

EFFECTIVENESS OF PROBLEM-BASED LEARNING IN IMPROVING COMPETENCY IN P-DRUG SELECTION AMONG MEDICAL STUDENTS

Suhaina Abdul Samath¹, Supriya S.S², Sumina S³

¹Associate Professor, Department of Pharmacology, Sree Mookambika Institute of Medical Sciences, Kulasekaram, Tamil Nadu, India

²Assistant Professor, Department of Pharmacology, Madha medical College and Hospital, Chennai, Tamil Nadu, India

³Assistant Professor, Department of Pharmacology, Sree Mookambika Institute of Medical Sciences, Kulasekaram, Tamil Nadu, India

Received : 16/04/2026
Received in revised form : 21/05/2026
Accepted : 06/06/2026

Keywords:

Clinical Competence; Education, Medical, Undergraduate; Learning; Pharmacology; Problem-Based Learning.

Corresponding Author:

Dr. Supriya S.S,

Email: supriyaselvakumar.s@gmail.com

DOI: 10.47009/jamp.2026.8.3.215

Source of Support: Nil,

Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (3); 1203-1207



ABSTRACT

Background: Rational prescribing and P-drug selection are essential competencies for undergraduate medical students. Conventional lecture-based pharmacology teaching often emphasizes factual learning with limited clinical application. Problem-based learning (PBL) may improve prescribing competency, critical thinking, and retention of pharmacological knowledge. This study evaluated the effectiveness of PBL in improving competency in P-drug selection among medical students. **Materials and Methods:** This randomized controlled interventional study was conducted among 100 second-year MBBS students over 12 weeks. Participants were randomly allocated into PBL (n=50) and control (n=50) groups. Baseline competency was assessed using a 20-item MCQ and five OSCE stations related to P-drug selection. The PBL group attended eight 90-minute sessions conducted twice weekly using clinical case scenarios, while the control group received conventional lectures with MCQ practice sessions. Post-intervention and follow-up assessments were performed using MCQ, OSCE, Likert-scale perception questionnaires, and prescription-writing simulations. **Result:** Baseline characteristics and pre-test scores were comparable between groups ($p>0.05$). The PBL group demonstrated significantly higher post-test MCQ (74.8 ± 8.1 vs 69.2 ± 8.4 ; $p=0.018$), OSCE (76.9 ± 7.6 vs 70.8 ± 7.9 ; $p=0.015$), and total competency scores (75.9 ± 7.5 vs 70.0 ± 7.8 ; $p=0.016$). Follow-up total scores were also significantly higher in the PBL group (71.8 ± 7.9 vs 66.2 ± 8.6 ; $p=0.025$). Confidence, understanding, interest, and satisfaction scores were significantly better among PBL students ($p<0.05$). Prescription simulation outcomes showed higher scores in the PBL group, although differences were not statistically significant. **Conclusion:** Problem-based learning was more effective than traditional lecture-based teaching in improving P-drug selection competency, retention of prescribing-related skills, and student perceptions toward rational prescribing among undergraduate medical students.

INTRODUCTION

Rational prescribing is an essential competency for medical students and future physicians, as it directly affects patient safety, treatment outcomes, and the appropriate use of medicines. The concept of P-drug selection, introduced through the WHO rational pharmacotherapy approach, helps students choose drugs based on efficacy, safety, suitability, and cost.^[1,2] Developing competency in P-drug selection enables students to make evidence-based and patient-centered prescribing decisions in clinical practice. However, many undergraduate medical students face difficulty applying pharmacological knowledge to

real clinical situations because conventional pharmacology teaching mainly emphasises factual learning and memorisation rather than practical problem-solving skills.^[3,4]

