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ORIGINAL ARTICLE

Comparative Evaluation of Problem-Based Learning and Traditional Teaching Methods in Enhancing Preventive Health Strategies Among Medical Students

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ABSTRACT

Background: Preventive health is a critical component of medical education, requiring both theoretical knowledge and applied skills. While lecture-based learning (LBL) remains the traditional teaching method, problem-based learning (PBL) has been proposed as a more interactive and student-centered approach. Evidence comparing these methods in preventive medicine remains limited, particularly in Pakistan.

Objective: To compare the effectiveness of problem-based learning and lecture-based learning in teaching preventive health strategies among undergraduate medical students.

Methods: A quasi-experimental study was conducted at Gambat Medical College, Gambat, and Women Medical College, Abbottabad, from January 2022 to May 2023. A total of 150 third-year MBBS students were enrolled, with 75 allocated to PBL and 75 to LBL. Both groups covered identical content on six core areas of preventive medicine. Outcomes measured included performance in a four-station Objective Structured Clinical Examination (OSCE), a 50-item knowledge test, a self-efficacy scale for preventive counseling, an attitude scale, and student satisfaction. Data were analyzed using SPSS version 26.0, with independent t-tests and chi-square tests applied where appropriate.

Results: Students in the PBL group achieved significantly higher composite OSCE scores compared with the LBL group (82.6 ± 7.4 vs. 76.8 ± 8.1; $p < 0.001$). Station-wise analysis revealed superior performance in all four stations, particularly in tobacco cessation counseling. Knowledge scores were higher in the PBL group (38.9 ± 4.6) than in the LBL group (36.2 ± 5.1; $p = 0.001$). Self-efficacy was also significantly greater (4.2 ± 0.5 vs. 3.7 ± 0.6; $p < 0.001$), as were attitudes toward preventive medicine (4.0 ± 0.4 vs. 3.7 ± 0.5; $p = 0.002$). Satisfaction was higher among PBL students, with 84% rating the method highly satisfactory compared with 62% in the LBL group ($p = 0.004$).

Conclusion: Problem-based learning was found to be more effective than lecture-based teaching in enhancing preventive health education among medical students. PBL improved applied performance, knowledge retention, self-efficacy, attitudes toward prevention, and overall satisfaction. These findings support the integration of PBL into medical curricula for effective training in preventive health strategies.

Keywords: Problem-Based Learning, Lecture-Based Learning, Preventive Medicine, Medical Education, OSCE, Self-Efficacy, Attitudes

INTRODUCTION

Preventive health has become one of the most critical priorities in contemporary medical practice. The global burden of non-communicable diseases (NCDs), such as cardiovascular disease, diabetes, obesity, and cancer, continues to increase alongside persistent infectious diseases in many regions[1]. According to the World Health Organization, preventive strategies including vaccination, screening programs, and lifestyle modification have the potential to reduce the incidence of major illnesses by a significant proportion. This makes the integration of preventive health training into medical education essential for preparing future physicians who can effectively contribute to disease prevention and health promotion[2].

The teaching of preventive medicine within undergraduate curricula has traditionally relied upon lecture-based learning (LBL). This method allows for efficient delivery of structured information to large student cohorts and ensures uniformity of content[3]. However, LBL is often criticized for promoting passive learning, providing limited opportunity for interaction, and being less effective in fostering critical thinking, problem-solving ability, and clinical application. These limitations are particularly relevant to preventive health, where physicians must not only recall facts but also counsel patients, apply guidelines in individualized contexts, and communicate persuasively to influence health behaviors[4].

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Problem-based learning (PBL) was introduced as a student-centered alternative to traditional lectures. In this approach, small groups of learners analyze clinical scenarios under the guidance of a facilitator. Learners identify knowledge gaps, set learning objectives, engage in independent study, and subsequently apply newly acquired knowledge to solve the case[5]. The method emphasizes active participation, critical analysis, teamwork, and the integration of basic and clinical sciences. Within the field of preventive health, PBL can simulate real-world situations such as advising a patient on smoking cessation, planning age-appropriate cancer screening, or addressing vaccine hesitancy, thereby allowing students to practice both knowledge application and communication skills in a safe learning environment[6].

