

# Introduction of Problem Based Learning (PBL) as a Supplementary Tool to Enhance Active Learning in Physiology – A Study in a Medical College of Southern Kolkata

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## ABSTRACT

### BACKGROUND

The motivation to learn begins with a problem. The ideology of problem-based learning (PBL) is to encourage the students to think beyond the books and apply the basic knowledge to various clinical scenarios. Problem based learning has been a concept in existence for decades, yet its implementation in medical education is limited. So the study on PBL was taken up to know analytical skills, comprehensive understanding of disease process and inculcate the practice of self-directed learning in physiology.

### METHODS

This was an educational interventional study carried out on 60 first MBBS students chosen by simple random sampling. Students were further randomly divided into two groups containing 30 students in the control group and 30 students in the study group. Control group was taught by didactic lectures. 10 clinical scenarios were given to study group and discussions were conducted under the moderation of faculties. Objective evaluation was performed using pre-test and post-test examination for both groups. Subjective evaluation of attitude in study group towards PBL was recorded using self-developed questionnaire using Likert's scale. Data was analysed by using paired students t test.

### RESULTS

The mean pre-PBL (9.83±4.88) and post-PBL scores (15.61 ± 2.99) in study group were significant ( $p < 0.00001$ ). The comparison of mean scores of post-didactic lectures (12.88 ± 3.13) in control group and post-PBL (15.61 ± 2.99) in study group were significant ( $p < 0.001$ ). Subjective evaluation using Likert's scale revealed increased interest in active learning, better confidence, communication, comprehension, and motivation amongst the PBL group.

### CONCLUSIONS

From the results of this study, it can be concluded that problem-based learning is a good supplementary tool in teaching physiology, and it can be included in the regular medical teaching programmes so that the students have a better understanding of the various challenges in the field of medical education and research so that newer strategies for better health care provision can be planned.

### KEYWORDS

Active Learning, Medical Education, Problem Solving, Self-Directed Learning

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*DOI: 10.18410/jebmh/2021/631*

*How to Cite This Article:*

*Narhare P, Sasane P, Mohanan R, et al.  
Introduction of problem-based learning  
(PBL) as a supplementary tool to  
enhance active learning in physiology –  
a study in a medical college of southern  
Kolkata. J Evid Based Med Healthc  
2021;8(40):3483-3488. DOI:  
10.18410/jebmh/2021/631*

*Submission 11-06-2021,*

*Peer Review 20-06-2021,*

*Acceptance 30-09-2021,*

*Published 04-10-2021.*

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## BACKGROUND

The motivation for learning begins with a problem. The concept of problem-based learning is to encourage the students to think beyond the books, apply the fundamental knowledge to numerous clinical scenarios. This might be the primary step to push the understanding of the disease process. Active student participation plays a pivotal role in the drift from the paradigm of knowing the concept to applying the concept.

The problem-based learning curriculum was originally designed in late 1960 at McMaster University's medical school by Barrows and his colleagues with a purpose to solve various student's practical problems of lack of interest and concentration. Besides, this method was introduced to overcome the drawbacks which the students faced in their practical field i.e. not being able to apply their basic medical knowledge in solving their problems in clinical field and also to develop their professional skills following which various concepts and theories of learning and education arise. This new beginning led to further analysis in various disciplines and led to the development of problem-based learning which may arise from a problem that has multiplicity of solutions. Moreover, few facts may also be considered in adopting PBL. PBL needs fewer things to be memorized than a lecture and also to the fact that the content of lectures is frequently forgotten and the extent of recollection of lectures can be less than 50 %. As facilitators, our role is to make students aware of the different important concepts and possible methods to retain them. Hence, an effective approach may be elicited and accordingly appreciate the advantages and also look into the limitations of PBL.<sup>1</sup>

Besides teaching in a traditional way with relevant material and expecting students to solve problems by applying the knowledge, if a different approach is adopted that initially the students are presented with a problem, then the students will be asked to solve the problem in their own way by proper reasoning during which the facilitator will give his/her valuable opinion and gives a new approach to the teaching learning process.

Problem based learning is a process which facilitates "active learning apart from achieving the specific learning objectives. This distinguishes PBL from traditional learning where teaching is via didactic lectures by teacher-designed instructions. This process of teacher designed instructions is teacher centric and passive whereas the modern PBL approach is student centric approach and is being introduced in undergraduate, postgraduate and in continuing medical education programs. Students learn through the experience of solving problems, they can learn both content and thinking strategies.

