

*Original Article***Blended Learning in Undergraduate Respiratory Medicine: A Crossover Study**Rekha Bansal¹, Praveen Kumar Sharma²¹Professor, Pulmonary Medicine, SLBS Government Medical College, Mandi, India²Professor, Pharmacology, SLBS Government Medical College, Mandi, India**ABSTRACT**

Background: Competency-Based Medical Education promotes learner-centered strategies to enhance clinical reasoning and engagement. Problem-based self-directed learning is increasingly adopted in undergraduate teaching; however, its effectiveness compared with traditional lectures in respiratory medicine remains uncertain. This study compared learning outcomes of problem-based self-directed learning and didactic lectures and assessed student perceptions of these methods.

Methods: A quasi-experimental crossover study was conducted among 120 second-phase MBBS students in a tertiary care teaching institution. Students were divided into two groups and exposed to both teaching methods across six respiratory medicine competencies. Each group attended three sessions of each method in a crossover design. Knowledge was assessed using multiple-choice and short-answer questions. Student perceptions were collected through a structured feedback questionnaire. Data were analyzed using Student's t-test and analysis of variance.

Results: Attendance was comparable between the two methods. Overall assessment scores did not differ significantly between groups. However, significant differences were observed in two competencies ($p < 0.05$). Most students reported both methods as helpful for understanding patient management and expressed a preference for a blended approach incorporating lectures, case discussions, and interactive learning.

Conclusion: Problem-based self-directed learning demonstrated comparable effectiveness to didactic lectures in short-term knowledge acquisition in undergraduate respiratory medicine, with students showing a preference for combined teaching approaches.

Keywords: Blended learning, Competency Based Medical Education, Problem-based self-directed learning, Respiratory Medicine, Undergraduate Medical Education

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INTRODUCTION

Medical education is undergoing a paradigm shift from teacher-centred instruction to learner-centred approaches with the implementation of Competency-Based Medical Education (CBME).^[1] The National Medical Commission (NMC) curriculum emphasizes active learning strategies that encourage critical thinking, clinical reasoning, and self-directed learning among medical students.^[2]

Problem-Based Self-Directed Learning (PBSDL) is a student-centred pedagogical approach in which learners work collaboratively to solve open-ended clinical problems. In this method, the problem acts as a stimulus that drives students to identify knowledge gaps, explore relevant resources, and apply newly acquired knowledge to clinical scenarios. PBSDL promotes deeper learning, improves communication skills, and fosters problem-solving abilities.

Despite its theoretical advantages, the effectiveness of PBSDL compared with traditional didactic lectures remains debated^[3], particularly in specialty subjects such as Respiratory Medicine. Understanding student perceptions and learning outcomes associated with different teaching methods can help educators design more effective instructional strategies.

Therefore, the present study was conducted to evaluate the effectiveness of PBSDL in comparison with Didactic Lectures (DL) in teaching selected competencies in respiratory medicine to undergraduate medical students and to assess their perceptions regarding this teaching method.

METHODS

This quasi-experimental crossover study was conducted in the Department of Pulmonary Medicine at Shri Lal Bahadur Shastri Government Medical College and Hospital, Ner-Chowk, Himachal Pradesh, India. A total of 120 second-phase MBBS students participated in the study after providing informed consent. The students were divided into two groups of 60 each. Prior to the

intervention, a sensitization session was conducted to familiarize students with the objectives and format of PBSDL sessions.

Selection of Competencies: Six competencies from the CBME curriculum prescribed by the National Medical Commission were selected by departmental faculty experts (CT1.2, CT1.9, CT1.15, CT2.16, CT2.19, and CT2.20).^[2] These competencies included topics related to tuberculosis, airway diseases, and respiratory infections. Specific Learning Objectives (SLOs) were developed for each competency and shared with the students before the sessions.

Teaching Intervention: The two groups were initially assigned to either DL or PBSDL sessions. For subsequent competencies, the groups were reversed so that each group was exposed to both teaching methods. In total, each group attended three DL sessions and three PBSDL sessions.

Group allocation was non-randomized; however, the crossover design ensured that each group was exposed to both interventions, minimizing intergroup variability. A formal washout period was not implemented given the educational nature of the interventions.

Didactic lectures were delivered by faculty members using structured presentations aligned with the predefined learning objectives.

For PBSDL sessions, a clinical case scenario related to the competency was presented. Students were encouraged to work collaboratively in small groups to analyze the case and identify learning issues. They explored the etiological, pathophysiological, clinical, diagnostic, and management aspects of the condition using available learning resources. Faculty members acted as facilitators, guiding the discussion and ensuring that the learning objectives were addressed. At the end of each session, group representatives summarized their discussion,

followed by feedback from the facilitator.