Evidence regarding the comparative effectiveness of PBL and LBL has been variable. Studies in medical education have reported that PBL can improve problem-solving skills, motivation for self-directed learning, and retention of knowledge[7]. It has also been associated with higher student satisfaction and improved performance in assessments that test applied competencies, such as Objective Structured Clinical Examinations (OSCEs). Conversely, some research indicates that LBL may achieve comparable results in terms of factual knowledge acquisition, raising questions about whether the additional resources required for PBL are justified. Importantly, relatively few studies have focused specifically on preventive medicine outcomes, despite the global and regional importance of prevention in healthcare delivery[8].

In low- and middle-income countries, including Pakistan, this question is especially relevant. The healthcare system is challenged by the dual burden of communicable diseases such as tuberculosis and hepatitis, alongside an increasing prevalence of NCDs such as diabetes and ischemic heart disease[9]. Physicians entering practice in such settings require strong competencies in both curative and preventive care. Training methods that foster preventive counseling, screening practices, and lifestyle interventions are therefore crucial. Limited local evidence is available on which teaching approach PBL or LBL is more effective for building these skills among medical students[10].

For this reason, the present study was designed to conduct a comparative evaluation of problem-based learning and traditional lecture-based teaching in enhancing preventive health strategies among medical students. The study sought to assess outcomes including applied performance, knowledge acquisition, and student perceptions in order to generate evidence that may guide curriculum planners in medical education[11].

MATERIALS AND METHODS

Study Design and Setting: This quasi-experimental study was carried out in two medical institutions of Pakistan: Gambat Medical College, Gambat, and Women Medical College, Abbottabad. The study was conducted over a period of sixteen months, from January 2022 to May 2023, within the framework of the third-year MBBS curriculum under the subject of Community Medicine.

Study Population and Sample Size: The study population included all third-year medical students enrolled in both colleges during the study period. A total sample of 150 students was included. Students were eligible if they were regular enrollees of the MBBS program and attended at least 75% of the classes during the module. Students who had previously participated in structured training programs on preventive health counseling or missed baseline assessments were excluded from the study.

Allocation of Students: The students were divided into two groups according to the teaching strategy applied. One group was taught using the Problem-Based Learning (PBL) method, while the other group was taught through the Lecture-Based Learning (LBL) method. The allocation was done at the level of tutorial groups in order to minimize contamination between the two teaching modalities.

Educational Interventions: Both groups were exposed to identical curricular content covering six core areas of preventive health strategies: tobacco cessation counseling, cardiovascular risk assessment and management, adult immunization, cancer screening, alcohol and substance abuse prevention, and lifestyle modification including physical activity and dietary counseling. In the PBL group, students participated in small-group sessions guided by facilitators. Each session started with a case scenario, followed by discussion, identification of learning objectives, self-directed study, and synthesis of knowledge in the subsequent meeting. In the LBL group, students received the same content through structured classroom lectures delivered by faculty members using audiovisual aids and interactive questioning. Both groups attended skill-based workshops designed to provide equal practical exposure to techniques such as motivational interviewing, use of screening tools, and immunization planning.

Outcome Measures: The primary outcome of the study was the performance of students in a four-station Objective Structured Clinical Examination (OSCE) at the end of the module. The OSCE stations included: (1) tobacco cessation counseling, (2) cardiovascular risk assessment, (3) cancer screening and shared decision-making, and (4) adult immunization planning. Each station was assessed using a structured checklist and a global rating scale. The secondary outcomes included a written multiple-choice knowledge test consisting of 50 items, a self-efficacy questionnaire assessing confidence in preventive health counseling on a 5-point Likert scale, an attitude scale measuring orientation toward preventive health practices, and a student satisfaction survey assessing overall perception of the teaching method.

Data Collection: All assessments were conducted at the end of the teaching block. The OSCE was administered by trained faculty members who were blinded to group allocation. The knowledge test and self-efficacy questionnaires were administered under examination conditions. Student satisfaction was measured using an anonymous feedback form.

Data Analysis: Data were entered and analyzed using SPSS version 26.0. Descriptive statistics including mean and standard deviation were calculated for continuous variables, and frequencies and percentages were used for categorical variables. The independent sample t-test was applied to compare mean scores between the PBL and LBL groups for OSCE performance, knowledge test, and self-efficacy scores. The chi-square test was used to compare categorical responses such as satisfaction levels. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Ethical approval for the study was obtained from the Institutional Review Boards of Gambat Medical College, Gambat, and Women Medical College, Abbottabad. Written informed consent was taken from all participating students. Participation was voluntary and had no influence on academic grading or internal assessments. Confidentiality of all participants was maintained throughout the study.