Traditional lecture-based teaching remains one of the most commonly used methods in medical education. Although lectures are useful for delivering theoretical concepts to large groups, they often promote passive learning with limited interaction and clinical application. As a result, students may show poor retention of knowledge, low confidence in prescribing, and difficulty integrating pharmacological concepts into clinical decision-making.^[5,6] Recent advances in medical education

therefore emphasize student-centered teaching methods that encourage active participation, self-directed learning, critical thinking, and teamwork.^[1,7] Problem-based learning (PBL) is an interactive educational approach in which students learn through discussion and analysis of clinical case scenarios. In this method, students work collaboratively in small groups to identify learning objectives, solve clinical problems, and apply theoretical knowledge to patient care situations. Several studies have demonstrated that PBL improves academic performance, communication skills, motivation, and prescribing competency among medical students.^[1,4,7] Yang et al. reported that PBL significantly improved examination performance and students' learning interest compared to lecture-based learning.^[1] PBL has been shown to improve pharmacology knowledge, therapeutic decision-making skills, communication abilities, and student motivation when compared to traditional lecture-based teaching methods.^[4] Furthermore, studies have suggested that PBL may improve attitudes toward rational prescribing and enhance long-term retention of prescribing-related skills.^[8,9]

Despite these advantages, the implementation of PBL in pharmacology education remains limited in many medical institutions, and evidence regarding its effectiveness in improving competency in P-drug selection is still evolving.^[3,10] Therefore, the present study was conducted to determine whether problem-based learning improves competency in P-drug selection compared to traditional lecture-based teaching among medical students. The study also aimed to compare pre- and post-intervention competency scores, evaluate students' attitudes toward rational prescribing and confidence in drug selection using a Likert scale, and assess long-term retention of P-drug skills through follow-up prescribing simulations.

MATERIALS AND METHODS

In this randomized controlled interventional study conducted in the Department of Pharmacology at Sree Mookambika Institute of Medical Sciences over a period of 12 weeks (April 2025 to June 2025), 100 second-year MBBS students were randomized equally into two groups (n = 50 each). Eligible participants were recruited using convenience sampling during pharmacology practical sessions. Written informed consent and baseline demographic details were obtained from all students. Ethical clearance was obtained from the Institutional Ethics Committee prior to the study. Confidentiality of participants' data was maintained throughout the study.

Inclusion and Exclusion Criteria

Second-year MBBS students who were willing to participate and provided informed consent were included in the study. Students who were absent during the intervention sessions or assessment

periods and those unwilling to participate were excluded from the study.

Methods: All eligible participants underwent a baseline assessment consisting of a 20-item multiple-choice questionnaire (MCQ) and five Objective Structured Clinical Examination (OSCE) stations related to P-drug selection. The assessment evaluated students' ability to identify diagnoses, define therapeutic objectives, select appropriate drug groups, and choose specific P-drugs according to the WHO P-drug selection approach. The total score was calculated out of 100. The MCQ and OSCE assessments were developed and reviewed by faculty members in the Department of Pharmacology to ensure content validity.

Participants were then randomly allocated in a 1:1 ratio into two groups using computer-generated random numbers stratified by gender. The intervention group consisted of students exposed to PBL, while the control group received traditional lecture-based teaching.

The intervention was conducted over four weeks. The PBL group attended eight 90-minute sessions conducted twice weekly, during which students worked in small groups to solve clinical case scenarios related to common conditions such as hypertension, asthma, and infections using the P-drug selection approach. The control group attended eight conventional teaching sessions conducted twice weekly, each consisting of a 60-minute lecture followed by a 30-minute MCQ practice session covering the same topics.

At the end of the intervention period, all participants underwent a post-intervention assessment using the same MCQ and OSCE-based competency test. The assessments were conducted by a blinded evaluator. Students' confidence, understanding, interest, and satisfaction regarding rational prescribing and drug selection were additionally assessed using a Likert scale questionnaire.

A follow-up assessment was conducted during the twelfth week to evaluate long-term retention of P-drug selection skills. This included a repeat competency test and prescription writing simulation exercises.

Statistical Analysis: Continuous variables were expressed as mean \pm SD and categorical variables as frequencies and percentages. Between-group comparisons were performed using the unpaired Student's t-test for continuous variables and Chi-square test for categorical variables. Mean competency score improvements and effect size (Cohen's d) were also calculated. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline characteristics and pre-test scores were comparable between the PBL and control groups, with no significant differences observed ($p>0.05$) [Table 1].

