

Implementing problem based learning for first MBBS students in biochemistry

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Abstract

To understand the perception of students and teachers about implementation of Problem Based Learning (PBL) in Biochemistry and to assess its cognitive impact on student.

100 students from Ist MBBS participated in the study. PBL was conducted in two sessions with pre validated case designed on hyperlipidemia. Marks scored in pre & post tests were compared by applying students paired 't' test. An attitude survey of the student and teachers was done using Likert Scale ranging from strongly disagree to strongly agree.

Score of post-test was significantly increased ($p < 0.001$). Both teachers and students have favoured PBL as the best method of teaching as it would assist them in seeing relevance of learning to their future role in the community. Both the groups appreciated PBL as it stimulates the learner for self-study, facilitate better and healthy teacher student relationship improves communication skills and problem solving ability in Biochemistry. Student felt that PBL should be made mandatory in biochemistry and suggested other topics as well. However teachers agreed that PBL is time consuming and it would deprive students to acquire knowledge from experienced and good teachers. Teachers and students differ in opinion about nature of the case and active involvement of facilitators.

PBL motivates student for self-study and helps to improve communication skills. However guidance of experienced teacher is needed to summarize the topic. Though time consuming PBL should be made mandatory in Biochemistry as a teaching learning tool.

Keywords: PBL, Hyperlipidemia, First MBBS.

Introduction

At the entry in medical fraternity students of first MBBS are more enthusiastic to learn about diseases and patients. Most of the first year MBBS curriculum in Anatomy, Physiology & Biochemistry is taught by the conventional methods of teaching in which 70 % of share is by didactic lectures. While learning normal aspects of human body with didactic lecture series student face some amount of dissatisfaction, they find it is like learning basic science with limited reference with their future role.⁽¹⁾ Though conventional method is a convenient method of delivering knowledge to large number of gathering but it has numerous constraints, one being potential boredom due to limited student participation and reflection. Hence MCI and WHO have given tremendous responsibility on the institute for bringing about required innovations by stressing upon community oriented and need based curriculum which should stimulate students interest and inculcate drive to learn more mainly through active self-directed approach.^(2,3,4)

In the evolving field of Biochemistry, unprecedented expanding knowledge base and accelerated information input has caused for review and reexamination of what idea, facts and attitude are required for undergraduate students. Knowledge of the applications of biochemistry, molecular biology, and genetics in the practice of medicine has been and continues to be a vital part of medical students' and continuing education. The technical background and the

rapid expansion of information and new applications have made it an difficult & tiring task to learn and teach this material within the already crowded medical school curriculum.⁽⁵⁾ PBL can solve problems associated with the limited amount of time for biochemistry instruction and motivating students to use biochemistry for clinical problem solving.⁽⁶⁾

Problem-based learning (PBL) is a student-centered pedagogy in which students learn about a subject in the context of complex, multifaceted, and realistic problems. Previous studies have revealed that PBL motivated students to actively control the direction of their learning needs and encouraged those to acquire self-learning skills.⁽⁶⁾ In order to implement active teaching learning method we choose to introduce problem based learning in Biochemistry for first MBBS students. PBL can be useful in clinical problem solving in contrast to exam-centered, lecture-based conventional curriculum.

Objective

1. Introduction & implementation of application & techniques of PBL.
2. To assess the perception of students and teachers about PBL in Biochemistry
3. To assess knowledge gain of students by PBL.

Methods Setting

Lipoprotein metabolism and its disorders were deliberately skipped while teaching lipid metabolism.

Problem with case scenario of Hyperlipidemia was designed and validated by the team members of Medical Education Technology including subject experts in the Biochemistry. Facilitators were invited from departments of anatomy, physiology, pathology, biochemistry and pharmacology. They were briefed on hyperlipidemia and steps of PBL in a short training programme. Copies of problem and structured cues were handed over to them on the same day.

Study design: An experimental study in form of two sessions of PBL was designed. Data was obtained in form of response to feedback questionnaire and scores of pre and post test

Participants and sample size: 100 students studying in First MBBS in the medical college of central India, NKP Salve Institute of Medical Sciences participated in the study.

The synopsis was submitted to the institutional ethical committee and was for ethical approval.

