.4%) respondents were satisfied with present scenario in JNMC. Overall satisfaction of the respondents with availability of resources/facilities (library, internet, journals) for PBL sessions is reflected in Fig 3.



**Fig. 3: Overall Satisfaction of students with availability of facilities for various teaching methods.**

The item content validity index for clarity was 0.80 or higher for 17 out of 18 questions. The corresponding index for relevancy was 0.80 or higher for 16 out of 18 questions.

#### **Content validity for the questionnaire:**

Using the average approach, the overall scale validity index for clarity and relevancy were 0.97 and 0.96, respectively. The inter-rater agreement for clarity and relevancy were 0.83 and 0.85 respectively. All the 3 experts rated the comprehensiveness of the questionnaire as good or excellent, thus

yielding an overall comprehensiveness score of 100%.

#### **Reliability**

The ICC for quantitative items ranged from 0.72 to 1.0. The large majority of categorical items were above the predetermined acceptable level (0.70), with the only exception being question 15 where of training of lecturers / demonstrators for traditional teachings / PBL in delivering lectures was to be assessed by students (0.55). This question was retained as it was where low reliability was due to factors that were not relevant to the way the question was asked.

#### **Discussion**

Research on PBL in various settings have shown that students in a PBL curriculum have better knowledge application and clinical reasoning skills [16] and they consistently outperformed traditional students on long-term retention assessments. [17],[18] It is also reported that PBL students have superior ability to synthesize basic knowledge and clinical experience in addition to applying and transferring the knowledge and skills into the workplace. [19] Studies on PBL graduates provide strong evidence for positive long-term effect on students self-directed and lifelong learning skills and attitude, as well as developing higher order thinking skills. [20] Student perception studies have also suggested an overall positive attitude, as students consider PBL to be effective in promoting their learning in dealing with complex

problems, [21] enriching their learning of basic science information, [22] developing thinking and problem-solving skills, [23] improving interpersonal and professional skills, [24] as well as advancing self-directed learning, higher level thinking, and enhancement of information management skills. [25] However, the most interesting debate in PBL research has been its comparison with conventional teaching methodologies.

In present study, majority of the students 78(58.6%) liked PBL while only 52(39.1%) liked LBL and 93(69.9%) respondents were in the favor of both PBL parallel with LBL. This might be due to great diversity in medical subjects/topics. Some of them are easily understood by self-learning while comprehension of some topics needs the help of tutor for better understanding. A study on teaching methods in Shifa College of Medicine showed that 67% of the students wanted LBL and PBL going on side by side. [26] A cross-sectional study showed that 79% of the medical students liked PBL sessions and it was observed that PBL helped them in building up communication skills, interpersonal relationship and problem solving capacity to great extent. [27] Maximum students expressed that PBL leads to better understanding of subject and invokes self-learning habit among students. Probably this was due to the fact that PBL scenarios in JNMC are designed by the trained faculty members of the college who have full command on their respective subjects/topics. This methodology not only helps the students to understand the subject in depth but the process of PBL conductance also inculcates self-learning practice among students as they have to formulate their learning objectives themselves after receiving PBL scenarios, solve the problem themselves by means of internet, consulting various books etc. and actively participate in group discussions.

A similar study by Alam AY et al also concluded that PBL along with LBL will

promote independent and creative learning among medical students. [26] In this study, 82 (61.7%) students claimed that facilitator was well trained for conducting PBL sessions. Facilitators committed for PBL sessions have to undergo various workshops to polish their skills for PBL facilitation. Moreover, facilitators in PBL are not supposed to teach the students. Rather they have just to observe their performance and check them from deviation of their right track that is why students might not be able to judge the capability of their facilitators. An international study to assess the role of facilitators in PBL tutorials showed that facilitators must regularly review PBL tutorial processes and group dynamics with in tutorial settings. [28] In current study, only 58(43.6%) were satisfied with availability of resources for PBL sessions. As JNMC has a well-established library that is equipped with all the latest editions of all the medical books, the reason might be the provision of limited computers with internet facility and various online journal institutional subscriptions in the college due to which students are facing difficulty in finding solutions to their PBL scenarios. In our study, 73.2% students agreed with the significance of the subjects' integration in the clarification of concepts in medical studies. Likewise, another study revealed that integrated curriculum promoted better understanding of health sciences pertaining to common diseases and majority of the respondents (77.61%) expressed that PBL in modules assisted to great extent in interpreting the cases in their annual examinations. [29]

This study also examined the content validity and test-retest reliability of a questionnaire designed to compare problem based learning with traditional lecture based learning as perceived by the students of Jawaharlal Nehru Medical College, Aligarh. The findings suggest that the questionnaire is comprehensive, has content validity, and the results are replicable over a two or three-

week period. Moreover, the findings indicate that the individual questions are clear and relevant, necessitating only minor changes to the questionnaire. Inter-Class correlation coefficients (ICC) and kappa statistics for categorical variables suggest acceptable test-retest reliability for the large majority of questionnaire items.

Systematic review of the literature suggests a large number of studies in favor of PBL with an equally large number of studies suggesting no difference between the curriculums. [6],[17] Strobel and van Barneveld [30] in their meta-synthesis of meta-analyses comparing PBL with learning in conventional classrooms conclude that traditional learning approaches tend to produce better outcomes on assessments of basic science knowledge, but don't always do so, and PBL approaches tend to produce better outcomes in terms of clinical knowledge and skills. This view has been supported by many studies conducted thereafter. However, an argument among researchers remains that studies that compare and measure the outcome or effects of PBL do not focus on the theoretical claims behind PBL, which results in unreliable insights. [12] Norman and Schmidt [31] argue that the trails of curriculum level interventions are a waste of time and resources because there is no such thing as a blinded intervention or an uniform intervention in educational research.

What is needed is research that bridges theory and practice and extends knowledge about developing and improving PBL in practice. Dolmans and Gijbels [32] in a recent dialogue on PBL suggest that the research in PBL needs to go beyond measuring the outcomes of PBL in terms of student achievement. They also suggest that a micro-analytic approach to investigating the process of PBL is more necessary and sensible than the question of which learning environment is better. Thus, future research in PBL should be focused on the micro-components of PBL such as self-directed

learning, group interactions, quality of feedback, use of real patient compared with paper-based scenarios and effects of cultural backgrounds on the tutorial group interactions. It is also high time that Indian medical curriculum should evolve and facilitate the learning process with time.

### Conclusion

As a student-centered method of pedagogy built on the principles of learning, PBL has been implemented in many schools in different formats worldwide. Research evidence on its effects or its comparison with the traditional curriculum is not entirely conclusive but is strongly suggestive of positive perception among learners and positive impact on overall understanding and clinical reasoning skills as well. [16] Implementing PBL in colleges is a demanding process that requires resources, a lot of planning and organization. There is need to improve the facilities for better performance of the students in PBL, especially the provision of computers, journals and internet facility in hostels as well as in colleges. As health professions education enters the next millennium with young learners who are all digital natives, [33] it is highly imperative that we also imbibe this practice in Indian medical curriculum. Last but not the least regular training and assessment of teachers and facilitators is the need of the hour.

**Conflicts of Interest:** None

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