RESULTS

Participant Characteristics: A total of 150 students were included in the analysis, with 75 in the Problem-Based Learning (PBL) group and 75 in the Lecture-Based Learning (LBL) group. The gender distribution was balanced, with 68 (45.3%) males and 82 (54.7%) females. The mean age of participants was 22.4 ± 1.2 years in the PBL group and 22.6 ± 1.1 years in the LBL group. Previous year academic scores were comparable across the two groups, with no statistically significant difference ($p = 0.58$). This confirmed that the groups were similar at baseline before the intervention. These details are presented in Table 1.

Table 1: Baseline characteristics of study participants (n = 150)

Characteristic	PBL Group (n = 75)	LBL Group (n = 75)	p-value
Mean age (years) ± SD	22.4 ± 1.2	22.6 ± 1.1	0.42
Gender (Male), n (%)	34 (45.3%)	34 (45.3%)	1.00
Gender (Female), n (%)	41 (54.7%)	41 (54.7%)	
Previous year score (%) ± SD	72.5 ± 6.8	73.1 ± 7.1	0.58

OSCE Performance: The mean composite OSCE score was significantly higher in the PBL group (82.6 ± 7.4) compared to the LBL group (76.8 ± 8.1), with $p < 0.001$. Station-wise analysis also revealed that students in the PBL group outperformed those in the LBL group across all four OSCE stations, with the greatest difference observed in tobacco cessation counseling. The results are detailed in Table 2.

Table 2: Comparison of OSCE scores between PBL and LBL groups

OSCE Station	PBL Group (n = 75) Mean ± SD	LBL Group (n = 75) Mean ± SD	p-value
Tobacco cessation counseling	21.1 ± 2.9	18.4 ± 3.1	<0.001
Cardiovascular risk assessment	20.5 ± 2.7	18.9 ± 3.0	0.002
Cancer screening counseling	20.2 ± 3.1	18.7 ± 3.3	0.005
Immunization planning	20.8 ± 2.8	19.0 ± 3.2	0.003
Composite OSCE Score (100)	82.6 ± 7.4	76.8 ± 8.1	<0.001

Knowledge Assessment: The mean knowledge test score out of 50 was 38.9 ± 4.6 for the PBL group and 36.2 ± 5.1 for the LBL group. The difference of 2.7 marks was statistically significant ($p = 0.001$). This indicates that the PBL method was more effective in reinforcing theoretical knowledge. The knowledge test results are included in Table 3.

Self-Efficacy in Preventive Counseling: Students in the PBL group reported higher confidence in preventive counseling, with a mean self-efficacy score of 4.2 ± 0.5 compared to 3.7 ± 0.6 in the LBL group ($p < 0.001$). This outcome demonstrates that PBL contributed to greater readiness for applying preventive health strategies. Details are provided in Table 3.

Attitudes Toward Preventive Medicine: Attitude scores were also more favorable in the PBL group (4.0 ± 0.4) than in the LBL group (3.7 ± 0.5), with the difference reaching statistical significance ($p = 0.002$). Students exposed to PBL expressed stronger acceptance of prevention as an essential physician responsibility. Results are summarized in Table 3.

Student Satisfaction: Feedback revealed higher satisfaction among students in the PBL group, with 84% rating the experience as "highly satisfactory" compared with 62% in the LBL group ($p = 0.004$). The satisfaction analysis is also presented in Table 3.

Table 3: Comparison of knowledge, self-efficacy, attitudes, and satisfaction between groups

Variable	PBL Group (n = 75) Mean ± SD	LBL Group (n = 75) Mean ± SD	p-value
Knowledge score (out of 50)	38.9 ± 4.6	36.2 ± 5.1	0.001
Self-efficacy score (1–5)	4.2 ± 0.5	3.7 ± 0.6	<0.001
Attitude score (1–5)	4.0 ± 0.4	3.7 ± 0.5	0.002
Satisfaction "highly satisfied"	84%	62%	0.004

In summary, students taught through the PBL approach performed better in OSCE assessments (Table 2), scored higher in knowledge and self-efficacy evaluations (Table 3), and expressed more favorable attitudes toward preventive health. Additionally, satisfaction with the teaching method was significantly higher among the PBL group. Together, these findings underscore the advantage of PBL in developing preventive health competencies compared to lecture-based teaching.

