

Students' Perception on Problem-based and Limerick-based Learning Methods: A Mixed-method Study

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ABSTRACT

Introduction: Medical education continuously explores innovative teaching methods to enhance student engagement, critical thinking, and knowledge retention. Problem-based Learning (PBL) and Limerick-based Learning (LBL) are two distinctive approaches aimed at fostering these skills. PBL emphasises real-world problem solving and critical thinking, while LBL uses creative mnemonic techniques to improve memory retention.

Aim: To assess medical students' perceptions of both PBL and LBL approaches after undergoing sessions of both methods.

Materials and Methods: The present mixed-method study was conducted at Mata Gujri Memorial Medical College, Kishanganj, Bihar, India, from June 2024 to September 2024. The study included 66 medical students who participated in three PBL and three LBL sessions. The students provided feedback on various aspects of the sessions using a Likert-scale questionnaire and in open-ended feedback. Since the data were non parametric, the Mann-Whitney U test was applied to compare the two samples. Alongside, a thematic analysis of

student feedback was performed to identify common themes and insights.

Results: There were 66 medical students: 39 males and 27 females, with a mean age of 21.75 ± 1.49 years. PBL was found to be more effective in improving critical thinking skills and applying theoretical knowledge to practical scenarios ($p < 0.0001$). Students found LBL to be more enjoyable and creative, fostering better memory retention of medical concepts ($p < 0.0001$). Both methods were perceived as equally beneficial in enhancing collaboration ($p = 0.09$), but LBL received higher satisfaction in terms of time and resource adequacy ($p < 0.0001$). Qualitative feedback highlighted PBL's strength in critical thinking, while LBL was appreciated for simplifying difficult concepts and making learning more enjoyable.

Conclusion: Both PBL and LBL provide valuable learning experiences. A blended approach that combines the strengths of both methods may optimise medical education by fostering deep, critical thinking and efficient recall of essential medical concepts. Further research is needed to explore how these methods can be integrated effectively into medical curricula.

Keywords: Critical thinking, Educational innovation, Knowledge retention, Learning strategies, Practical application, Skill development

INTRODUCTION

Traditional lecture-based methods often fail to engage students deeply or foster critical thinking. Therefore, medical education is increasingly shifting from traditional didactic methods to more student-centered, active-learning approaches that foster critical thinking, clinical reasoning, and long-term retention of knowledge [1]. Among such approaches, PBL has been widely adopted and recognised for promoting deeper understanding through collaborative case-solving. PBL is widely recognised for its effectiveness in promoting active learning and critical thinking by presenting students with real-world problems to solve collaboratively. PBL is an approach to active learning that is centered on the learner and engages students in the process of learning via the experience of solving meaningful issues. PBL is a method of instruction that differs from traditional lectures in that it involves students working together in small groups to achieve comprehension [2].

Similarly, LBL is an innovative educational approach that incorporates the use of limericks, a type of humorous, five- or six-line poem, to facilitate learning in medical education. Limericks offer a playful yet structured format to help students remember complex concepts, making them engaging and memorable learning tools. This approach aligns with educational theories that emphasise the role of creativity, humour, and mnemonic devices in enhancing retention and recall [3]. It offers an innovative and engaging method by using limericks to present new topics, simplify complex medical concepts, and encourage reflective thinking. Limericks and riddles

can break the monotony of conventional lectures, making learning more interactive and enjoyable. LBL provides an innovative method to support medical education by enhancing memory retention and fostering an engaging learning experience. The humour and rhythm align with mnemonic and adult-learning theories, making it a valuable supplementary tool in medical curricula. The rhythm and rhyme of limericks make difficult terminology and sequences easier to recall. For instance, a limerick summarising the clinical features of a disease can help students recall symptoms, risk factors, and treatment protocols [4].

While PBL encourages students to explore clinical problems through systematic inquiry and teamwork, LBL leverages the mnemonic and narrative value of poetry—specifically limericks—to present key concepts in a memorable and entertaining format. However, limited evidence exists comparing the effectiveness and student reception of these two instructional methodologies in medical education [2,4].

The current study makes a valuable contribution by directly comparing PBL and LBL within the same student cohort, thereby offering clearer evidence of the respective strengths and limitations of each educational approach. To authors' knowledge, this is among the first studies to systematically compare PBL and LBL through student feedback using both Likert-scale quantitative assessment and in-depth qualitative thematic analysis. Comparing these two teaching methods based on student feedback can provide valuable insights into their relative effectiveness in fostering engagement and enhancing critical thinking among students.