Problem-based learning is a different approach of instructional method wherein the students learn via facilitated problem solving ways. In PBL, student learning focuses on a composite problem that does not have a single correct answer. Students work in small groups to find out their need to solve a problem and learn effectively. Hence by applying their new knowledge in solving the problem via self-directed learning (SDL) they reflect on

their learning and the new strategies adopted to find their effectiveness and also their learning styles and behaviour. Here the teacher acts as a facilitator who facilitates the learning process rather than providing knowledge. PBL has several goals, which helps students develop effective problem-solving skills, acquire flexible knowledge, self-directed learning skills, effective collaboration, and intrinsic motivation.<sup>2</sup> Some research studies demonstrate equivalent or superior professional competencies in problem-based curriculum as compared with graduates of more traditional curriculum.<sup>3</sup>

Problem based learning has been a concept in existence for decades, yet its implementation in medical education is limited. So the study on problem based learning was taken up to understand the overall analytical skills in the medical students to achieve a better health care provision and inculcate the practice of self directed learning among the first MBBS students.

## Objectives

1. To evaluate the efficiency of PBL over traditional teaching methods.
2. To compare the outcome of didactic lecture and PBL method of teaching.
3. To inculcate the awareness to self-directed learning through PBL method of teaching.

## METHODS

This was an educational interventional study carried out in the Department of Physiology, ESIC Medical College, Joka, Kolkata-700104 (West Bengal) from October 2018 to March 2019.

## Study Participants

First year MBBS students of 2018-19 batch were included in the study.

## Sample Size and Sampling Method

A total of 60 first year MBBS student out of 73 available students who consented for the study were selected for the study. Hence, 60 students were further randomly divided into two groups - 30 students in the control group (Group A – Didactic lecture group) and 30 students in the study group (Group B – PBL group). Students in study group were further divided into 3 sub - groups to undergo problem-based learning containing 10 students in each sub-group. Written informed consent was obtained from all the first year MBBS students participating in the study. Institutional Ethics Committee approval was taken before proceeding for the study. Teaching in different groups was done by same teachers.

## Inclusion Criteria

First year MBBS students willing to participate in the study

**Exclusion Criteria**

Students not willing to participate in the study.  
Second- and third-year part I and part II MBBS students.

Data collection was done by 10 qualitative and quantitative questions of both subjective and objective type for pre-test and post-test. Moreover, questionnaire based on Likert’s scale were used to assess perception of students towards problem based learning. The validation and reliability of the questionnaires were done by moderator faculties. The faculty members were oriented to facilitate the small group discussion of clinical scenarios in the study group. The problem-based learning scenarios were developed to lead students to a particular area of study to achieve those learning objectives. Discussions were conducted among the students of study group under the moderation of faculties and 10 clinical scenarios were given to the study groups/problem-based learning groups and discussions were conducted by application of knowledge of basic medical sciences in the initiation and the progression of the disease processes. Didactic lectures were conducted for the control group by the faculty.

**Example of PBL Question**

A woman aged 30 years complained of general fatigue, breathlessness on exertion, giddiness, headache, palpitation, anorexia & dysphagia. On examination, the patient showed pallor of the skin & mucous membranes, tachycardia, glossitis, spooning of the nails, sometimes tingling in the fingers, toes and oedema of the dependant parts of the body.

**Investigations**

Haemoglobin - 6 gm/100 ml, RBC. count - 3 millions/cu mm. of blood, MCHC.- 28 gm/100 ml of blood, MCV - 60 cubic microns, WBC - Eosinophilia + , Stool examination — Hook worm ova present.

Questions:

1. What is the type of anaemia in this patient?
2. What is the cause of anaemia in this patient?
3. Mention the principles involved in the treatment of this patient.

**Evaluation Methods**

Objective evaluation of performance of the students: This was performed using pre-test and post-test examination prior and after didactic lectures and PBL sessions for both control group (Group A) and study group (Group B - PBL Group). Pre-test was conducted for all the students of both groups using a pre-test questionnaire containing 10 questions having 2 marks for each question. Post-test was conducted for using the same questionnaire to assess the understanding and analytical capabilities of the students by the moderators.

Subjective evaluation of attitude of the study group towards the problem-based learning was recorded using

self-developed questionnaire against Likert’s scale to reveal change in the attitude of the students to the process of learning including their confidence levels, communication skills, motivation, understanding and application.

**Statistical Analysis**

Data was analysed by using paired students t test and presented in the form of tables, graphs, figures and conclusions were drawn.

