ORIGINAL ARTICLE

# Influence of Problem-based Learning Method on Learning Outcomes in Medical Curriculum

Saara Banu EPM[1], Yazhini Karuppiah[2*], Bhuvaneswari K[3]

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## Abstract

**Introduction:** Problem-based learning (PBL) is a student-centered learning approach in which students learn through analyzing and solving problems.

**Justification:** Traditional teaching program is in the form of a dictated lecture and is teacher-centered. A larger number of topics can be covered without active student participation. In PBL, which promotes deep learning, students learn to justify their knowledge with the help of cognitive skills and complex thinking.

**Methods:** This retrospective study was done after obtaining Institutional Human Ethics Committee (IHEC) approval. Data collected from three internal assessment examinations (IAEs) written between the period of January 2017 and August 2017 by 151 students pursuing second-year MBBS training in the Department of Pharmacology. Examination papers for second-year MBBS students contain questions such as short notes, ultrashort, and PBL.

**Results:** Wilcoxon Mann–Whitney test analysis of IAE-1 with IAE-2 and IAE-1 with IAE-3 in SPSS software gave *p*-value—0.393 and 0.020, respectively. Using analysis of variance (ANOVA), IAE-2 with PBL and IAE-3 with PBL showed *p*-value 0.001, which was statistically significant. There was an increase in the pass percentage [number of students who scored 40 and above in IAE-3 (with PBL) when compared to IAE-1 (without PBL)].

**Conclusion:** This audit showed definite knowledge improvement by the students using PBL as a tool along with a traditional teaching program.


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## Introduction

Problem-based learning (PBL) is a learning program which promotes self-regulated learning, improves knowledge, and develops complex thinking.[1] PBL was first introduced in 1969 at McMaster University, Canada.[2] The two scholars, Howard Barrows and Robyn Tamblyn,[3] were the first to publish a book on PBL: "Problem-based learning: An approach to medical education" in 1980.

Problem-based learning is a student-centered learning approach in which students learn through analyzing and solving problems. PBL replaces teacher-centered traditional teaching programs, enhances students' critical thinking, and promotes knowledge retention for a much longer period due to a deep understanding of the subject. In a traditional teaching program, the ideas are transferred directly from the minds of the tutor to students, as depicted in Figure 1, whereas in PBL, which promotes deep learning, students learn to justify the knowledge applied with the help of cognitive skills,[4] as depicted in Figure 2.

In traditional lecture-based learning, students passively listen to the lecturer which does not promote complex learning, and they fail to connect ideas with the facts. PBL helps students gain immense knowledge and promotes self-directed learning. PBL promotes constructive learning and improves cognitive skills.

This study aims to evaluate the percentage of knowledge gained through PBL method in the second-year MBBS students' learning program and to compare the percentage of marks obtained through PBL and traditional teaching assessment.

## Materials and Methods

- Ethical clearance: Institutional Human Ethics Committee has exempted this study from Ethical Review, EC letter no. 17/333; dated October 27, 2017.
- Study population: Second-year MBBS students, 2015 batch.
- Place: Department of Pharmacology, PSG IMSR.
- Sample size: 151.
- Duration: 6 months.

### Methods

Problem-based learning methods were implemented through class activities by small-group teaching. The students were randomly sorted into small groups under a facilitator. They were provided with a clinical scenario with structured questions. Students were encouraged to actively participate in group discussion; they analyze, interpret, and identify what is known and how to apply it to bring about a solution. Internal assessment examination (IEA) papers of the 2015 batch second-year MBBS which includes theory papers (recall type of questions having short notes, very short answers, and PBL (structured questions) were used to analyze the performance and outcome. IAE-1 with only the recall type of questions without PBL was used to compare the mean scores of the other two IAE papers (IAE-2 and IAE-3) with PBL, as shown in Table 1.

The audit focused on:

- Assessing the knowledge of students based on problem-based learning.
- PBL and its impact on students' performance.

