

To Explore The Effectiveness Of Problem-Based Learning Over Conventional Didactic Lecture In Microbiology For Phase 2 MBBS Students

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Abstract

Background: Problem based learning [PBL] has been identified and approved by many medical educationists as one of the best teaching learning methods due to the fact that it improves students' learning in all 3 domains and improves higher order thinking. Research has found its positive effect to be variable in different geographic settings.

Aim & objectives: To explore the effectiveness of PBL over conventional lecture. To evaluate students' performance using PBL rubrics. To determine student's acceptance and perceptions of PBL.

Material & methods: the present study is a prospective experimental and interventional type. The IERB approval was obtained and project was pilot tested. Study participants were enrolled by verbal consent and sampled using quota and randomisation method. The sequential steps of the study include: orientation on PBL method, pre-test, a questionnaire on preparedness for self-directed learning [SDL], conduct of sessions by 2 different TL methods with exchange of groups, post-test, students grading and lastly general feedback.

Statistical methods: Mean \pm SD, unpaired t test and 5-point Likert scale was used for analysis of results.

Results: Around 114 /147 [77.55%] enrolled and continued till the end. The overall mean scores for DL & PBL method of teaching were as 1.65 ± 0.53 & 1.70 ± 0.62 in pre-test and 6.84 ± 1.22 and 7.36 ± 1.07 in post-test with p values as 0.178 & 0.118. For individual topics in post-test the PBL group secured higher scores than DL except for one. The assessment and feedback on PBL gave variable results.

Discussion & Conclusion: the present study couldn't find any statistically significant difference in the learning outcomes while using 2 different TL methods. However, the questionnaire on SDL preparedness, assessment and feedback data revealed certain grey zones which demand further enquiry into students learning plans & preferences which could be one of the reasons for the outcome observed and open doors for future qualitative research.

Limitations: students and faculty related factors besides study design might have influenced the outcomes observed.

Keywords: Problem-based learning [PBL], Didactic lecture [DL], Self-directed learning [SDL], Pre-test, Post-test.

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I.Introduction

As per the medical council of India [MCI] or national medical commission [NMC] findings in vision 2015 document, the Indian medical graduate [IMG] performance is not up to the expectations of local & global standards [1]. It is observed that our medical graduates are scoring less in competency-based exams when posed with questions on higher order thinking and also in affective and psychomotor domains of learning [2]. Therefore, the consensus reached was to reform the medical curricula from age old teacher centered to learner centered program [1,2]. And also, to include in assessments the attitudinal and communication skills component besides the regular cognitive and psychomotor aspects of curricula [1,2]. This is possible only through development & uniform implementation of competency based medical education curriculum [CBME] across the nation. Moreover, with active involvement of students in their learning process using different teaching learning methods. In this context problem-based learning [PBL] over the decades has been identified

and approved by many medical educationists across the globe as one of the best teaching learning methods due to the fact that it improves students' learning in all 3 domains and gave better learning outcomes [3]. The key objectives of PBL are to improve higher order thinking amongst students' like ability to apply basic sciences knowledge to clinical context, develop critical reasoning and problem-solving skills, promotes self-directed learning and enhances motivation in the learning process [3-5]. And the key features being a trigger [problem], self-directed learning, small group discussion, concept map, and identification and closure of knowledge gaps by the facilitator [3-5]. The present study is designed with the aim to explore the effectiveness of PBL over conventional lecture. To evaluate students' performance using PBL rubrics. To determine student's acceptance and perceptions of PBL in our local settings.