**RESULTS**

**Objective Evaluation**

This was performed using pre-test and post-test examination prior and after didactic lectures and PBL sessions for both control group (Group A) and study group (Group B - PBL Group). The mean pre-test score was 9.83 ± 4.88 and post-test score was 15.61 ± 2.99 in the students of study group. The pre-test and post-test scores varied significantly in the study group as depicted in table 1 (p < 0.00001). (Paired students t test)

Test Score	Observations	Mean ± Std. Deviation	Standard Error	95% Conf. Interval	p-Value
Pre-PBL	30	9.83 ± 4.88	0.8926048	8.00, 11.65	<
Post-PBL	30	15.61 ± 2.99	0.5475564	14.49, 16.73	0.00001

**Table 1. Mean Pre-PBL and Post-PBL Scores of Students in Study Group (PBL Group)**

The control group showed significant change in their performance as depicted in Table 2. The mean pre-didactic Lecture score was 7.25 ± 3.13 and post- didactic lecture score was 12.88 ± 3.13 in the students of control group. The scores varied significantly in the control group as depicted in table 2 (p < 0.00001). (Paired students t test)

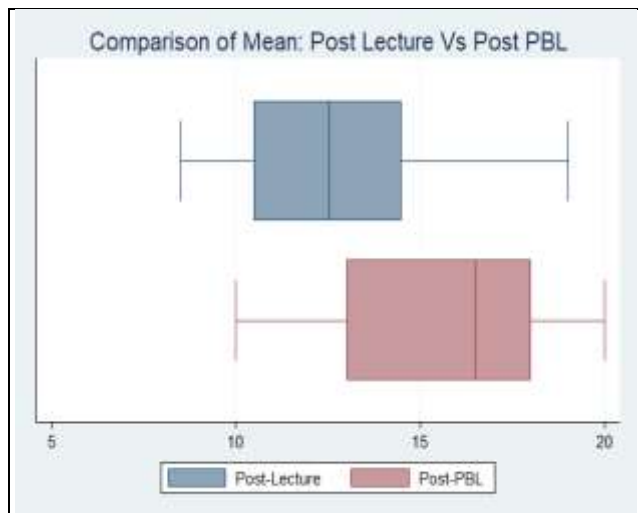
Test Score	Observation	Mean ± Std. Deviation	Standard Error	95% Conf. Interval	P-Value
Pre-didactic lecture	30	7.25 ± 3.13	0.5717235	6.080694, 8.419306	<
Post-didactic lecture	30	12.88 ± 3.13	0.5726944	11.71204, 14.05462	0.00001

**Table 2. Mean Pre-Didactic Lecture & Post-Didactic Lecture Scores of Students in Control Group**

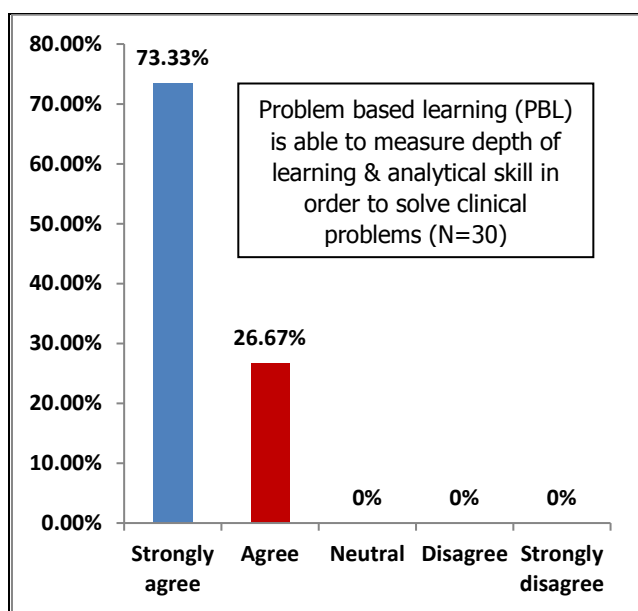
Test Score	Observation	Mean ± Std. Deviation	Standard Error	95% Conf. Interval	P-Value
Post- didactic lecture	30	12.88 ± 3.13	0.5726944	11.71, 14.05	<
Post-PBL	30	15.61 ± 2.99	0.5475564	14.49, 16.73	0.001