Table 1: Baseline Characteristics and Pre-intervention Competency Scores of Participants

Variable	PBL Group	Control Group	p value
Age (years)	20.8 ± 1.1	21.0 ± 1.2	0.421
Male	28 (56%)	27 (54%)	0.842
Female	22 (44%)	23 (46%)	
Previous pharmacology score (%)	64.5 ± 8.2	63.9 ± 7.9	0.732
MCQ pre-test score	48.6 ± 9.5	47.9 ± 8.8	0.731
OSCE pre-test score	46.2 ± 10.2	45.8 ± 9.7	0.842
Total pre-test score	47.4 ± 8.9	46.8 ± 8.5	0.764

The PBL group showed significantly higher post-test MCQ (74.8 ± 8.1 vs 69.2 ± 8.4), OSCE (76.9 ± 7.6 vs 70.8 ± 7.9), and total scores (75.9 ± 7.5 vs 70.0 ± 7.8)

compared to the control group (p<0.05). Improvement and follow-up scores were also significantly better in the PBL group [Table 2].

Table 2: Comparison of Post-intervention Improvement and Follow-up Competency Scores

Parameter	PBL Group	Control Group	p value
Post-test MCQ score	74.8 ± 8.1	69.2 ± 8.4	0.018
Post-test OSCE score	76.9 ± 7.6	70.8 ± 7.9	0.015
Post-test total score	75.9 ± 7.5	70.0 ± 7.8	0.016
Mean improvement score	+28.5 ± 7.1	+23.2 ± 6.7	0.021
Follow-up MCQ score	70.8 ± 8.5	65.2 ± 9.3	0.027
Follow-up OSCE score	72.9 ± 8.0	67.1 ± 8.7	0.024
Follow-up total score	71.8 ± 7.9	66.2 ± 8.6	0.025

Students in the PBL group reported higher confidence, understanding, interest, and satisfaction scores compared to the control group, with

statistically significant differences (p<0.05) [Table 3].

Table 3: Students' Perceptions Regarding Rational Prescribing and Drug Selection

Domain	PBL Group	Control Group	p value
Confidence	4.2 ± 0.6	3.8 ± 0.6	0.024
Understanding	4.3 ± 0.5	3.9 ± 0.5	0.022
Interest	4.1 ± 0.6	3.7 ± 0.7	0.03
Satisfaction	4.3 ± 0.5	3.8 ± 0.6	0.019

The PBL group demonstrated better performance in prescription simulation outcomes, including correct drug selection (80% vs 68%) and rational prescribing

(78% vs 66%). However, these differences were not statistically significant (p>0.05) [Table 4].

Table 4: Follow-up Prescription Simulation Performance

Outcome	PBL Group	Control Group	p value
Correct drug selection	40 (80%)	34 (68%)	0.072
Correct dose & duration	38 (76%)	32 (64%)	0.081
Rational prescription	39 (78%)	33 (66%)	0.068

DISCUSSION

Problem-based learning is increasingly used in pharmacology education to enhance rational prescribing skills and clinical decision-making among medical students. The present study aimed to compare the effectiveness of PBL and traditional lecture-based teaching on P-drug selection competency, student perceptions, and retention of prescribing skills. The findings showed better post-intervention and follow-up competency scores, along with improved confidence, understanding, interest, and satisfaction among students exposed to PBL compared to conventional teaching methods.

In our study, both the PBL and control groups were comparable with respect to demographic characteristics and pre-intervention competency scores. Similarly, a study by Zhan et al. reported no significant difference between the two groups in age (p=0.462) and gender (p=0.442) at baseline,

establishing comparable groups prior to intervention.^[11] Similarly, Setu et al. reported comparable pre-intervention group characteristics before implementation of the PBL module, indicating homogeneity between study groups prior to intervention.^[7] These findings indicate that comparable baseline characteristics between groups are a consistent feature of well-designed PBL intervention studies and support the validity of attributing outcome differences to the teaching method rather than pre-existing variation between groups.

In the present study, students exposed to problem-based learning showed better post-intervention performance and improved retention of P-drug selection skills compared to those receiving traditional lecture-based teaching. Similarly, Brinkman et al. reported that students in the PBL programme had significantly higher overall knowledge scores (76% vs 67%, p=0.002) and made

significantly fewer inappropriate therapy choices ($p=0.023$), though the difference in erroneous prescriptions did not reach statistical significance ($p=0.27$).^[4] Similarly, Yang et al. reported that the standardized mean difference in examination scores between PBL and lecture-based learning groups was 2.03 (95% CI: 1.53–2.53), indicating a significantly superior academic performance in PBL students, alongside better self-rated scores for learning interest, comprehension, and thinking ability.^[1] These findings suggest that PBL may improve both immediate and long-term retention of P-drug selection competency in medical students compared to traditional lecture-based teaching.