II. Material & Methods

The present study is a prospective experimental and interventional type. The Institutional ethical and research board approval was obtained prior to the commencement of the study. Project was pilot tested on small number of immediate passed out phase 2 MBBS students for its feasibility, validity and reproducibility. Study participants were enrolled by verbal consent and sampled using quota followed by randomisation. Study was carried out in Deccan college of medical sciences; college lecture gallery and demonstration rooms in the department of microbiology between September to December 2023. The study participants were phase 2 MBBS student's of 2021 batch [N=147] and the inclusion criteria was all the students of phase 2 MBBS; 2021 batch in microbiology who didn't have any prior knowledge about the topics chosen for the study. The exclusion criteria were students of 1st and 3rd year MBBS. Statistical analysis was done by calculating Mean \pm SD and using unpaired T test for deriving level of significance and 5-point Likert scale for evaluation of questionnaire. The sequential steps of the study are as follows: the participants and faculty were first orientated on PBL method followed by pre-test, a questionnaire on preparedness for SDL, delivery of 4 topics by 2 different methods with crossover of groups, post-test, students grading using PBL rubrics and lastly general feedback on acceptance and perceptions on PBL. The topics chosen for study were from different competencies in CBME curriculum, code MI. 2.2, MI. 3.3, MI. 5.2 -5.12, MI. 6.5 and included infective syndromes like diphtheria, enteric fever, sepsis & acute bacterial meningitis. After obtaining verbal consent to enrol [114/147] the participants were divided into groups A & B with 57 students in each. Subsequently a one-hour session as didactic lecture and a total of 2 hours of problem-based learning activity on different days was carried out on each topic. The students were crossed over after each topic so as to provide equal exposure to both the teaching learning methods used in the study. Post-test was administered after 6 weeks of completion of all the sessions and in the last general feedback was administered. Students' preparedness for SDL and general feedback questionnaire were checked using 5 point Likert scale with scores ranging from 1-5, strongly disagree =1, disagree =2, neutral =3, agree =4 and strongly agree =5. The PBL rubric had questions on 4 PBL domains with 6 questions on critical appraisal, 1 question on utilization of resources, 8 questions on group activity and 5 questions on attitudinal and communication skills with altogether 30 questions were used and the score ranged from minimum as 30 to maximum as 150. The pre-test and post-test had questions on comprehension & analysis of the symptoms provided in the trigger to answer suspected aetiology, critical thinking to explain the pathogenesis of the disease. Laboratory test reports were provided for reasoning & interpretation of tests results. Synthesis or construct ability was tested on advice for various lab investigations to the patient based on specific symptoms. Lastly with questions on treatment options and justification for choice of antibiotic for management of the infectious disease. The maximum score awarded for pre and post-test was [7.5 x 4 topics = 30 marks] each. Results obtained were analysed using mean \pm SD and unpaired t test.

III. Results

Around 114 /147 [77.55%] enrolled and continued till the end of the study. The overall mean scores for DL & PBL method of teaching were as 1.65 ± 0.53 & 1.70 ± 0.62 in pre-test and 6.84 ± 1.22 and 7.36 ± 1.07 in post-test with *p* values of 0.178 & 0.118. The mean pre-test scores for individual topics were similar for both the groups except for sepsis topic where the *p* value was 0.03. The mean post-test scores for individual topics were higher for PBL group than DL except for diphtheria topic as shown below in table 1.

TABLE 1: Results of two different teaching learning methods used in the study.

Topic	Didactic Lecture group N= 57 Pre-test scores Mean \pm SD	PBL group N= 57 Pre-test scores Mean \pm SD	P value	Didactic Lecture group N= 57 Post test scores Mean \pm SD	PBL group N= 57 Post test scores Mean \pm SD	P value
Diphtheria	1.96 \pm 1.12	2.21 \pm 1.39	0.152	5.82 \pm 2.85	6.149 \pm 3.06	0.2823
Enteric Fever	2.2 \pm 1.36	2.43 \pm 1.78	0.218	5.76 \pm 2.85	6.77 \pm 3.0	0.035
Sepsis	1.01 \pm 1.00	1.39 \pm 1.11	0.0302	7.75 \pm 2.97	8.39 \pm 3.12	0.0129

Acute Bacterial Meningitis	1.41 ± 1.44	1.3 ± 1.57	0.3496	8.05 ± 3.23	8.14 ± 3.45	0.0417
Overall mean score	1.65 ± 0.53	1.70 ± 0.62	0.1786	6.84 ± 1.22	7.36 ± 1.07	0.1189

Results of preparedness for self-directed learning which is a prerequisite for problem-based learning activity revealed that no doubt students have understanding of their learning responsibility and identified their needs, and were able to plan learning strategies and set goals but were just above good grade in sustaining motivation to learn and monitor their learning progress and identify areas of improvement.

