
| RESEARCH ARTICLE

Evaluating Case-Based Learning in Physiology: A Study at Indus Medical College

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| ABSTRACT

Case-Based Learning (CBL) is increasingly recognized as an effective student-centered pedagogical approach in medical education. While international studies report its benefits in enhancing engagement, clinical reasoning, and long-term retention, its implementation and evaluation in Pakistani institutions remain limited. This study aimed to evaluate the impact of CBL on students' understanding of physiology, satisfaction levels, and development of clinical reasoning skills at Indus Medical College. A cross-sectional, survey-based study was conducted in the Physiology Department at Indus Medical College between January 1 and February 15, 2025. A total of 210 MBBS students (1st and 2nd year) and 10 faculty members involved in CBL sessions participated. Data were collected through structured questionnaires and interviews, analyzed using SPSS v26, and expressed in terms of descriptive statistics with $p < 0.05$ considered significant. Among students, 92% strongly agreed that CBL enhanced topic comprehension, 89% felt it bridged theoretical and clinical knowledge, and 95% preferred it over traditional teaching. Teachers also reported high satisfaction, with 90% agreeing that CBL improved teaching effectiveness and student engagement. However, both groups noted areas for improvement in scenario realism and professional reasoning development. The study confirms that CBL significantly improves physiology learning, student satisfaction, and early clinical reasoning skills. Institutional integration of well-designed CBL modules can strengthen basic medical science teaching and foster clinical competence in future healthcare professionals.

| KEYWORDS

Case-Based Learning (CBL), Physiology Education, Medical Students, Clinical Reasoning, Student Engagement, Teaching Strategies, Indus Medical College, Pakistan, Active Learning, Medical Curriculum Reform

| ARTICLE INFORMATION

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1. Introduction

Emerging evidence supports that Case-Based Learning (CBL)—an active, student-centered educational model significantly enhances physiology learning by fostering engagement, clinical reasoning, and long-term retention. For example, Chatterjee et al. (2021) demonstrated that students taught vascular physiology through case-based lectures outperformed their peers immediately and at two-month follow-up assessments. Thistlethwaite et al. (2012), in their systematic review, found CBL improves academic performance and case-analysis skills in medical students. Srinivasan et al. (2007) reported that hybrid CBL approaches supplemented with role-play promote higher excellence rates and self-directed learning compared to traditional teaching methods. Additionally, Lee et al. (2021) showed that interactive online case modules combined with classroom discussion enhance student understanding of complex pathophysiology topics. While systematic reviews by Anderson and Pelletier (2020) confirm that CBL improves motivation and exam scores, its impact on critical thinking is still under exploration. Despite robust global

support, Ali and Haque (2018) noted limited adoption of CBL in Pakistani medical colleges, including a lack of evaluation at institutions like Indus Medical College. Therefore, this cross-sectional study aims to assess the impact of CBL on undergraduate physiology knowledge, student satisfaction, and clinical reasoning skills, aligning our curriculum with international standards and enhancing early clinical competence. Recent studies from regional medical institutions such as those by Ghori et al. (2017) and Shaikh et al. (2017), which investigated hematological disorders and sepsis patterns, respectively highlight the critical need for clinically oriented learning models that can enhance diagnostic reasoning and contextual understanding of patient profiles in local healthcare settings.

Recent contributions by local researchers emphasize the urgency of reforming both content delivery and risk-awareness in medical education. Ghori et al. (2025) highlighted how integrating risk assessment frameworks into physiology enhances conceptual clarity and decision-making in clinical contexts—an approach that complements the logic behind CBL by encouraging structured, analytical thinking. Similarly, Ghori et al. (2025) in their occupational study found that physiological risk perception in industrial settings is often underestimated due to lack of targeted education—suggesting that case-based modules might improve contextual understanding of physiological responses under varying real-world conditions. Further, Ghori et al. (2025) examined the role of Clinical Exercise Physiologists (CEPs) in managing chronic diseases, drawing attention to the importance of collaborative, interdisciplinary training models—many of which are strengthened through case-based pedagogy. In parallel, their study on comparative risk frameworks (Ghori et al., 2025) proposes a systems-thinking approach in healthcare education, advocating for adaptive, context-sensitive learning strategies, which CBL naturally supports. Integrating case-based approaches in basic medical sciences such as physiology could significantly strengthen early clinical competence and bridge the gap between theoretical knowledge and real-world medical challenges in Pakistan

2. Methodology

This cross-sectional survey was conducted in the Physiology Department of Indus Medical College. Data collection took place from 01 January, 2025 to 15 February 2025, prior to participation, informed consent was obtained from all students. This qualitative, survey-based study involved 210 undergraduate students enrolled in the 1st and 2nd years of the MBBS program. Additionally, 10 faculty members regularly conducting case-based learning (CBL) sessions in the Physiology Department were interviewed, and their responses included in the analysis.