Hence, the present study was conducted to obtain perceptions of medical students on both PBL and LBL approaches after undergoing sessions of both learning methods.

The aim of the present study was to implement PBL and LBL as teaching methodologies for second professional Bachelor of Medicine, Bachelor of Surgery (MBBS) students to gather students' feedback on PBL and LBL as teaching methodologies. and to evaluate students' engagement and satisfaction with PBL and LBL methodologies.

MATERIALS AND METHODS

The present mixed-method study was conducted from June 2024 to September 2024 at Mata Gujri Memorial Medical College, Eastern India. Ethical clearance was obtained from the Institutional Ethics Committee (Approval No MGM/IEC/101-2024, dated 24 May 2024). All students were informed about the study purpose and methodology, and written informed consent was obtained.

Inclusion criteria: All second-year professional MBBS students who consented to attend sessions beyond routine class hours (Saturday 2:00-4:00 pm) were included.

Exclusion criteria: Second-year professional MBBS students who did not consent to attend sessions beyond routine class hours (Saturday 2:00-4:00 pm) and the students who were absent on the day of group allocation were excluded from the study.

Sample size calculation: Participation required attending four Saturday sessions (2:00-4:00 pm) beyond regular class hours. Of a total of 100 students, 66 consented to participate; of the remaining 34, 12 were absent, and 22 opted out due to reluctance to attend extra sessions. Anonymity and confidentiality were maintained throughout.

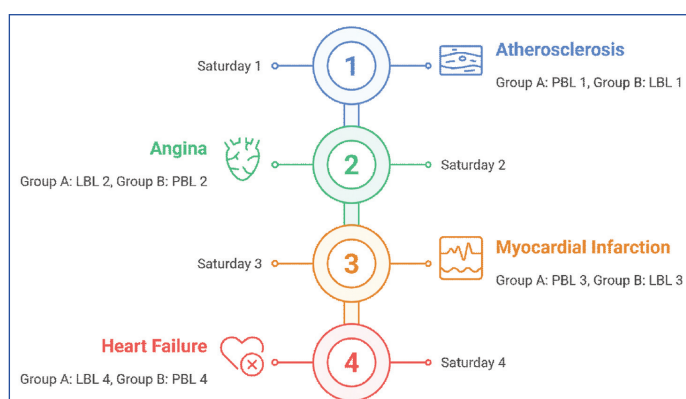
Group allocation and study design: The 66 consenting students were randomised into two equal groups (Group A and Group B) by drawing chits numbered 1-66; odd numbers were assigned to Group A and even numbers to Group B. Randomisation was conducted by a faculty member from the Department of Microbiology who was not associated with the study. The topic was ischaemic heart disease, divided into four subtopics. For each subtopic, one PBL case and one LBL activity were developed. Each group underwent four two-hour sessions on Saturdays, alternating between PBL and LBL formats.

Study Procedure

The study consisted of four sessions, each focusing on a sub-topic of ischaemic heart disease: atherosclerosis (Session 1), angina (session 2), myocardial infarction (session 3), and Heart Failure (session 4). The 66 participants were randomly divided into two equal groups (Group A and Group B, n=33 each). In session 1, Group A received PBL 1, while Group B underwent LBL 1, both addressing atherosclerosis. In session 2, the instructional methods were swapped, with Group A experiencing LBL 2 and Group B receiving PBL 2, focusing on angina. The crossover design continued with Group A receiving PBL 3 and LBL 4 in sessions 3 and 4, and Group B receiving LBL 3 and PBL 4, covering myocardial infarction and heart failure, respectively. This alternating method, shown in [Table/Fig-1], ensured each group experienced both pedagogical approaches across all four subtopics.

Implementation of PBL and LBL:

- Sessions were conducted in two separate demonstration rooms, followed by a joint plenary session. Each group was divided into four subgroups (three groups of eight and one group of nine students) with two facilitators per room.
- The PBL sessions involved clinical case scenarios requiring collaborative analysis and solution-building over 90 minutes,



[Table/Fig-1]: Conduct of sessions and distribution of groups.

followed by a 30-minute cross-group discussion. Facilitators guided the learning process without providing direct answers, promoting critical thinking and self-directed learning.