TABLE 2: Results of self-directed learning preparedness

Questions	Preparedness to do self-directed learning:	Score obtained on 5-point scale
1.	I am responsible for my own learning	4.42
2.	I identify my own learning needs	4.10
3.	I am able to plan and set my learning goals	3.85
4.	I am able to decide learning strategies [best way of learning]	3.79
5.	I always look for additional sources of information to improve my learning	3.74
6.	I identify important points while reading a chapter	4.20
7.	I am able to maintain self-motivation for learning	3.35
8.	I am able to monitor my learning progress	3.56
9.	I am able to relate knowledge with clinical problem	3.79
10.	I am able to identify further areas of improvement	3.66

Facilitator rating of participants on various attributes of PBL shown in table 3 below, revealed that in critical appraisal of PBL activity participants were just above good in defining the learning objectives, demonstrating initiative and interest in learning, identifying and analysing the trigger, preparing concept maps and application of knowledge and problem-solving skills. Comprehension of general and specific concepts of the topic was reflected in the concept maps prepared by majority of the students. Utilization of resources by majority was optimal. In group dynamics it is observed that some participants are just good in abiding to the roles assigned in the group activity, express their thoughts freely, considering interactions with others in the group as stimulus for learning, and keeping a note of findings [scribe]. In attitudinal and communication skills it is noted that they are just good in tolerance to others point of view, accepting constructive feedback and reflect on learning.

TABLE 3: Results of attributes tested in students during PBL activity

Question no:	Attributes checked by the facilitator in participants	Obtained score on 5-point scale
Critical appraisal of PBL learning		
1.	Identifies and analyse the problem from the trigger	3.49
2.	Identify the learning objectives	3.63
3.	Demonstrate initiative and interest	3.57
4.	Is able to analyse and critically reflect on others' ideas	3.57
5.	Prepares concept map logically	3.70
6.	Applies knowledge gained to the problem to solve and reach a decision	3.71
Utilization of resources		
1.	Utilizes relevant resources effectively	3.52
Group activity		
1.	Is able to identify and abide to the role in the group	3.24
2.	Participate in group discussions [contribute knowledge]	3.59
3.	Shares resources and results with group members actively	3.41
4.	Share thoughts and opinions with peers effectively	3.62
5.	Feels interaction with others provides a stimulus for further learning	3.35
6.	Keep note or summary of all ideas during discussion [scribe]	3.36
7.	Finds easy to work in collaboration with others	3.69
8.	Is able to express views freely	3.33
Attitude & communication skills		
1.	Effectively communicates with other members	3.25
2.	Accepts constructive feedback	3.41
3.	Use presentation tools effectively	3.82

4.	Keeps an open mind to others point of view	3.47
5.	Review and reflect on learning activities	3.24

Feedback using survey questionnaire on acceptance and perceptions of PBL as a teaching learning method showed results depicted in table 4 below.

Majority of the students strongly agreed that PBL is motivating, engaging and interesting teaching learning method. Further they have also strongly agreed that it helps in identifying the problem, develops reasoning and critical thinking skills, helps apply knowledge to problem solving and decision-making skills. Majority have strongly agreed that SDL is essential for PBL activity. The points that were just agreed are PBL helps them develop interpersonal relationship, it can be implemented for certain topics in the curricula, and application of it in real time. The only question where majority of the students remained neutral is its preference over didactic lecture.