### Statistical Analysis

One-way analysis of variance (ANOVA) was used to compare students' performance between groups, Mann–Whitney *U* test was applied to compare students' performance within the groups, and the International Organization for Standardization (ISO) grading system was used to grade the students' scores.

## Results

The scores obtained by the students in the IAE-1–3 are shown in Table 2.

Normal distribution pattern of the students' scores in the three IAEs is shown in Figure 3. The blue curve represents IAE-1 score of 151 students; the red curve on the

[1]Assistant Professor, Department of Pharmacology, Government Medical College & Hospital, The Nilgiris, Ooty; [2]Associate Professor, Department of Microbiology, Saveetha Medical College and Hospital, SIMATS University, Thandalam; [3]Professor and HOD, Department of Pharmacology, PSG Institute of Medical Sciences & Research, Coimbatore, Tamil Nadu, India; *Corresponding Author

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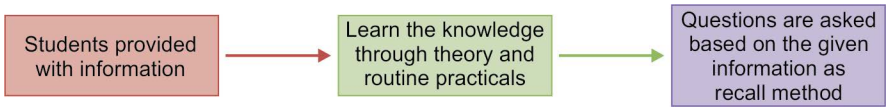



**Fig. 1:** Traditional teaching program

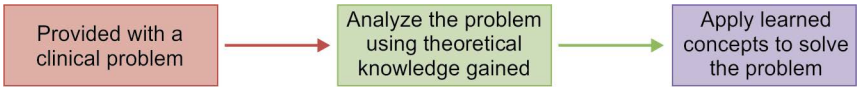



**Fig. 2:** Problem-based learning

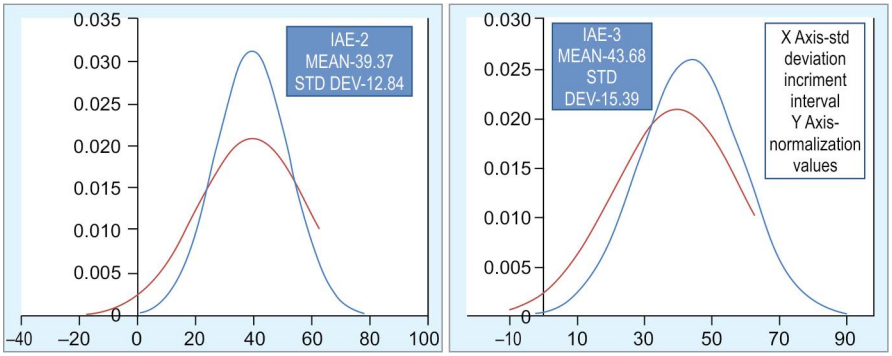



**Fig. 3:** Normal distribution pattern of the students' score in the three IAE.

left represents IAE-2, and on the right, that of IAE-3.

Analyzing IAE-1 and IAE-2 by comparing the mean values using Mann–Whitney *U* test in SPSS software gives a *U* value—11,047.5 and *Z* score—0.26625 with *p*-value—0.39358 (*p*-value >0.05). Analyzing IAE-1 with IAE-3 by comparing the mean scores using Mann–Whitney *U* test in SPSS software gives U value—9513 and Z score—2.30903 with *p*-value—0.02088 (statistically significant). Statistical analysis reports are shown in Tables 3 and 4. Using one-way ANOVA, IAE-2 with PBL and IAE-3 with PBL gives *p*-value 0.001 (statistically significant), as shown in Table 5.

It was noticed that there was a significant improvement in students' performance in IAEs with PBL, and the percentage of students below a score of 34 had been reduced. There was an increase in students' number in the score group of 50–74 in IAE-2 and IAE-3 with PBL, as depicted in Figures 4 and 5.