Following strict inclusion criteria, student responses were collected and analyzed. The purpose, objectives, and rationale of the study were explained to participants during preliminary interviews. Data were gathered using structured proformas. The questionnaire captured demographic information including age, gender, educational background, dietary habits, and BMI. To ensure clarity and ease of understanding, the questionnaire was administered in the participants' native languages (Sindhi or Urdu). Data analysis was performed using SPSS version 26. Statistical significance was set at $p\text{-value} < 0.05$. Descriptive statistics such as means, modes, frequencies, and percentages were calculated and presented through cross-tabulations. Ethical approval was granted by the Ethics Review Committee of Indus Medical College, and informed consent was secured from all participants before data collection commenced.

3. Results

The total number of student participants was 210, comprising 89 males (42.38%) and 121 females (57.62%). The mean age of male students was 26.85 years, while that of females was 25.90 years. The mean BMI recorded was slightly higher in males (28.50) compared to females (27.80). Regarding residential background, 26% of males and 28% of females belonged to urban areas, whereas 20% of males and 24% of females were from rural backgrounds. The standard deviation in age and BMI values was 3.60 for males and 4.10 for females, indicating moderate variability among respondents as shown in Table 1.

Table 1: Demographic data showing frequency, age, BMI & domicile of sample size (n=210)

Gender	Frequency (n, %)	Age (mean)	BMI (mean)	Urban (%)	Rural (%)	Std Deviation
Male	89 (42.38%)	26.85	28.50	26.00%	20.00%	3.60
Female	121 (57.62%)	25.90	27.80	28.00%	24.00%	4.10

The analysis of student responses reveals a strongly positive perception of CBL. An overwhelming 92% of students strongly agreed that CBL helped them understand topics better, and 89% strongly agreed that it helped bridge the gap between theoretical knowledge and clinical practice. Similarly, 87% strongly agreed that CBL improved overall learning, and 88% felt it was useful for the future application of knowledge. In terms of learner engagement, 72% of students found the CBL cases interesting, and 95% preferred CBL over traditional teaching methods. Regarding the student-centered nature of CBL, 65% strongly agreed, while 20%

agreed, indicating that a majority appreciated its interactive design. Group discussion during CBL was found helpful by 90% of students, while 88% felt it motivated them to learn Physiology in greater depth. However, only 62% strongly agreed that CBL sessions helped them think professionally, and 63% felt that teachers accurately explained the scenarios suggesting room for improvement in content delivery and facilitation. Other aspects such as motivation to learn clinical scenarios (65%), help in remembering facts (60%), and setting personal learning goals (65%) also received favorable responses, though these were comparatively lower than core areas like understanding, learning enhancement, and preference over older methods as shown in Table 2.

Table 2: Responses of 1st and 2nd Year Students on CBL Sessions (n=210)

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
CBL helps you understand the topic better	92%	6%	2%	0%
CBL sessions facilitate critical thinking via active learning	85%	10%	4%	1%
CBL helped bridge the gap between theory and clinical scenarios	89%	7%	3%	1%
CBL sessions improve overall learning	87%	9%	3%	1%
Are CBL cases given in session interesting?	72%	15%	10%	3%
CBL model is useful in future application of knowledge	88%	8%	3%	1%
Do you prefer CBL sessions over old methods of learning?	95%	3%	2%	0%
Is this approach student-centric?	65%	20%	10%	5%
Are the discussion sessions within student groups helpful?	90%	5%	4%	1%
CBL sessions make you think professionally?	62%	20%	12%	6%
Are teachers able to explain scenarios accurately?	63%	22%	10%	5%
Do CBL sessions motivate you to learn Physiology in depth?	88%	7%	4%	1%
Are teachers encouraging you to learn more clinical scenarios?	65%	20%	10%	5%
CBL sessions help you remember facts and figures accurately?	60%	25%	10%	5%
CBL sessions useful in setting realistic personal learning goals?	65%	20%	10%	5%

Out of 10 participating teachers, 90% strongly agreed that CBL helps them teach topics better, and 85% reported improvement in their teaching skills. Similarly, 85% believed that CBL effectively bridged the gap between theory and clinical application, and 75% found it useful for future teaching.