- The LBL sessions involved interpreting humorous limericks containing embedded medical concepts. Each group received one limerick to:
- Interpret (i.e., understand the medical meaning behind the rhymes)
- Identify the underlying medical principles
- Present their analysis and explanation to others

Facilitators provided feedback and reinforcement, clarified medical concepts embedded in the limerick, and encouraged discussion, which helped consolidate understanding. They also fostered engagement, creativity, and peer learning, making the session educational and enjoyable.

Feedback collection: Seven days after the final session, students submitted quantitative feedback using a pre-validated, structured questionnaire circulated via Google Forms. Students were requested to complete it within seven days at their convenience. The questionnaire was self-constructed by the investigators based on educational objectives and student-centered learning frameworks. No previously validated tool was available that specifically addressed both PBL and LBL methodologies in the context of undergraduate medical education. However, face validity and content validity of the instrument were established by the Institutional Research Committee in collaboration with the Medical Education Unit. Reliability analysis was performed to determine the internal consistency of the questionnaire. Internal consistency of the items was evaluated using Cronbach's alpha values. Items were considered to represent an acceptable level of internal consistency if Cronbach's alpha was between 0.5 and 0.7, and a good level if it was greater than 0.7.

Students provided feedback on 10 items for both processes using a Likert scale, scored as Strongly disagree (1), Disagree (2), Neutral (3), Agree (4), and Strongly agree (5). The same questions were used for PBL and LBL. Thus, for each item the score ranged from 1 to 5. The ten items are listed below:

- Sessions were engaging and fostered active participation
- Sessions were fun and enjoyable
- Sessions helped in improving critical thinking skills
- Sessions helped you apply theoretical knowledge to practical scenarios
- Sessions helped in improving collaboration and group work
- Sessions helped in fostering creative thinking skills
- Sessions helped in remembering and retaining medical concepts
- Time and other learning resources allotted for the session were adequate

9. The session complemented other learning activities (lectures, practicals, etc.) on the same topic

10. Sessions should be a frequent part of the medical curriculum

In addition, students provided written qualitative feedback on PBL and LBL in response to open-ended questions.

STATISTICAL ANALYSIS

The questionnaire scores were compared using the Mann-Whitney U test, and the qualitative inputs were analysed thematically to identify themes and subthemes, with representative quotes presented. Quantitative analyses were performed using GraphPad Prism version 9.5.0, and qualitative data were analysed using Qualitative Data Analysis (QDA) Miner Lite.

RESULTS

All 66 students who participated in the study provided feedback. Among them, 39 were male and 27 were female, with a mean age of 21.75 ± 1.49 years.

The comparative analysis of student perceptions between PBL and LBL methods has been depicted in [Table/Fig-2]. Questions 1, 5, 8, and 10 showed no significant difference ($p > 0.05$), indicating they did not effectively distinguish between the two approaches. However, the remaining items had statistically significant differences ($p < 0.05$), highlighting key contrasts. PBL was perceived as more effective in enhancing critical thinking and applying theoretical knowledge to practical situations. In contrast, LBL was rated higher for enjoyment, fostering creative thinking, aiding concept retention, and being more resource-efficient with greater satisfaction regarding time and resource adequacy. Both methods were viewed similarly in terms of resource availability and curricular inclusion, with no significant difference in engagement or collaboration.

The themes, sub-themes, and direct quotes from the students has been depicted in [Table/Fig-3]. Thematic analysis of student feedback revealed that PBL was appreciated for fostering active engagement, critical thinking, and real-life clinical reasoning, though some students faced challenges with group dynamics and uneven participation. In contrast, LBL was praised for enhancing creativity, enjoyment, and memory retention through its unique approach, especially for simpler concepts. However, students found it less effective for complex topics. While both methods were valued, PBL was seen as more beneficial for developing clinical reasoning and the application of knowledge, whereas LBL excelled in making learning enjoyable and aiding recall. Suggestions included improving group structure in PBL and using LBL selectively for suitable topics.