Assessment and Feedback: Following each session, all students were assessed using a structured questionnaire comprising multiple-choice questions (MCQs) and short-answer questions (SAQs) related to the topic. In addition, student perceptions regarding the teaching methods were collected through an online feedback questionnaire.

Statistical Analysis: Descriptive statistics were used to summarize attendance, assessment scores, and feedback responses. Analysis was performed using session-wise mean scores, as student attendance varied across sessions. Mean scores between DL and PBSDL sessions were compared using ANOVA and Student’s t-test, with a p-value <0.05 considered statistically significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee (IEC No.: HFW(H)/SLBSGMC/IEC/2018-148; Protocol No.: 26/2023), dated 25.09.2023. Written informed consent was obtained from all participants.

RESULTS

Student Attendance: A total of 120 second-phase MBBS students provided consent to participate in the study. The mean attendance per session was comparable between didactic lecture sessions (37.33 ± 9.93 students) and problem-based self-directed learning sessions (37.5 ± 6.66 students), indicating similar participation across both teaching methods.

Students’ Interest in Teaching Sessions: Students’ perceptions regarding the level of interest in the sessions are presented in Figure 1. A higher proportion of students reported DL sessions as “very interesting” or “interesting” compared with PBSDL sessions. However, the majority of students in both groups reported that the sessions were interesting overall.

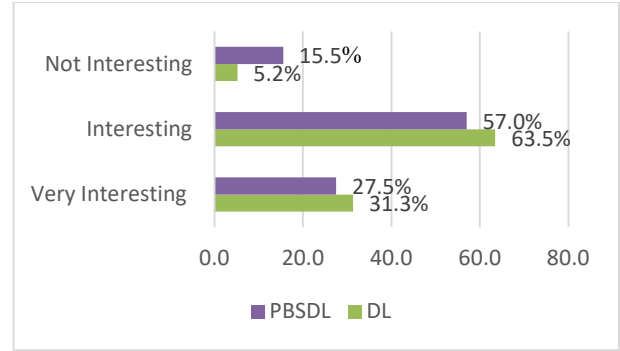


Figure 1: Do you find this session interesting?

Preferred Teaching Method: Students’ preferences regarding teaching methods are shown in Figure 2. Although some students indicated that DL sessions alone were sufficient, the majority of respondents expressed a preference for a combination of teaching-learning methods, incorporating both DL and PBSDL approaches.

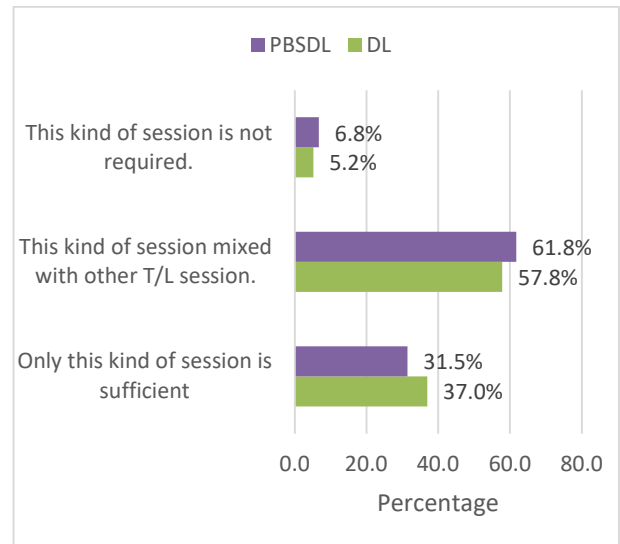


Figure 2: For this competency what would you prefer?

Components Appreciated by Students: The aspects of DL sessions that students appreciated the most are shown in Figure 3, where content (40%), followed by presentation (31%) and presenter (29%), were the most frequently cited components.

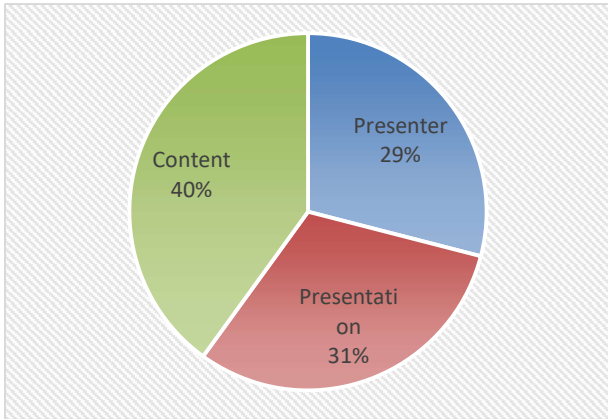


Figure 3: What did you like most about this session? (DL)