Description of the intervention: Students were informed about the new intervention in detail. They were divided into multiple batches of ten each with a facilitator. Pretest was conducted by giving multiple choice questions based on lipoprotein metabolism and its disorder. All the MCQ were of single best response type.

Pre-designed case based on hyperlipidemia was distributed in the first session. All the steps in PBL were followed stringently. During the first session students were asked to frame learning objectives based on the cues, a list of references was given to them to prepare for the next session. Students were encouraged to explore the topic by their own. Second session was conducted after one week. In the second session more information in the form of investigation reports was provided to the students & they were asked to reach the final diagnosis. The teacher present with students facilitated the learning process, streamlined their thought process & clarified controversy if there was any. The post test was conducted at the end of second session.

A feedback questionnaire was handed over to students & participant teachers to assess their perception regarding PBL on different aspects. The questionnaires had 5 common questions for teachers and students to seek their perception about PBL. Few more questions were added to teacher's questionnaire to assess their experience as facilitators. The questionnaire had both structured and open ended questions. A five point Likert scale with a score of 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree & 5= strongly agree was used to find out overall rating of the programme by students & teachers.

Statistical Analysis: Data obtained were of two types qualitative and quantitative. 100 students participated in the both sessions of the PBL. Marks scored in pretest and

post test were considered as tool to judge cognitive effects of PBL. Paired t test was applied to find out statistical significance.

To study the perception of the intervention feedback questionnaire was administered to the students & teachers. Likert scale was given score from 1 to 5 ranging from strongly disagree as one to strongly agree as 5. Final Likert score was achieved by applying unpaired students t test.

Result

Assessment of Cognitive effects: Out of 100 students, 83 students scored higher, 7 scored same and 10 students scored less than pretest. (Fig. 1) The mean of the score of the students in post test was found to be increased significantly than pretest. (Fig. 2; $p < 0.001$)

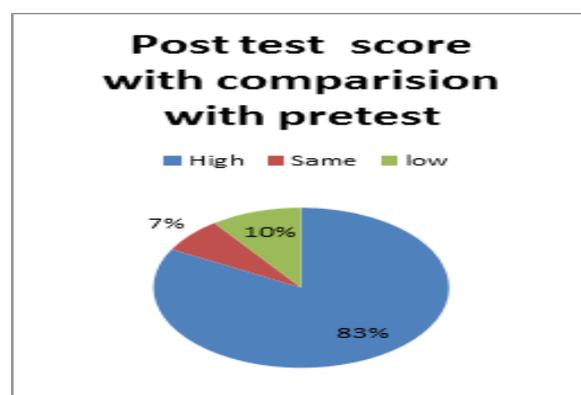


Fig. 1: Result

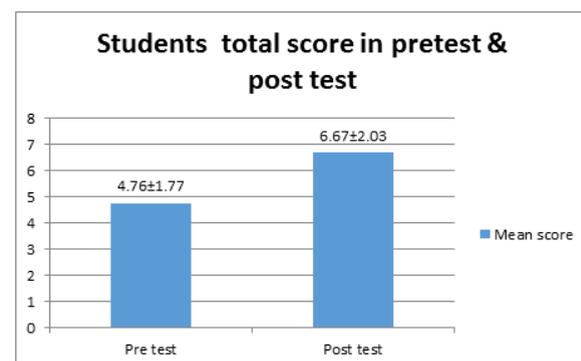


Fig. 2: Students total score in pre-test and post-test

Comparison of student and teacher view on common points: Both students and teachers appreciated the PBL as better teaching learning method than conventional one as it stimulate learner, assist them in seeing relevance of learning to the future role. They strongly supported PBL as a tool which promotes self study and problem solving ability in Biochemistry. Student strongly felt that PBL facilitates better and healthy teacher student relationship. Teachers also agreed to the same. Teachers strongly agreed that PBL being time consuming cannot cover whole syllabus while students were indecisive about time consumption in PBL as compared to didactic lecture

series. The participants of both groups in the present study agreed that PBL improves communication skill with little change in degree of Likerts scale. (Table 1)