Theme	Subtheme	Direct quote
Engagement and participation	Positive engagement with PBL	"The case-based approach in PBL made me feel like I was solving real-life patient cases, which kept me fully engaged throughout the session."
	Engagement with LBL	"I loved solving the limericks- it made complex topics fun and easier to remember."
	Challenges in PBL	"Sometimes, one or two people dominated the discussion, and the quieter ones, like myself were overshadowed."
Skill development	Critical thinking in PBL	"PBL pushed me to think on my feet, especially when faced with evolving case details. It's not just about what you know but how you apply it."
	Creative thinking in LBL	"Coming up with limericks made me look at medical concepts from a different angle."
Application of knowledge	Practical knowledge in PBL	"During clinical rotations, I remembered a case we worked on in PBL, and it helped me make the connection between theory and practice instantly."
	Memory retention in LBL	"I used a limerick I wrote about the clotting cascade during an exam- it was a lifesaver!"
Likes and dislikes	PBL strengths	"I loved how PBL made you think about every possibility before arriving at a conclusion- it wasn't just about getting the right answer but the process of getting there."
	LBL strengths	"When you're drowning in textbooks, limericks provided a refreshing break."
Comparative effectiveness	Critical thinking skills	"PBL made me think deeper about patient care and what's happening at a molecular level- it's all about reasoning, not just memorisation."
	Engagement and enjoyment	"LBL was like a game- it made learning fun, which I think is important when we're dealing with such heavy subjects."
Challenges	Group dynamics in PBL	"Not everyone contributed equally, and that made the learning experience less effective for some of us."
	Complexity of LBL	"LBL is great for quick facts, but when it comes to more complex conditions it's hard to simplify them into a limerick."
Recommendations for improvement	Suggestions for PBL	"I think PBL would work better in smaller groups. That way, everyone would have more opportunities to contribute and engage actively"
	Suggestions for LBL	"LBL should be used for key facts or mnemonics, but for the more complex concepts, a more detailed approach is needed"

[Table/Fig-3]: Themes, sub-themes, and direct quotes from the students.
PBL: Problem-based learning, LBL: Limerick-based learning

Statement	Characteristics	PBL	LBL	p-value	Cohen's d
Sessions were engaging and fostered active participation	Engagement	3.57±1.13	3.86±1.07	0.12	0.26
Sessions were fun and enjoyable	Enjoyability	2.51±1.23	4.09±0.91	<0.0001	1.46
Sessions helped in improving critical thinking skills	Critical thinking	4.25±0.98	2.58±0.70	<0.0001	1.96
Sessions helped you apply theoretical knowledge to practical scenarios	Application	4.03±1.1	2.66±0.69	<0.0001	1.49
Sessions helped you in improving collaboration and group work	Collaboration	3.34±1.11	2.97±1.27	0.09	0.31
Sessions helped in fostering creative thinking skills	Creativity	2.49±1.24	4.03±0.93	<0.0001	1.41
Sessions helped in remembering and retaining medical concepts	Retention	3.29±1	4.06±0.85	<0.0001	0.83
Time and other learning resources allotted for the session was adequate	Adequacy	4.03±0.9	4.03±0.9	1	0
Session complemented with the other learning activities (lectures, practicals etc.) on the same topic	Complementarity	2.57±1.24	4.17±0.93	<0.0001	1.46
Sessions should be a frequent part of the medical curriculum	Frequency	4.03±0.9	4.03±0.9	1	0

[Table/Fig-2]: Comparative characteristics of the students' perception for PBL and LBL.

p-value is of Mann-Whitney U test Interpretation of Cohen's d: 0-0.19=negligible, 0.2-0.49=small, 0.5-0.79=medium, 0.8-1.29=large, ≥ 1.3 =very large

DISCUSSION

The present study explored students' perceptions of two innovative teaching methods, PBL and LBL, in undergraduate medical education. Both qualitative and quantitative analyses revealed complementary strengths and limitations of these strategies in promoting student engagement, critical and creative thinking, knowledge application, and retention. PBL was consistently valued for its ability to simulate real-world clinical reasoning, fostering deeper engagement and critical thinking [5]. Students felt more

practical application, while LBL aids memorisation and enjoyment. The findings reflect how each method aligns differently with learning goals, emphasising the importance of blended, context-appropriate instructional strategies in medical education.

The findings of the current study (i.e., index study) and comparison with existing literature are shown in [Table/Fig-4] [3,7-12]. Most of the studies are systematic or narrative reviews, offering generalised insights rather than direct experimental evidence. These reviews consistently support the benefits of PBL in enhancing critical