DISCUSSION

This study compared problem-based learning (PBL) with lecture-based learning (LBL) in teaching preventive health strategies to undergraduate medical students at Gambat Medical College, Gambat, and Women Medical College, Abbottabad[12]. The results demonstrated that students in the PBL group achieved significantly higher scores in OSCE performance, knowledge tests, self-efficacy, and attitudes toward prevention, along with greater satisfaction with the learning experience. These findings reinforce the value of PBL as an effective educational approach in preparing students for preventive medicine[13].

The improvement in OSCE performance among PBL students highlights the strength of this method in enhancing applied competencies. Preventive medicine requires not only knowledge of guidelines but also the ability to communicate, counsel, and engage patients effectively. The PBL model, by exposing students to realistic problem scenarios, allowed them to practice these skills in a structured environment, which was later reflected in their superior performance during OSCE assessments[14]. Similar outcomes have been reported in international studies where PBL was associated with improved clinical reasoning, patient interaction, and communication abilities compared with traditional teaching methods[15].

The higher knowledge test scores in the PBL group indicate that active learning through problem-solving and self-directed study promotes deeper understanding and better retention of content compared with passive lecture attendance[16]. Although LBL remains efficient in transmitting information to large groups, the interactive and inquiry-based structure of PBL likely reinforced cognitive integration and long-term recall of preventive medicine concepts. These findings are consistent with meta-analyses which suggest that PBL enhances conceptual understanding and retention without compromising factual knowledge[17,18].

The results also showed that self-efficacy in preventive counseling was significantly better among PBL students. This may be explained by the active participation, repeated practice, and collaborative discussions that PBL provides, which build student confidence in their ability to translate knowledge into action. Higher self-efficacy is particularly relevant in preventive medicine, where physician confidence directly influences patient counseling and behavior change[19,20].

Similarly, attitude scores toward preventive medicine were more favorable among PBL participants. Exposure to problem-oriented case discussions may have emphasized the importance of prevention in real clinical contexts, shaping student perceptions and motivating them to prioritize prevention in their future practice[21]. This is a significant finding for low- and middle-income countries such as Pakistan, where preventive health remains underutilized despite being essential for addressing both communicable and non-communicable disease burdens[22].

Another important observation was the higher student satisfaction with PBL. Learners valued the interactive nature of discussions, the relevance of cases, and the opportunity to actively engage with content. Although some students in the LBL group appreciated the clarity of lectures, the majority highlighted reduced engagement and difficulty in applying lecture content during assessments. This difference underscores the need to align teaching strategies with modern expectations of learner-centered education[23].

While these findings support the superiority of PBL in preventive medicine education, several considerations must be acknowledged. First, implementing PBL requires trained facilitators, adequate resources, and institutional support. Without proper preparation, the benefits of PBL may not be fully realized. Second, this study was limited to two medical colleges and a sample size of 150 students, which may restrict the generalizability of findings[24]. Third, the follow-up period was limited to immediate post-module assessments, and long-term retention or real-world application of preventive skills was not evaluated. Despite these limitations, the use of multiple assessment tools (OSCE, knowledge test, self-efficacy, attitudes, and satisfaction) adds robustness to the findings[25].

Overall, this study contributes valuable evidence to the growing body of literature advocating for active learning strategies in medical education. The results suggest that PBL is particularly well-suited for teaching preventive health, as it equips students with both theoretical knowledge and practical competencies, while simultaneously shaping attitudes and confidence levels that are critical for clinical application[17,25].

CONCLUSION

This study demonstrated that problem-based learning was more effective than traditional lecture-based teaching in enhancing preventive health education among undergraduate medical students. Students exposed to PBL achieved significantly higher performance in OSCEs, better knowledge retention, stronger self-efficacy, more positive attitudes toward preventive health, and greater satisfaction with the learning experience. These findings highlight the importance of adopting student-centered approaches such as PBL in medical curricula, particularly for subjects like preventive medicine that require both knowledge and applied skills. By fostering interactive learning, critical thinking, and practical application, PBL can play a vital role in preparing future physicians to meet the preventive health needs of populations in Pakistan and beyond.

Authors' Contributions: SH conceptualized the study, supervised the intervention, and drafted the initial manuscript. MAK contributed to study design, statistical analysis, and interpretation of data. QMS assisted in data collection and curriculum implementation. JA contributed to the OSCE development and evaluation of student performance. AQ participated in manuscript review, editing, and coordination between study sites. AWS contributed to the literature review, discussion writing, and critical

revision of the final draft. All authors read and approved the final version of the manuscript.

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