**Table 1:** Scores of recall type questions vs PBL

| *Sr. no.* | *IAE-1 (recall type questions)* | *IAE-2/PBL-2* | *IAE-3/PBL-3* |
|---|---|---|---|

**Table 2:** Scores obtained by the students in the internal assessment examinations

| *Sr. no.* | *IAE-1* | *IAE-2* | *IAE-3* |
|---|---|---|---|
| 1. Sum | 5,865.5 | 5,984.5 | 6,596.5 |
| 2. Mean | 39.63176 | 39.37171 | 43.68543 |
| 3. Median | 37.75 | 38.5 | 42 |
| 4. Mode | 43 | 38.5 | 40.5 |
| 5. Standard deviation | ±19.09269 | ±15.39604 | ±12.84703 |

**Table 3:** Descriptive statistics tests of within-subjects effects SPSS version 19

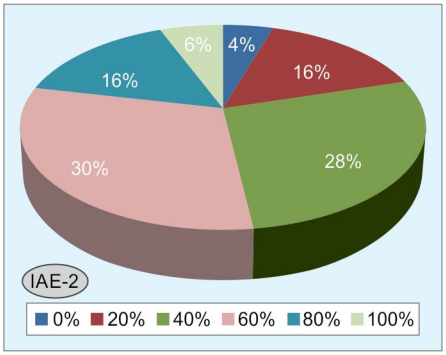
| | *N* | *Minimum* | *Maximum* | *Mean* | *Standard deviation* | *Skewness* | |
|---|---|---|---|---|---|---|---|
| | *Statistic* | *Statistic* | *Statistic* | *Statistic* | *Statistic* | *Statistic* | *Standard error* |
| IAE-3 | 151 | 15.00 | 81.00 | 43.6854 | 12.84703 | 0.165 | 0.197 |
| IAE-2 | 151 | 4.0 | 81.0 | 39.298 | 15.4204 | 0.207 | 0.197 |
| IAE-1 | 151 | 0.00 | 85.50 | 38.3974 | 19.92478 | 0.253 | 0.197 |

**Table 4:** Paired samples statistics

| | | *Mean* | *N* | *Standard deviation* | *Standard error mean* |
|---|---|---|---|---|---|
| Pair 1 | PBL-2 | 9.8675 | 151 | 8.03050 | 0.65351 |
| | PBL-3 (out of 30) | 8.715 | 151 | 5.5918 | 0.4551 |

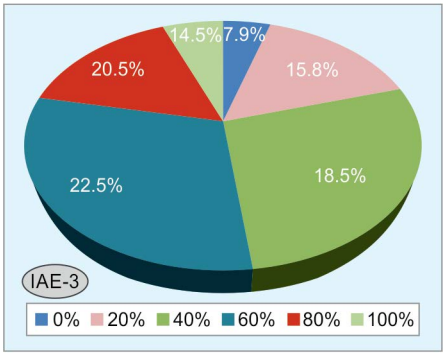
**Table 5:** One-way ANOVA, *p*-value 0.001 (statistically significant)

| | | *Sum of squares* | *Degrees of freedom (df)* | *Mean square* | *F* | *Significance* |
|---|---|---|---|---|---|---|
| IAE-2 | Between groups | 28,594.944 | 97 | 294.793 | 2.212 | 0.001 |
| | Within groups | 7,197.804 | 54 | 133.293 | | |
| | Total | 35,792.748 | 151 | | | |
| IAE-3 | Between groups | 21,500.680 | 97 | 221.656 | 2.323 | 0.003 |
| | Within groups | 5,152.115 | 54 | 95.410 | | |
| | Total | 26,652.794 | 151 | | | |




0% - Not attempted
20% - **1** question correctly answer
40% - **2** questions correctly answered
60% - **3** questions correctly answered
80% - **4** questions correctly answered
100% - **5** questions correctly answered

**Fig. 4:** Number of PBL questions correctly answered by the students in IAE-2




0% - Not attempted
20% - **1** question correctly answer
40% - **2** questions correctly answered
60% - **3** questions correctly answered
80% - **4** questions correctly answered
100% - **5** questions correctly answered

**Fig. 5:** Number of PBL questions correctly answered by the students in IAE-3

## Discussion

In lecture-based traditional teaching programs, face-to-face interaction between the students and teacher is possible. It is usually of mixed type, i.e., didactic and interactive.[4] A larger number of topics can be covered. But learning is an active process which requires active student participation. In case of lecture-based learning, students' active participation is less. Attention is not the same throughout the lecture. On many occasions, students take a passive role because traditional teaching methods are usually teacher-centered.