Study	Learning method	Study design	Key findings	Limitations	Comparison with index study
Index study (2024)	PBL and LBL	Interventional, comparative	PBL improved critical thinking, LBL enhanced memory retention	Limited to single institution	Aligns with PBL's critical thinking benefits. LBL aids memory
Dolmans DJHM et al., (2005) [7]	PBL	Literature review	PBL improves clinical reasoning, critical thinking	Generalised findings	Supports the index study's findings on PBL
Hmelo-Silver CE (2004) [9]	PBL	Review of PBL	Group dynamics can be a strength or weakness	No specific data	Reflects index study's observation on group dynamics
Khoshnevisasl P et al., (2014) [10]	PBL	Quasi-experimental	PBL improved analytical and problem-solving skills	Limited sample size.	Consistent with index study's findings on problem-solving
Schmidt HG et al., (2011) [8]	PBL	Systematic review	PBL enhances long-term retention	Variability in PBL implementation	Aligns with index study's retention results
Wood DF (2003) [11].	PBL	Review	PBL fosters independent learning	Limited empirical evidence	Consistent with index study
Carnegie JA et al., (2012) [3]	LBL (Limericks)	Interventional	LBL enhanced engagement and retention	Subjective evaluation	Matches index study's LBL outcomes
Berk RA (2002) [12]	Humour in learning	Book	Humour can reduce stress, enhance retention	Generalised findings	Supports index study's use of LBL

[Table/Fig-4]: The current study finding and its comparison with existing literature [3,7-12].

confident applying theoretical concepts to practical scenarios and appreciated the structured problem-solving format. However, concerns were raised regarding group dynamics, with some students expressing frustration over unequal participation and lack of facilitation, echoing similar challenges reported in previous PBL literature. LBL, on the other hand, emerged as a novel and enjoyable method that supported creative thinking and memory retention. Its mnemonic and rhythmic elements helped students recall complex medical concepts during assessments. However, its utility appeared limited when addressing more complex pathophysiological concepts that required a comprehensive understanding beyond simplified rhymes.

The absence of differences in students' perceptions regarding the adequacy and frequency of sessions suggests that both PBL and LBL were delivered with similar logistical support, such as time, facilitators, and resources. Students likely found both methods sufficiently structured and well integrated into the curriculum. The identical ratings may also reflect a ceiling effect, where students already viewed the sessions as optimally adequate and worth repeating, regardless of the teaching format. This indicates that while the methods differ in educational impact, they are equally valued in terms of delivery and curricular relevance.

The differences in students' perceptions of PBL and LBL stem from the distinct cognitive demands and strengths of each method. PBL encourages deep learning by simulating real-life clinical reasoning, enhancing critical thinking, the application of knowledge, and active participation. The realism and relevance of PBL cases foster engagement, but group dynamics, such as dominance or unequal contribution, can limit their effectiveness without proper facilitation [6]. LBL, on the other hand, leverages rhyme and rhythm to enhance memory retention, making it enjoyable and effective for recalling factual information. However, its simplicity makes it less suitable for understanding complex clinical scenarios [3]. Students appreciated LBL's novelty and creativity, but noted limitations in the depth of learning. Overall, PBL supports analytical skills and

thinking, problem-solving, and long-term retention, which aligns with the findings of the index study. The findings of the study are largely in line with the existing literature on PBL and Lecture-Based Learning (LBL). PBL consistently demonstrates advantages in fostering critical thinking, problem-solving abilities, and a deeper understanding of content, as supported by previous research such as Dolmans DHJM et al., and Schmidt HGet al., and reaffirmed in the current study [7,8]. In contrast, while LBL is often creative and engaging, it is primarily effective in enhancing memory retention and learner engagement, as also noted by Carnegie JA [3]. However, group dynamics in PBL can act as a double-edged sword, beneficial or detrimental depending on the context, a complexity echoed by Hmelo-Silver CE and reflected in the present study [9].

Limitation(s)

Despite its strengths, the study has several limitations. First, it was conducted in a single institution with a modest sample size, which may limit the generalisability of the findings. Second, the feedback was collected immediately after the sessions, which may reflect short-term impressions rather than long-term educational outcomes. Third, as participation was voluntary, there may be a response bias favouring students more inclined toward active or creative learning. Finally, objective academic performance measures were not incorporated, so the findings rely solely on subjective perceptions.

CONCLUSION(S)

The study highlights that both PBL and LBL offer distinct educational benefits in undergraduate medical education. PBL was valued for promoting critical thinking, clinical reasoning, and the practical application of knowledge, while LBL stood out for enhancing memory retention and adding enjoyment to the learning process. Students appreciated the complementary nature of both methods, with PBL supporting deep learning and LBL facilitating quick recall of facts. The findings suggest that a blended approach, integrating PBL and LBL selectively based on topic complexity and learning objectives, may enhance student engagement and overall learning outcomes.

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