Table 1: Perception of students and teachers for PBL on common points

Que:1	Group	Que	Mean \pm Std. Dev.	P-value
1	STU	PBL is a better method of Teaching/Learning than the conventional one.	4.43 \pm 0.641	0.257
	TEA		4.21 \pm 0.893	
2	STU	PBL promotes self-study & problem solving ability of the students in Biochemistry	4.67 \pm 0.515	0.342
	TEA		4.50 \pm 1.092	
3	STU	PBL stimulates the learners & assist them in seeing the relevance of learning to future roles	4.45 \pm 0.594	0.101
	TEA		4.14 \pm 1.027	
4	STU	PBL is time consuming as compare to didactic Lecture series.	2.56 \pm 1.081	<0.001
	TEA	PBL cannot cover whole syllabus as it is time consuming.	4.07 \pm 0.730	
5	STU	PBL helps in improving communication skills of the students.	4.71 \pm 0.539	0.028
	TEA	PBL helps students for improving their communication skills.	4.36 \pm 0.633	
6	STU	PBL facilitates a better & healthy Teacher Student relationship.	4.56 \pm 0.688	0.183
	TEA		4.29 \pm 0.825	

Perception of students about PBL: Students supported that PBL should be mandatory in teaching schedule of Biochemistry as it helps in better retention of knowledge and will help them to organize knowledge properly to reproduce in exam. (Table 2)

Table 2: Perception of students about PBL

Questions asked in feedback questionnaire	Likerts score
PBL will helps to organize knowledge properly to reproduce in exams	4.24 \pm 0.83
PBL helps in better retention of knowledge as compared to Lecture series	4.41 \pm 0.79
PBL should be done mandatory in teaching schedule of Biochemistry	4.03 \pm 0.98

Perception of facilitators about PBL: When asked about role of facilitators teachers accepted that directing whole group to desired discussion without interference was a challenge for them. Teachers nearly agreed that PBL would deprive students to acquire knowledge from experienced and good teachers however staff members with poor teaching skill could be good facilitators. The teachers could not take up a stand on whether facilitator should be a subject expert.(Table 3)

Table 3: Teachers response on their experience as a facilitators

Questions asked in feedback questionnaire	Likerts score
1. Main challenge in PBL is to direct whole group to desired discussion without interference.	4.14 \pm 0.66
2. Facilitators should be subject experts only.	3.29 \pm 0.914
3. PBL deprives students to acquire knowledge from the experienced & good teachers.	3.57 \pm 1.01
4. PBL gives opportunity to even the staff members with poor teaching skills to be a good facilitator.	3.79 \pm 0.89

Topics suggested by students for PBL: As a response to suggest topics to be taught using PBL, carbohydrate metabolism especially diabetes mellitus and hemoglobin metabolism were amongst most demanded. Other metabolisms and vitamin deficiency disorders, enzymes

and molecular biology were suggested as well. 70% Students expressed that problem should be designed around the pathways of metabolism.

Advantages and Disadvantages of PBL: Overview of suggestions and disadvantage of PBL on students and teachers perspective is tabulated in (Table 4 & 5). Here also we find similarity of opinion in both groups as they recommended compulsory attendance and increased frequency of sessions would make PBL better. They also felt that it would be more beneficial for higher classes. Though PBL is student centered active process both group expressed need of summarization of topic by subject expert at the end. But both group had different opinion on design of case. 20% Students wanted long case with more symptoms explained against 40% of teachers in the present study who suggested small case with fewer learning objectives to be given.

Time constraint was found to be common drawback of PBL perceived by both the group. Directing students discussion toward desired direction without interference was found to be greatest challenge for facilitators while student expected more active involvement from them. However need to summarize topic by expert at the end was suggested by both groups. Lack of focus, spread of ideas, and some students needing more stimulation and inability of some students to do objective oriented learning were some of practical drawbacks experienced by the teachers. Some students also felt difficulties like quick involvement was not possible, could not get chance to speak. Students suggested incentives should be given for good performer and attendance should make compulsory.