**Table 3. Comparison of Mean Post-Didactic Lecture & Post-PBL Scores of Students in Control and Study Groups**

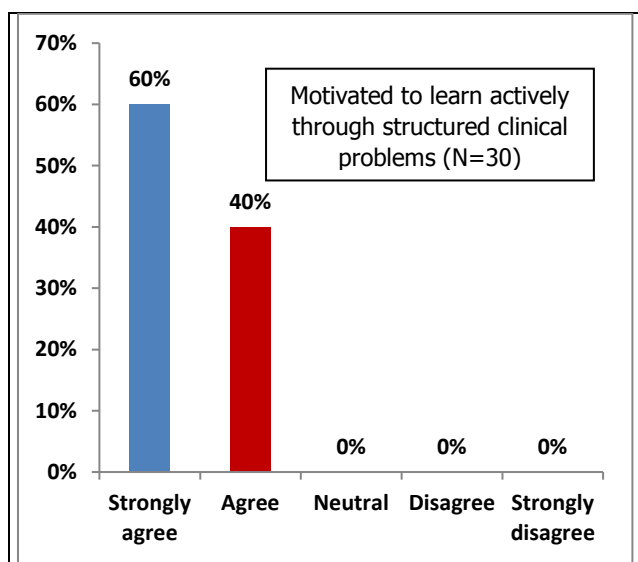
After comparison between mean scores of students in study group were higher than control group as depicted in table 3. The mean post-didactic lecture score of 12.88 ± 3.13 in control group (Group A) and post-PBL score of 15.61 ± 2.99 were found in the students of study group. The post-PBL scores in the study group (Group B) were significantly higher than control group (Group A) as shown in table 3 and graph 1 (p < 0.001). (Paired students t test)



**Figure 1. Comparison of Mean: Post Lecture Vs Post PBL (X axis - Scores & Y axis – Study & Control Group)**



**Figure 2. Depth of Learning & Analytical Skill in Order to Solve Clinical Problems**



**Figure 3. Motivated to Learn Actively through Structured Clinical Problems**

Sl. No.	Variable	SA	A	N	D	SD
1	Learning physiology with clinical problems is interesting	27	3	0	0	0
2	Problem based learning is a refreshing change from routine of day today learning in the classroom	22	8	0	0	0
3	Problem based learning is able to measure depth of learning & analytical skill in order to solve clinical problems	22	8	0	0	0
4	Requires teacher's strong involvement to induct discussion on clinical problems in real life scenarios	9	18	3	0	0
5	Learning from a problem is not the best way to learn in medical field	1	1	1	7	20
6	More effective to learn as a group than to learn individually	12	15	2	1	0
7	PBL is a necessary approach in meeting the changing needs of the learning environment	15	12	3	0	0
8	Improved your confidence and communication skills to solve the clinical problems on your own	18	11	1	0	0
9	Motivated to learn actively (Self-directed learning) through structured clinical problems	18	12	0	0	0
10	Problem based learning is suitable approach for your learning outside the academics	21	8	1	0	0

**Table 4. Response to the Questionnaire to Assess Perception of Students towards Problem Based Learning Using Likert's Scale**

SA – Strongly Agree; A – Agree; N – Neutral; D – Disagree; SD – Strongly Disagree

Subjective evaluation about the perception and attitude of students towards problem-based learning was performed using Likert's scale. Evaluation of data revealed increased interest in active learning, better confidence levels, communication skill, comprehension levels, analytical skills and motivation amongst the PBL group as depicted in table 4 and graph 2 and graph 3.

## DISCUSSION

Problem based learning addresses the need to promote continuous learning through the process of enquiry and constructivist learning. PBL works because it encourages the activation of prior knowledge in the small-group setting and provides opportunities for elaboration on that knowledge. These activities facilitate the comprehension of new information related to the problem and enhance its long-term memorability. In addition, there is evidence that problems arouse interest in learning. Flexible scaffolding provided by cognitively and socially congruent tutors also seems to be reasonably effective, as compared to hard scaffolding represented by for instance, worksheets or questions added to problems. Small group work protects against dropout and encourages students to study regularly. The extent of learning in PBL results in group collaboration i.e. social constructivist point of view and individual knowledge acquisition in PBL.<sup>3</sup> It can be considered as a constructive approach to instruction, emphasizing collaborative and self-directed learning and being supported by flexible teacher scaffolding along with instructional approach that allows for flexible adaptation of guidance.<sup>4</sup> Yew and Schmidt explained that significance of collaborative learning in PBL process which is important in students achievement and this process seems more

important than individual study in determining students work output and in achieving overall goals.<sup>5</sup> Schmidt and Hung, elaborated the concepts of theoretical learning and student's learning outcomes and its effectiveness on problem-based learning and also the constructivist process of problem-based learning from cognitive point of view.<sup>3,6</sup>

PBL is also believed as learning method that can promote the development of critical thinking skills.<sup>7</sup> This also corroborates with our study findings where the students exposed to PBL had better understood and analytical capabilities which itself signifies critical thinking and brainstorming activities in students due to the PBL. Because of the brainstorming nature of problem-based learning, students remain more focussed, oriented and remain more alert on the topic.