TABLE 4: Students reflections on the study acceptance and perceptions of PBL

Question no:	Survey question on PBL acceptance & perceptions	5point Likert scale score obtained
1.	I find Problem-based learning motivating helps me to actively involve and keeps me engaged in learning process	4.32
2.	I find the facilitator guidance essential & useful for understanding complex or difficult to comprehend areas of topic	4.32
3.	I find didactic lecture more useful than Problem based learning	2.75
4.	PBL helps us to identify and analyse the problem	4.34
5.	PBL helps us to apply reasoning and do critical thinking in order to solve the problem	4.36
6.	PBL helps us retain knowledge gained for longer period	4.21
7.	PBL helps us to work in groups and develop interpersonal relationship [sharing of information and findings & respect for peers]	3.99
8.	Self-directed learning [independent] is essential for meeting learning expectations in PBL	4.28
9.	Problem based learning can be implemented for certain topics in each subject	4.17
10.	I am able to apply the knowledge gained through PBL session in my regular clinical postings	4.14

IV. Discussion

Research through original studies had found PBL to be superior to other teaching learning methods for reasons like improvement in students' abilities on critical thinking, self-directed learning, problem solving skills, collaborative work etc [3-6]. Majority of the studies published so far on PBL as TL method proved it to be statistically significant method in improving students' performance when compared to traditional lecture [6-13]. No doubt, in our study PBL group showed improved students' scores in post-test for individual topics delivered in comparison to didactic lecture group [6-13]. However, the present study contradicts these findings with respect to the overall mean scores obtained for 2 different teaching learning methods [14-19]. The reason could be any of these identified factors such as lack of student's exposure to PBL as a teaching learning method in previous years of learning, year of study, preparedness to do self-directed learning, difficulty in identifying their roles and responsibilities in the group and hesitation to participate and express views freely during group activity. In attitudinal domain lack of tolerance to other points of view and failure to effectively reflect on learning and exhibit effective communication skills [14-19]. Moreover, the study methodology involved cross over of batches in order to provide an equal opportunity of exposure to each group [A & B] of PBL as a teaching learning which might have resulted in insignificant outcome which is not observed in other studies [6-13]. Self-directed learning has been identified as one of the important quality an Indian medical graduate should possess in his/her career to be competent enough to deliver the 5 duties assigned by GMER 2019 [1]. In our study majority of them strongly agreed for it and identified as a prerequisite of PBL activity to participate in group discussion and also agreed that it enhances learning outcomes [20-24]. Learning by preparing concept maps for the topic is the key feature of PBL and helps students acquire general and specific concepts and cross link them to solve the problem and make decisions. In the present study majority of the participants accomplished the required attribute as PBL rubric score on concept map correlated well with post-test performance results, however, some were found to be average in cross linking of concepts which could be because of lack of sufficient clinical exposure in 2nd year of MBBS, inadequate clinical knowledge, its correlation and application with the findings in the trigger [33]. However, in feedback questionnaire many of the students remained neutral to the most preferred teaching learning method out of the two, which infers that they need time to morph to student centered learning process which is possible through continued and appropriate training and mentoring and researching on their learning needs and preferences [34].

V. Conclusion

The present study couldn't find any statistically significant difference in students learning outcome while using 2 different TL methods. However, the questionnaire on preparedness for SDL, assessment [PBL rubric] and feedback data revealed certain grey zones which demands further exploration of students learning preferences which could be one of the reasons for the outcome observed and open doors for future qualitative research preferably with open ended questions on them.

VI. Limitations

The present study had certain limitations amongst which the most important is the time management followed by attendance of participants, motivation, engagement and interest in the learning process which are quite subjective. The study methodology included as intervention; 2 different teaching learning methods with cross over of batches so that all participants get equally exposed to both the TL methods which could have compromised the results. And moreover, public rubrics can be applied and assessed only on PBL group hence the two batches cannot be compared on PBL scale which makes the study results less significant.

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Conflict of Interest: none

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