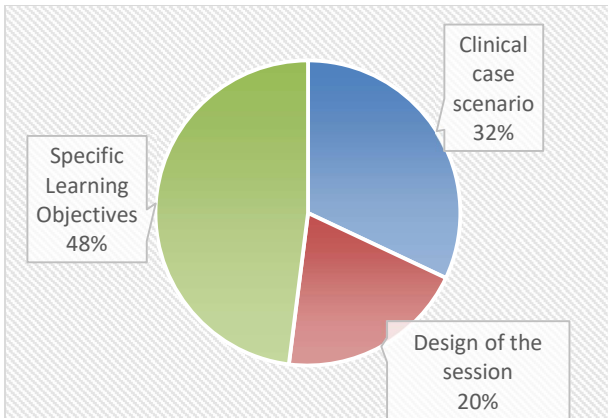


Figure 4: What did you like most about this session? (PBSDL)

In PBSDL sessions, students reported that specific learning objectives (48%) and clinical case scenarios (32%) were the most useful components, followed by session design (20%), as illustrated in Figure 4.

Preferred Types of Learning Activities: Students' preferences regarding different types of learning sessions are presented in Figure 5. A considerable proportion of students expressed preference for combined learning approaches, including image-based sessions, case discussions, and interaction with real or simulated patients.

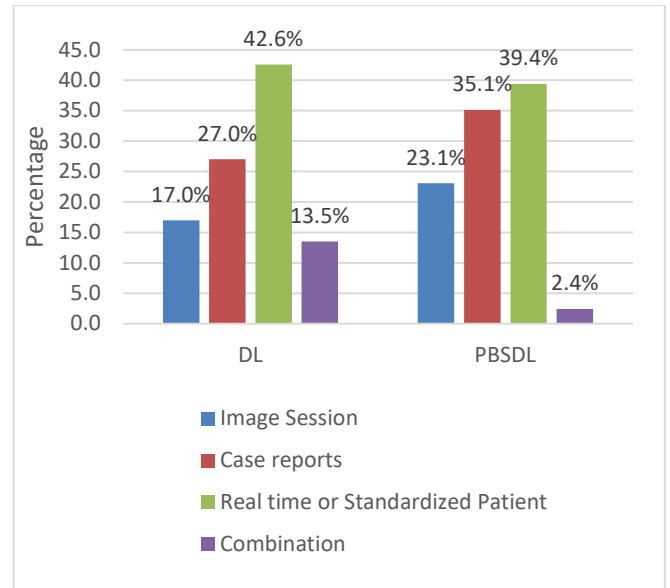


Figure 5: Which session would you prefer most?

Perceived Helpfulness in Patient Management: Students' perceptions regarding the usefulness of sessions in improving patient management are shown in Figure 6. Most students in both DL and PBSDL groups reported that the sessions were either very helpful or helpful in enhancing their understanding of patient management.

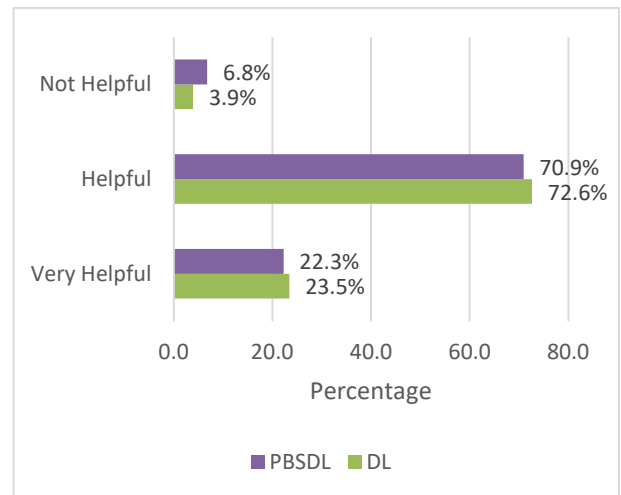


Figure 6: Do you think this session will help you in better management of patients?

Achievement of Learning Objectives: Students' perceptions regarding the achievement of competency objectives are presented in Figure 7. A majority of students reported that the sessions helped them achieve the learning objectives either completely or to some extent.