Table 4: Students perception for PBL on open ended questions

Suggestions made by students to make PBL better by students:	
1.	Attendance should made compulsory(60%)
2.	Teacher should get involved more actively.(70%)
3.	Learning objectives should be elaborated and distributed in students(20%)
4.	Should be taken once in a week.(65%)
5.	Symptoms should be explained in details (50%)
6.	There should be overview by subject expert on whatever discussed in the session at the end.(60%)
7.	There should be overview by subject expert on whatever discussed in the.(65%)
8.	Facilitator should use grading system or marks to enthusiastic participant(5%)
Drawbacks of PBL suggested by the students:	
1.	More time to be invested on one topic.(50%)
2.	Only interested students will attend.(50%)
3.	Only few members talk and incorrect statements are not corrected. (10%)
4.	Better for second year student. (40%)
5.	No quick involvement is possible as in lecture.(5%)
6.	Interesting and interactive topic should be choosen. (10%)
7.	Limited to study disease only.(10%)
8.	Each student should be given a chance to speak by the fascilitator. (10%)

Table 5: Teachers views on their participation as a facilitators

Suggestions to make PBL better:-	
1.	Small case with concise learning objective should be given.(40%)
2.	Case should be summarized at the end.(50%)
3.	Increase frequency 50%
4.	Best for second year & higher classes.(40%)
Drawbacks of PBL:-	
1.	Coordination with the other department (30%)
2.	All student do not study.(30%)
3.	Cues drawing was difficult.(30%)
4.	Students were not focused.(50%)
5.	Spread of imaginations by the students.(40%)
6.	All students are not vocal.(30%)
Problem faced as a facilitators	
1.	Students needs to be stimulated(50%)
2.	Not a subject expert. (40%)
3.	Students take PBL lightly(40%)
4.	Objective oriented learning was not done by the students. (50%)
5.	Directing students discussions(60%)

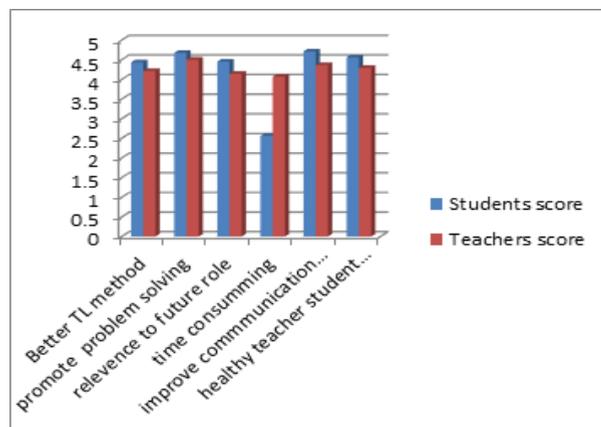


Fig. 3: Perception of students and teachers for PBL on common points

Discussion

Biochemistry is basic science subject introduced in first MBBS medical curriculum. In conventional curriculum provided by MUHS Nasik, most of the course is taught in didactic lectures along with practical. Biochemistry is one of fast evolving branch with continuous new inventions with most of the theory part revolving round the metabolism. The chain of reactions involved in the metabolism and seems to be boring and monotonous for students. By subjecting students to the well designed problem we can emphasize clinical significance of pathways and the learning is made more interesting.

Higher passing percentage was observed as a short term outcome of a near full term PBL curriculum in schools of Taiwan with increased scores in self-directed learning readiness scale.⁽⁷⁾ Effectiveness of PBL led as a model for excellence in medical education and could be counted by 100% pass rate and significantly higher average at national level amongst 150 students whose whole curriculum was PBL based.^(8,9) Previous study supported our results indicating that PBL motivates and actively controls the direction of their learning needs and encourages them to take charge of their own learning in biochemistry.⁽⁶⁾ Student's feedback at B.P. Koirala institute of Health Sciences about integrated PBL teaching curriculum, have shown that students found Biochemistry more clinically relevant and extremely useful in understanding and analyzing clinical problems.⁽¹⁰⁾ Student led discussion groups proved themselves more superior in learning complex material in term of memory retention. Hence integrated PBL curriculum could be considered as an example of need based curriculum. It also stimulates interest of students and teachers in teaching learning activities. PBL directs students adopt deep approach to learning with critical thinking after discussion led arguments.⁽¹¹⁾ In the present study our teachers and students strongly agreed to the facts and favored to make PBL mandatory in the curriculum as a one of the method of teaching learning.