Our findings revealed that students in the PBL group showed more positive perceptions toward rational prescribing and drug selection. The interactive and student-centered nature of PBL may have contributed to greater confidence, interest, understanding, and overall satisfaction among learners. Similarly, Yang et al. reported that the risk ratio for student satisfaction in improving learning interest was 2.08 (95% CI: 1.17–3.71), comprehension of knowledge was 1.84 (95% CI: 1.26–2.67), and thinking ability was 1.42 (95% CI: 1.19–1.69) in favor of PBL over lecture-based learning. Demonstrating that PBL consistently produces more positive student perceptions across multiple learning domains.^[1] Further, Chen et al. reported that students rated the value of PBL for their current or future practices at 3.82 ± 0.12 and for collaborative problem-solving at 3.93 ± 0.17 on a five-point Likert scale.^[12] Adhikari Yadav et al. reported that the Likert-scale-based perception questionnaire showed internal consistency (Cronbach's alpha 0.893), and that 53.27% of students preferred PBL for pharmacology-related concepts compared to 44.86% who preferred conventional lectures. Understanding and knowledge retention assessed by MCQ scores was comparable between both teaching methods (median score 17 for PBL vs 16 for lectures; $p=0.48$).^[13] These findings suggest that interactive and student-centered nature of PBL boosts greater confidence, understanding, interest, and satisfaction among learners, reinforcing its role as an effective pedagogical approach for rational prescribing education.

In this study, students trained through PBL performed better in prescription simulation exercises compared to the control group. Although the differences were not statistically significant. The overall trend suggests that PBL may support the practical application of prescribing skills in simulated clinical settings. Similarly, Brinkman et al. reported that while PBL students made significantly fewer inappropriate therapy choices ($p=0.023$). The difference in erroneous prescriptions between the two groups did not achieve statistical significance ($p=0.27$).^[4] Further, Avraam et al. reported that surface learning was negatively associated with satisfaction toward PBL-generated pharmacology learning objectives and prescribing confidence. Strategic learners showed greater preference for

lectures over PBL and lower satisfaction with pharmacology integration in PBL sessions, suggesting that the benefits of PBL may vary among different learner types.^[14] Furthermore, Trullàs et al. reported that evidence regarding the effectiveness of PBL in medical education remains heterogeneous, particularly due to the predominance of small single-center studies with variable methodological quality.^[15] These findings suggest that while PBL showed a positive trend toward improved practical prescribing simulation performance, larger study samples and extended follow-up periods may be required to confirm statistically significant differences in real-world clinical prescribing skills. Overall, problem-based learning demonstrated superior effectiveness compared to traditional teaching in improving P-drug selection competency, retention of prescribing skills, and student perceptions toward rational prescribing. Although prescription simulation outcomes were not statistically significant, the observed positive trends suggest that PBL may enhance practical prescribing abilities among undergraduate medical students.

Limitations: This study was conducted in a single institution with small sample size, which may limit the generalizability of findings. The follow-up period was limited to 12 weeks, and long-term clinical prescribing performance was not assessed. In addition, students' perceptions were self-reported and may have been affected by response bias.

CONCLUSION

Problem-based learning was more effective than traditional lecture-based teaching in improving P-drug selection competency, retention of prescribing skills, and students' perceptions toward rational prescribing. Students exposed to PBL showed better academic performance, confidence, and satisfaction. Although prescription simulation outcomes were not significant, the positive trends observed suggest that PBL may help strengthen practical prescribing skills among undergraduate medical students.