In our study, the evaluation revealed much better confidence levels, motivation, and comprehension levels amongst the problem-based learning group than traditional learning group.

The study further found that the students who were exposed to problem-based learning had better thoughtfulness with logical problem-solving skills which could be due to discussion among study group moderated by faculties and will be prepared for learning difficult problems in real life scenarios. Problem based learning follows a constructivist perspective in learning, as the role of the instructor or the facilitator is to guide and enable the students to face the challenges and overcome the hurdles of the learning process rather than following the trend of traditional teaching where the facilitator delivers the didactic lectures for dissemination of knowledge without looking into the fact of knowledge assimilation, critical understanding, and application by the students.

Dolmans, Diana HJM et al. in their research on problem-based learning elaborated the challenges for educational practice and research which contributed towards a better understanding of the concepts of constructive learning, the role of self-directed learning process and the implication of collaborative and contextual learning in the work performance of the students. Such observation of constructive, self-directed learning approach and comprehension levels amongst the problem-based learning group is also found in our study. The findings of our study motivated the students to learn actively (Self-directed learning) through structured clinical problems.<sup>8</sup>

Problem based learning has various implications, one of which is to guide the students and assisting them in overcoming from the theoretical aspects and promoting them to apply the knowledge in their practice in real life scenarios during their journey which will enable them in solving their problems. Here the instructor plays the role of facilitator and serves as cognitive coach and helps the students by probing and challenging them.<sup>9</sup>

Problem based learning stimulates learning by facilitating students to see the relevance along with their knowledge application to their future roles. Higher level of motivation is a prerequisite in achieving the goals of learning. The professional attitudes, the values of teamwork and its importance are important components among them. Again, the motivation for learning initiates

interest as it allows selection of problems that have real-world application, and which corroborate with our study findings.<sup>10</sup>

Small groups in problem-based learning facilitates various desirable attributes, such as communication skills, teamwork, the nature of problem solving, independent responsibility for learning, information sharing and respect for others apart from the fact of dissemination of knowledge. PBL can therefore be used as a small group teaching method to combine the acquisition of knowledge with the development of skills and attitudes. This finding is also seen in our study where students learn more effectively as a group than to learn individually. Presentation of clinical material acts as the stimulus for learning which enables students to understand the relevance of underlying scientific knowledge and principles in clinical practice.<sup>11</sup>

Various learning outcomes are associated with PBL. Nilson (2010) has mentioned the important ones like working in teams, holding leadership roles and managing projects, communication (oral and written), independently working, self-awareness and evaluation, analysis with critical thinking, self-directed learning, concepts explanation, applying the contents to reality i.e. putting oneself in real world scenarios, solving of various problems across multiple discipline, researching and gathering information to achieve the goals.

Assignments in PBL is also an important aspect which can be made short, or they can be made more elaborate continuing for the entire semester, and which will motivate them to learn to work in groups and allowing them to solve various problems via PBL problems or case scenarios. A PBL project which is designed effectively will provide more developmental opportunity to students to nurture their all round development.<sup>12</sup>

Issues like curriculum design, ways of implementation of PBL in curriculum are not focused in our study which may be considered as a limitation apart from time consuming nature of framing PBL questions which needs to be tackled. Also, implications like staffing and accumulation of learning resources demands a distinct approach to arrangement of PBL sessions, related workload and conduction of assessment needs relative attention.

## CONCLUSIONS

From the results of this study, it can be concluded that problem-based learning is a good supplementary tool in the teaching-learning process, and it should be included in the regular medical teaching programmes so that the students have a better understanding of the various challenges in the field of medical research and newer strategies for better health care provision can be planned. Hence if adopted, it can have a significant impact in teaching the learning processes of medical education.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

Authors acknowledge

1. Dr. Ashish Kumar Yadav, Assistant Professor, Dept. of Community Medicine, ESIC Medical College, Joka, Kolkata-700104.
2. Dr. Surajit Lahiri, Professor, Dept. of General Surgery, ESIC Medical College, Joka, Kolkata-700104.
3. All the students of 2018-19 batch participating in the project work.

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