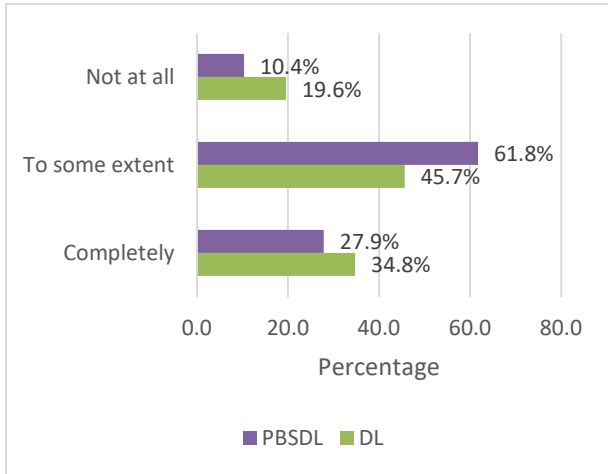


Figure 7: Do you think this session was helpful in achieving the objectives of the competency?

Assessment Scores: The comparison of mean assessment scores between DL and PBSDL sessions is presented in Figure 8. The average scores of students attending DL and PBSDL sessions were comparable, and no statistically significant difference was observed between the two teaching methods.

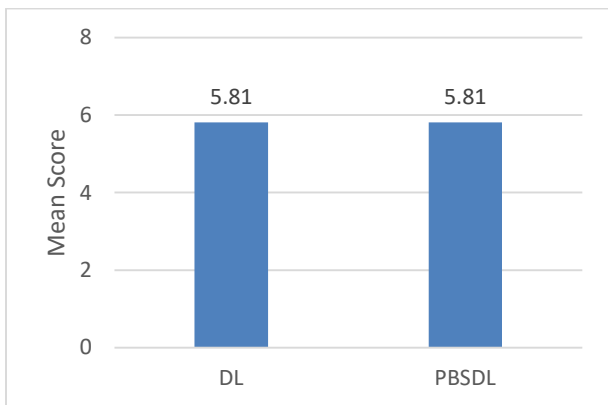


Figure 8: Average assessment score of students in DL & PBSDL sessions (N=6)

Session-wise Comparison of Scores: Session-wise comparison of assessment scores is shown in Figure 9. There was no significant difference in the average scores of students attended DL & PBSDL sessions (ANOVA F=2.16, p>0.05). A significant difference was observed in the DL & PBSDL scores of sessions 2 (CT1.9) and 5 (CT2.19) Student's t test p<0.05.

Student Feedback: Responses to the open-ended feedback question indicated that most students preferred a blended teaching approach, combining didactic lectures with case-based discussions, image-based learning, and opportunities for interaction with real or simulated patients and interaction with resource person wherever required.

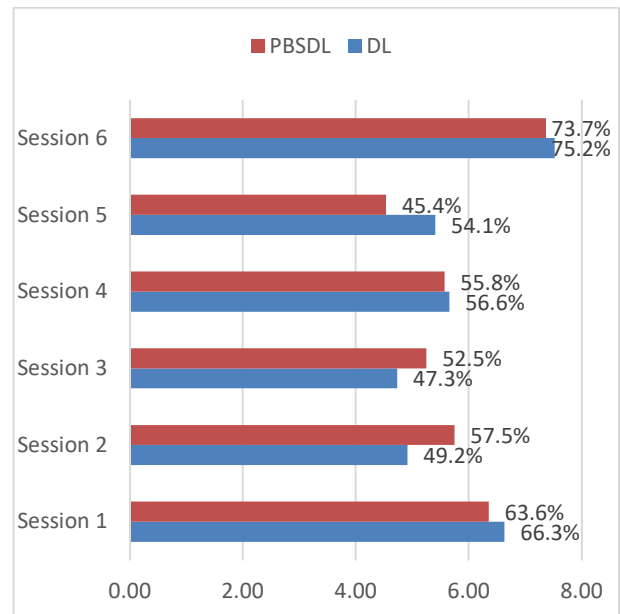


Figure 9: Average assessment scores of various sessions

DISCUSSION

The present study evaluated the effectiveness of problem-based self-directed learning (PBSDL) compared with traditional didactic lectures (DL) in teaching respiratory medicine competencies to undergraduate medical students. The findings demonstrated that

PBSDL sessions were comparable to didactic lectures in terms of short-term knowledge acquisition, as reflected by similar mean assessment scores between the two teaching methods. Statistical analysis also showed no significant difference in overall mean scores between the two groups ($F = 2.16$, $p > 0.05$). The absence of significant differences may reflect the limitation of written assessments in capturing higher-order cognitive skills such as clinical reasoning, which PBSDL is designed to enhance.