Problem-based learning methods are used most frequently in medical schools as an educational tool. Students are provided with a clinical scenario. The effectiveness of PBL can be achieved based on the nature of the clinical scenario. PBL method promotes in-depth learning and better retention[4] and helps students confidently face their examinations. PBL is student-centered and self-directed learning. Active group discussions through small-group teaching programs help students develop communication skills. It helps students to take the initiative in learning. Prior knowledge is essential in solving PBL questions, as it helps students to recall basic facts. PBL activities promote critical thinking.[5]

Problem-based learning activities are time-consuming. Only a limited number of topics can be covered. They require manpower to support the needs of the students. They require proper preparation of the scenario, time, and planning.[6]

Though PBL is an effective teaching program implemented in many teaching institutes across the countries, our audit focuses only on the 20% improvement in the class pass percentage using PBL when compared with theory-based examination without PBL (IAE-1) based on a study by Ahlam and Gaber[7] titled "Impact of problem-based learning on students critical thinking disposition, knowledge acquisition and retention" done in Mansoura University, Egypt. On statistical analysis, there were significant improvements in students' thinking capacity in the post-PBL group when compared with preintervention group. This study showed a 20% improvement in the mean value of students' performance in the post-PBL group. Since PBL is not the recommended teaching program as per our university guidelines, a 20% improvement in the class pass percentage when compared with a lecture-based learning program is used as the standard. One-way ANOVA showed improvement in individual students' performance ($p$-value –0.001). The estimated mean value of students' scores had also improved successively.

Improvement in the PBL scores in the second and third IAEs was associated with a corresponding improvement in theory marks as well. The number of students in the score group below 34 had decreased. The number of students in the score group between 35 and 49 had increased. The number of students in the score group between 50 and 70 had increased. There was successive improvement in the overall pass percentage of students in IAE-2 (with PBL) and IAE-3 (with PBL) when compared to IAE-1 without PBL.

## Conclusion

Problem-based learning has a significant role in enhancing the academic performance of second-year MBBS students. This audit compares students' performance (marks) of traditional lecture-based teaching in the IAE-1 (without PBL) with that of IAE-2 and IAE-3 (with PBL), showing statistically significant results and definite knowledge acquisition by the students using the PBL teaching program, comparable to international studies.

## Limitations of the Study

- This audit was based on the performance of only a single batch of second-year MBBS students.
- Students' interest is one of the important factors in gaining knowledge through learning pharmacology and applying pharmacological principles.

## Orcid

*Saara Banu EPM* https://orcid.org/0000-0002-1802-0646
*Yazhini Karuppiah* https://orcid.org/0000-0001-5592-0013

## References

1. Khan IA, Al-Swailmi FK. Perceptions of faculty and students regarding problem based learning: a mixed methods study. J Pak Med Assoc 2015;65(12):1334–1338.
2. Smits PB, Verbeek JH, De Buisonje CD. Problem based learning in continuing medical education: a review of controlled evaluation studies. BMJ 2002;324(7330):153–156.
3. Barrows HS, Tamblyn R. Problem-based learning: an approach to medical education. New York: Springer Pub Co, 1980.
4. Balagué Mola N. The use of ISO 9001 quality standard in higher education institution libraries. Lib Serv 2007;11(3):66–78.
5. Davis D, O'Brien MA, Freemantle N, et al. Impact of formal continuing medical education: do conferences, workshops, rounds, and other traditional continuing education activities change physician behaviour or health care outcomes? JAMA 1999;282:867–874.
6. McParland M, Noble LM, Livingston G. The effectiveness of problem-based learning compared to traditional teaching in undergraduate psychiatry. Med Educ 2004;38(8):859–867.
7. Ahlam ES, Gaber H. Impact of problem-based learning on students critical thinking dispositions, knowledge acquisition and retention. J Educ Pract 2014;5(14):74–83.