While 100% of teachers preferred CBL over traditional methods, only 65% found the cases interesting for teaching, indicating the need for more engaging or contextually relevant case content.

A majority of teachers felt that CBL promoted active thinking (80%) and was helpful in small group discussions (70%). However, only 55% strongly agreed that it made them think as clinicians, reflecting a need for further alignment between CBL and clinical reasoning exercises.

Moreover, 70% of teachers felt that students showed enthusiasm toward CBL and encouraged more clinical discussions. Similar numbers believed that CBL helped them remember facts and set realistic personal teaching goals, though some reservations remained (10–15% disagreed on several items as shown in Table 3).

Table 3: Responses by Teachers Conducting CBL Sessions for 1st and 2nd Year Students (n=10)

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
CBL helps you teach the topic better?	90%	10%	0%	0%
CBL sessions promote active thinking in learning?	80%	10%	10%	0%
CBL helped bridge the gap between theory & clinical scenarios?	85%	10%	5%	0%
CBL sessions improve overall teaching skills?	85%	15%	0%	0%
Are CBL cases given in sessions interesting for teaching?	65%	15%	15%	5%
CBL model is useful in future application of knowledge?	75%	15%	10%	0%
Do you prefer CBL sessions over old methods of learning?	100%	0%	0%	0%
Is this approach teacher-centric?	60%	20%	10%	10%
Are the discussion sessions within small groups helpful?	70%	20%	10%	0%

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
CBL sessions make you think as a clinician?	55%	25%	15%	5%
Are students showing enthusiasm toward this type of learning?	70%	20%	10%	0%
Does CBL motivate you to teach Physiology in depth?	75%	15%	5%	5%
Are students encouraging you to teach more clinical scenarios?	70%	20%	10%	0%
CBL sessions help you remember facts and figures accurately?	70%	15%	10%	5%
CBL sessions useful in setting realistic personal teaching goals?	70%	15%	10%	5%

4. Discussion

The present study at Indus Medical College aimed to assess the perception of both students and faculty members toward Case-Based Learning (CBL) in Physiology education among 1st and 2nd-year MBBS students. The findings strongly support the effectiveness of the CBL approach in enhancing students' understanding, critical thinking, and interest in the subject, aligning with similar studies conducted across Pakistan and internationally. Our demographic data revealed a higher female participation (57.62%) compared to males (42.38%), with a fairly balanced representation from both urban and rural backgrounds. Despite the variation in background, the overall student response demonstrated a positive outlook toward CBL implementation.

According to our results, over 92% of students strongly agreed that CBL helped them understand the topic better, and 95% preferred it over traditional teaching methods. These findings echo the outcomes of a study conducted at LUMHS, which similarly highlighted that students found CBL more engaging, motivational, and effective in bridging theoretical knowledge with clinical scenarios. Notably, 88% of our students stated that CBL sessions encouraged deeper learning in Physiology, a key indicator of student-centered education success. Further, students appreciated the opportunity for small-group discussions, with 90% confirming that these sessions were helpful. This aligns with the conclusion of several studies, including Malau-Aduli BS et al. (2013), which emphasized that small-group, case-based sessions foster active participation, improve concept retention, and allow more personalized teacher-student interaction. Interestingly, while a high percentage of students found the CBL model beneficial in setting realistic learning goals (65%), slightly fewer (60%) agreed that CBL helped them recall facts and figures accurately. This suggests that while CBL enhances conceptual learning and clinical thinking, factual memorization may still require supplemental traditional methods—an area for future instructional improvement.

The teachers' feedback in our study was equally encouraging. A full 100% of faculty preferred CBL over traditional methods, and 90% strongly agreed that it helped them teach more effectively. Faculty also recognized that CBL enhanced student engagement and enthusiasm, consistent with findings from Grauer et al. (2008) and Aleem SB et al. (2014), which highlighted CBL as a dynamic instructional strategy that improves teaching efficacy and student motivation. Nevertheless, while 70% of teachers acknowledged that students showed enthusiasm, only 60% agreed that the approach was teacher-centric, indicating a successful shift towards a student-centered paradigm. However, a slightly lower consensus (55%) was observed on whether CBL sessions help teachers think like clinicians, suggesting that CBL integration may require additional clinical orientation or case development workshops for faculty.