REFERENCES

1. Yang X, Yang Z, Ma S, Yan M, Yang Y. Evaluation of problem-based learning for pharmacology based on a comprehensive analysis in undergraduate students. *Medicine (Baltimore)* 2024;103:e39376. <https://doi.org/10.1097/MD.00000000000039376>.
2. Nicolaou SA, Televantou I, Papageorgiou A, Albert AP, Hitchings AW, McCrorie P, et al. Factors affecting pharmacology learning in integrated PBL in diverse medical students: a mixed methods study. *BMC Med Educ* 2024;24:324. <https://doi.org/10.1186/s12909-024-05289-2>.
3. Shi W, Qin H, Vaughan B, Ng L. Educational interventions for medical students to improve pharmacological knowledge and prescribing skills: A scoping review. *Perspect Med Educ* 2023;12:348–60. <https://doi.org/10.5334/pme.1006>.
4. Brinkman DJ, Monteiro T, Monteiro EC, Richir MC, van Agtmael MA, Tichelaar J. Switching from a traditional undergraduate programme in (clinical) pharmacology and therapeutics to a problem-based learning programme. *Eur J*

- Clin Pharmacol 2021;77:421–9. <https://doi.org/10.1007/s00228-020-03027-3>.
5. Gülmez SE, Özcan G, Orer HS. The integration of the British Pharmacological Society's prescription safety assessment into the WHO 6-step model of rational pharmacotherapy in a Turkish medical school. *Br J Clin Pharmacol* 2025. <https://doi.org/10.1002/bcp.70146>.
 6. Bull S, Sims L. Improving prescribing learning in problem-based learning. *Clin Teach* 2024;21:e13827. <https://doi.org/10.1111/tct.13827>.
 7. Setu MS, Shajjad Hossain M, Ferdous Z, Al Amin MMH, Gupta A, Hossain ME. Evaluating the effectiveness of problem-based learning in promoting rational prescribing among undergraduate medical students. *Int J Res Med Sci* 2025;13:5160–4. <https://doi.org/10.18203/2320-6012.ijrms20253936>.
 8. Omar SH, Barwick A. International benchmarking of pharmacology curricula and prescribing related learning outcomes, implications for Australian health professional education: A systematic review and meta-analysis. *Pharmacy (Basel)* 2026;14. <https://doi.org/10.3390/pharmacy14010027>.
 9. Crowley FC, Restini C, Burke K, Rieder MJ. Exploring the landscape of pharmacology education in Health Professions Programs: From historical perspectives to current approaches to teaching. *Eur J Pharmacol* 2025;994:177386. <https://doi.org/10.1016/j.ejphar.2025.177386>.
 10. Tekeş E, Güngör B, Silan C, Toraman Ç. Enhancing pharmacology education through role-play: impact on student attitudes. *BMC Med Educ* 2025;25:1306. <https://doi.org/10.1186/s12909-025-07900-6>.
 11. Zhan H-Q, Zhang X-X, Qin R, Fei J, Dong G-Y, Hao J-H. Application of integrated problem-based learning combined with lecture-based classroom teaching in undergraduate medical education: An effective teaching model in a Medical School in China. *Medicine (Baltimore)* 2023;102:e34792. <https://doi.org/10.1097/MD.00000000000034792>.
 12. Chen T, Zhao Y-J, Huang F-Q, Liu Q, Li Y, Alolga RN, et al. The effect of problem-based learning on improving problem-solving, self-directed learning, and critical thinking ability for the pharmacy students: A randomized controlled trial and meta-analysis. *PLoS One* 2024;19:e0314017. <https://doi.org/10.1371/journal.pone.0314017>.
 13. Adhikari Yadav S, Poudel S, Pandey O, Jaiswal DP, Malla BP, Thakur BK, et al. Performance and preference of problem-based learning (PBL) and lecture-based classes among medical students of Nepal. *F1000Res* 2022;11:183. <https://doi.org/10.12688/f1000research.107103.3>.
 14. Avraam D, Televantou I, Albert AP, Hitchings AW, Nicolaou SA, Papageorgiou A, et al. Exploring the relationship between learning approaches and problem-based learning: insights from a longitudinal study in medical students. *BMC Med Educ* 2025;25:619. <https://doi.org/10.1186/s12909-025-07171-1>.
 15. Trullàs JC, Blay C, Sarri E, Pujol R. Effectiveness of problem-based learning methodology in undergraduate medical education: a scoping review. *BMC Med Educ* 2022;22:104. <https://doi.org/10.1186/s12909-022-03154-8>.