Similar findings have been reported in several previous studies comparing problem-based learning with conventional lecture-based teaching. Chilwant reported that structured interactive learning methods produced learning outcomes comparable to traditional lectures in undergraduate medical students [4]. Likewise, Padmanabha et al. observed that problem-based learning and lecture-based learning produced similar knowledge scores, although problem-based learning promoted greater student engagement and analytical thinking [5]. These findings are consistent with the results of the present study, where PBSDL sessions did not demonstrate significantly higher knowledge scores than DL sessions in the short term. Recent Indian studies have also reported similar observations. Dwidmuthe et al. highlighted that problem-based learning enhances student engagement and active participation, although certain challenges related to facilitation and implementation persist [6,7].

However, a session-wise comparison of scores showed statistically significant differences in competencies CT1.9 and CT2.19 ($p < 0.05$), suggesting that the effectiveness of a teaching method may vary depending on the nature of the competency being taught. Competencies requiring greater clinical reasoning or case interpretation may benefit more from interactive learning approaches

such as PBSDL. Notably, limited published data exist evaluating competency-specific outcomes of teaching methods in respiratory medicine, further underscoring the need for such focused studies.

Although PBSDL is designed to promote active learning, critical thinking, and problem-solving skills, students in the present study did not demonstrate significantly higher assessment scores compared with didactic lectures. One possible explanation is that the assessments used consisted primarily of multiple-choice and short-answer questions, which predominantly measure knowledge recall rather than higher-order cognitive abilities such as clinical reasoning and decision-making. Similar observations have been reported in medical education literature, where short-term written assessments may not adequately capture the benefits of problem-based learning [3].

An important finding of this study was the students' preference for a blended teaching approach. The majority of students indicated that a combination of PBSDL and didactic lectures would be the most effective learning strategy. Similar preferences have been reported in studies conducted in India. Kumar et al. demonstrated that the introduction of problem-based learning improved student engagement and integration of basic and clinical sciences, although students still preferred it to be combined with traditional lectures [8]. Likewise, Singh et al. reported that while problem-based learning enhanced conceptual understanding and student participation, most students favoured a hybrid approach incorporating both lectures and problem-based sessions [9].

Student feedback in the present study also highlighted that PBSDL sessions were particularly appreciated for their structured learning objectives (48%) and clinical case scenarios (32%), which helped students understand the relevance of theoretical knowledge in clinical practice. These findings align with the principles of competency-based medical education, which emphasize contextual and clinically integrated learning. The use of clinical scenarios can facilitate deeper understanding and improve the application of knowledge in patient care^[9].

Furthermore, most students reported that both DL and PBSDL sessions were helpful in improving their understanding of patient management, with more than 70% indicating that the sessions were helpful or very helpful. This suggests that both teaching methods contribute positively to student learning, although they may address different aspects of knowledge acquisition and clinical reasoning.

Overall, the findings of the present study suggest that PBSDL is comparable to traditional didactic lectures in terms of short-term learning outcomes, while also promoting active engagement and contextual understanding among students.

The present study has certain limitations. It was conducted in a single medical college, which may limit the generalizability of the findings to other institutions with different student populations and teaching environments. The sample size was restricted to a single batch of undergraduate students; inclusion of participants from multiple batches or institutions could have strengthened the evidence. The assessment of learning outcomes was based primarily on short-term written evaluations, including multiple-choice and short-answer questions, which predominantly assess knowledge recall and may not adequately capture higher-order

cognitive skills such as clinical reasoning and problem-solving, or long-term knowledge retention. Furthermore, the study evaluated only short-term outcomes and did not assess the long-term impact of PBSDL on clinical performance or competency development. In addition, a formal washout period was not feasible due to the educational nature of the interventions, and the possibility of carryover effects between sessions cannot be excluded.

CONCLUSION

The present study demonstrated that problem-based self-directed learning (PBSDL) is comparable to traditional didactic lectures in achieving short-term knowledge outcomes in undergraduate respiratory medicine teaching. Although no significant difference was observed in overall assessment scores between the two teaching methods, PBSDL sessions were perceived by students as clinically relevant and helpful in contextualizing theoretical knowledge through case-based learning.

Student feedback indicated a clear preference for a blended teaching approach, combining traditional lectures with interactive and problem-based learning strategies. Such an integrated approach may enhance student engagement, promote active learning, and facilitate the development of clinical reasoning skills.

These findings support the incorporation of PBSDL as a complementary teaching method within the competency-based medical education (CBME) framework, rather than as a replacement for traditional lectures. Future studies involving larger multi-institutional samples and evaluation of long-term learning

outcomes are recommended to further explore the impact of PBSDL on competency development in medical education.

DECLARATIONS

Conflict of interest: None declared.

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