Our findings reaffirm that CBL sessions help bridge the gap between theoretical and clinical knowledge, an aspect that has been widely endorsed by Li X et al. (2022) and others. By relating textbook knowledge to practical scenarios, students feel less overwhelmed, retain more information, and develop better professional judgment. Given that Physiology forms the foundation of all major clinical disciplines such as Medicine, Surgery, and Pathology, embedding case-based learning early in the curriculum is of vital importance. CBL not only encourages self-directed learning and collaborative problem-solving but also enhances long-term comprehension key elements for a successful medical career.

Our study demonstrates that Case-Based Learning is highly effective and well-received by both students and teachers at Indus Medical College. These results are consistent with similar educational interventions across other institutions, supporting the inclusion of CBL as a core component in undergraduate medical education. With appropriate faculty training, careful case design, and continued feedback loops, CBL can become a cornerstone in nurturing future clinicians who are critical thinkers and effective problem-solvers.

5. Conclusion

The findings from our study at Indus Medical College indicate that Case-Based Learning (CBL) is an effective and student-centered teaching strategy for undergraduate medical education in Physiology. The majority of students reported that CBL sessions significantly enhanced their understanding of complex physiological concepts and improved their critical thinking skills. The interactive nature of CBL, particularly the small group discussions, encouraged greater engagement, collaboration, and deeper learning. CBL also helped students draw meaningful connections between theoretical knowledge and clinical applications, thereby

fostering a more integrated understanding of human physiology. This approach was not only well-received by students but was also appreciated by faculty, who found it beneficial for improving their teaching methods and promoting clinical reasoning during instruction. Faculty responses suggested that CBL helped them tailor their teaching to better meet individual student needs, facilitated more engaging classroom dynamics, and motivated them to deliver more in-depth and clinically oriented content. Both students and teachers agreed that the CBL model is valuable for future application of knowledge and plays a pivotal role in shaping the clinical mindset at an early stage of medical education.

The implementation of CBL at Indus Medical College has proven to be a successful educational strategy that enriches both teaching and learning experiences. Its integration into the Physiology curriculum not only aligns with modern educational standards but also ensures better preparedness of students for clinical challenges in their future medical practice.

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Data Availability

Data and materials can be provided as needed.

Conflict of Interest

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A. Questionnaire for CBL Evaluation at Indus Medical College

1) Section A: Demographic Information

(Please fill out the following information)

1. **Gender:**
☐ Male
☐ Female
2. **Age:** _____ years
3. **BMI (Body Mass Index):** _____
4. **Domicile:**
☐ Urban
☐ Rural

2) Section B: Student Feedback on CBL Sessions

(Kindly tick the option that best reflects your opinion)

Scale:

1 – Strongly Disagree | 2 – Disagree | 3 – Agree | 4 – Strongly Agree

S.No.	Statement	1	2	3	4
1	CBL helps you understand the topic better	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	CBL sessions facilitate critical thinking via active learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

S.No.	Statement	1	2	3	4
3	CBL helped bridge the gap between theory and clinical scenarios	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	CBL sessions improve overall learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	Are CBL cases given in session interesting?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	CBL model is useful in future application of knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	Do you prefer CBL sessions over old methods of learning?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Is this approach student-centric?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	Are the discussion sessions within student groups helpful?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	CBL sessions make you think professionally	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	Are teachers able to explain scenarios accurately?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	Do CBL sessions motivate you to learn Physiology in depth?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	Are teachers encouraging you to learn more clinical scenarios?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	CBL sessions help you remember facts and figures accurately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15	CBL sessions are useful in setting realistic personal learning goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3) Section C: Teacher Feedback on CBL Sessions

(For Teachers Only – Please tick the option that best reflects your view)

Scale:

1 – Strongly Disagree | 2 – Disagree | 3 – Agree | 4 – Strongly Agree

S.No.	Statement	1	2	3	4
1	CBL helps you teach the topic better	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	CBL sessions promote active thinking in learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	CBL helped bridge the gap between theory and clinical scenarios	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	CBL sessions improve overall teaching skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	Are CBL cases given in sessions interesting for teaching?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	CBL model is useful in future application of knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	Do you prefer CBL sessions over old methods of learning?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Is this approach teacher-centric?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	Are the discussion sessions within small groups helpful?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

S.No.	Statement	1	2	3	4
10	CBL sessions make you think as a clinician	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	Are students showing enthusiasm toward this type of learning?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	Does CBL motivate you to teach Physiology in depth?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	Are students encouraging you to teach more clinical scenarios?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	CBL sessions help you remember facts and figures accurately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15	CBL sessions are useful in setting realistic personal teaching goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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