In accordance to the previous studies high percentage of attendance in PBL session as compared to the didactic lecture series proved that students enjoyed PBL session to see the benefits in term of their own development.⁽¹²⁾ Our study also supports previous findings suggesting that PBL gives an opportunity to integrate psychosocial elements into students thinking about medical problem thus giving them sense of future responsibility.⁽¹³⁾ A well-written PBL case provides a learning environment in which students perceive the objectives as worth knowing. It provides opportunities for the students to identify aspects of the case as learning objectives while solving the mystery of the patient's case.⁽¹⁴⁾

In accordance to a systematic review of the effects of problem-based learning in medical school, students learn how to analyze a problem, identify relevant facts and generate hypotheses, identify necessary information and make reasonable judgments for solving the problem.⁽¹⁵⁾ The exposure of PBL in under graduation has shown clear positive effects on physician's social and cognitive competencies such as coping with uncertainty and communication skills.⁽¹⁶⁾ The employers have appreciated the positive attributes of PBL experienced students in terms of development of communication, teamwork, respect and collaboration skills which helps them to cope up with the ever-changing information explosion.⁽¹⁶⁾ In the recent randomized controlled trial results reinforced that PBL improve student's interest in learning, cultivate an ability to study independently, improve communication and analytical skills, and good team cooperation spirit. Along with positive effect lack of systematization in imparting knowledge was amongst the major observed shortcomings.⁽¹⁷⁾ Students in the present study expressed the need of summarization of topic at the end by experienced teacher.

The participant teacher's view in present study goes in accordance with past study which has concluded that facilitation skill varies amongst tutors, however no significant difference was found between the tutors of varied background. It supports teacher's view that teacher with poor teaching skill can be a good facilitator by non provision of information upon request and creating non threatening environment except skill of assisting group to focus on learning issues.⁽¹⁸⁾ However few studies have claimed that though PBL is more enjoyable but general problem solving skill does not improve though retention of knowledge is better. Moreover for some students important gaps in knowledge might occur.^(19,20) Hence in our study Students and teachers emphasized to summarize topic at the end of session by senior teachers. (Table 4 & 5)

Introduction and implementation of PBL is appreciated for long lasting benefits though it is time consuming and needs coordination between the departments.^(9,17,20) Review of the research on the effectiveness of PBL curricula conducted in the past

could not find convincing evidence that PBL improves knowledge base and clinical performance, at least not of the magnitude that would be expected given the extensive resources required for the operation of a PBL curriculum.⁽²¹⁾ Moreover one of the review article stated that PBL as a single intervention does not make any significant change. Interventions in PBL have both positive and negative effects as it varies with different populations and different contents and complex interaction amongst many of the components of PBL.⁽²¹⁾ This is reflected in our study in student's answer for disadvantages of PBL.

Some of the recent studies have demonstrated that PBL is more effective when applied to laboratory courses than to theory-based courses.^(9,17) Even students in present study had a similar opinion and felt that PBL is more suitable for higher classes like final MBBS where they will actually face patients.

Major challenge faced by our facilitators was directing whole group to desired discussion without interference. One of the review articles on PBL⁽¹⁹⁾ demonstrated that initial messy transitions of findings flow induces boredom and confusion in students. It has been further suggested that the PBL process skill of students and level challenge i.e. problem has to be matched in order to avoid anxious state and confusion in students.⁽²²⁾ Contradictory opinion about problem where students wanted long case while teachers advised to keep problem simple and concise can be easily explained due difference in PBL process skills of students and teachers.

Conclusions

- PBL is an active method of learning which encourages students for self study and improve their problem solving skills. Still guidance of experienced teacher is needed to summarize the topic. Though time consuming, use of PBL should be made mandatory in Biochemistry curriculum as one of the tool for teaching learning methods.

Limitation of the study

Introducing PBL to first MBBS students was the first exposure of the students for the active learning process. First MBBS students are habituated to pedagogy methods of teaching. They are in the process of getting acquainted with the adult learning processes. Subjecting them to the pure active process leads to the sudden transition in the methods of learning. Hence PBL process skills of the students may not be equal to the higher classes of the students. This session has sensitized them for active methods of learning. In first MBBS, as students are not exposed to the real patients and they are yet to study clinical subjects hence they have to put extra efforts to visualize clinical scenario. This leads them to put more efforts and time as compared with the higher classes.

Conflicts of the interest

The authors declare that they have no conflict of interest.

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