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A comparative study of student preferences between case-based learning and problem-based learning in Physiology

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ABSTRACT

Objectives: Case-based learning (CBL) and Problem-based learning (PBL), unlike traditional lectures, are innovative student-centred approaches that promote critical thinking, clinical reasoning, collaborative skills and the integration of basic science subjects with clinical disciplines. The present study was conducted to compare the effectiveness and preferences of CBL and PBL as teaching tools in Physiology.

Materials and Methods: A crossover educational interventional study was carried out among Phase I undergraduate medical students using PBL and CBL methods on two different topics of Physiology. Pre-test, post-test and retention test scores were analysed to assess the knowledge gain and retention ability. The student perceptions of these two methods were recorded using a feedback questionnaire based on a 5-point Likert scale. Binary logistic regression was performed on the factors identified through exploratory factor analysis (EFA) and academic performance (1st internal assessment scores) to predict student predilections between PBL and CBL.

Results: Of 223 total participants, 172 (77.13 %) preferred CBL, whereas 51 (22.87%) favoured PBL, as students appreciated faculty-guided, actively engaging case discussion within a structured learning framework in comparison to inquiry-driven driven self-directed, time-consuming, open-ended problem solving. CBL showed a higher retention score than PBL as it enhanced an in-depth understanding of core concepts and reinforcement of memory. Four factors identified by EFA were as follows: (I) Faculty-guided structured content, (II) Group discussion related comfort/anxiety/stress, (III) Time management and cognitive workload and (IV) Effectiveness and clinical relevance. Binary logistic regression analysis revealed that Factors I (odds ratio [OR] = 7.47, $P < 0.001$) and Factor II (OR = 0.43, $P = 0.003$) predicted CBL preference, whereas academically stronger students were inclined towards PBL (OR = 0.96, $P < 0.001$).

Conclusion: CBL is more suitable for novice Phase I M.B.B.S students, whereas PBL is appropriate in later phases of the curriculum when they have acquired the ability of self-directed learning, iterative thinking and logical reasoning.

Keywords: Case-based learning, Exploratory factor analysis, Physiology, Problem-based learning, Undergraduate medical students

INTRODUCTION

In the modern field of advanced medical education, the traditional lecture method is inadequate to meet the requirements of students in developing problem-solving, critical thinking, clinical reasoning and communication skills. Case-based learning (CBL) and problem-based learning (PBL) are both student-centred educational approaches effective in imparting in-depth knowledge

and improving long-term retention, thus preparing them for real-world challenges.

PBL introduced by Professor Howard Barrow at McMaster University of Medicine, Canada, in 1969, focused on solving an open-ended, ill-structured problem, triggering students to gather information through group collaboration, encouraging them to learn through active investigation, thus emphasising lifelong self-directed learning (SDL) skill.[1,2]

CBL, a pedagogical approach using real/hypothetical cases or scenarios, although first described by Professor Randall at Harvard University School of Law in 1870 and adopted by James Lorrain Smith while teaching pathology in 1912 at the University of Edinburgh, was formalised in medical education in the 1980s–1990s.[3-5] Students apply their theoretical knowledge to analyse the case, engage in discussion and develop a reasonable conclusion.

Both PBL and CBL are two novel teaching methods where students work in groups to solve a clinical case/problem, but differ in focus, approach, implementation and outcome. PBL commences with an open-ended problem where students identify the learning objectives themselves, but CBL starts with a structured clinical case having predefined objectives. PBL is more complex and demanding as it requires interdisciplinary knowledge and a high level of student autonomy to explore and solve the problem through group work, which may result in multiple potential solutions. In PBL, the instructor acts as a facilitator, allowing more flexibility and independent learning without interfering with the learners when they get diverted from the correct explanation.[6] In CBL, the instructor actively provides structured supervision in group discussions of students and uses guiding questions to navigate them back to the actual diagnosis in case of deviation.[6,7]

The National Medical Commission (NMC) of India has introduced early clinical exposure (ECE) and integrated learning strategies in Phase I M.B.B.S. students to make basic science subjects more relevant in clinical practice.[8] PBL and CBL methods have the prospect for ECE and integration of diverse medical disciplines both horizontally and vertically.

The efficiency of PBL over the lecture method or CBL over lecture is well documented in various literature[9-14] but comparative studies between PBL and CBL teaching–learning is less prevalent.[6,15-17] Moreover, the studies comparing these two methods have been performed only on clinical subjects to date.[6,15-17] Hence, the present study was taken up to compare the effectiveness and acceptability of the two methods by implementing PBL and CBL in the basic science preclinical subject of physiology on Phase I medical students. The study was intended to assess the perceptions and satisfaction of students and faculty about the two approaches, along with the identification of the factors influencing the student preferences.

MATERIALS AND METHODS

An educational interventional study using a crossover design was conducted on 250 Phase I M.B.B.S students of the academic session 2024–2025 in the Department of Physiology in a Government medical college in Eastern India from February 2025 to May 2025.

The study began after receiving approval from the institutional ethics committee and obtaining informed consent from the participating students. The students were divided randomly into 4 groups – Group A, B, C and D comprising of 62, 63, 62 and 63 students, respectively, which were further divided into two subgroups as A (A1 = 31, A2 = 31); B (B1 = 32, B2 = 31); C (C1 = 31, C2 = 31) and D (D1 = 32, D2 = 31).

The current study consisted of two sessions on two topics – Topic I: Heart failure (PY 5.13) and Topic II: Emphysema (6.7) from the revised competency-based medical education (CBME) curriculum by NMC.[18] The Physiology in the parentheses denotes code for physiology, and the number indicates the competency mentioned in the CBME curriculum for Physiology (Volume 1).[18]

- Session I on Topic I: The students of A1, B1, C1 and D1 attended CBL session
  while A2, B2, C2 and D2 attended PBL.
- Session II on Topic II: The students of A1, B1, C1 and D1 attended PBL session
  while A2, B2, C2 and D2 attended CBL.

An introductory session of 1 h for orientation was followed by a CBL (2 h)/PBL (4 h) session on two topics with a 1-week gap between Topics I and II. The study was designed for each and every student to experience both methods. Each subgroup of 31–32 students was further subdivided into 4 small groups of 7–8 students guided by one facilitator, for which 4 facilitators were engaged. PBL and CBL sessions were conducted simultaneously; hence, a total of 8 facilitators (4 for PBL and 4 for CBL) were recruited. The facilitators who conducted CBL in session I led PBL in session II, and vice versa. All the facilitators were trained by the senior faculty members. The students enrolled were given unique codes to keep their identities undisclosed.

The students prepared themselves for the CBL sessions with the study materials provided by instructors, while no prior preparation was required for PBL sessions. Each session commenced with a pre-test consisting of 10 multiple-choice questions (MCQ), each of 1 mark, based on analytical reasoning to assess the prior knowledge of the students. The elaborate framework of the CBL and PBL sessions is described vividly in Figure 1.

In both approaches, the students participated in small group discussions to explore the explanations and answers related

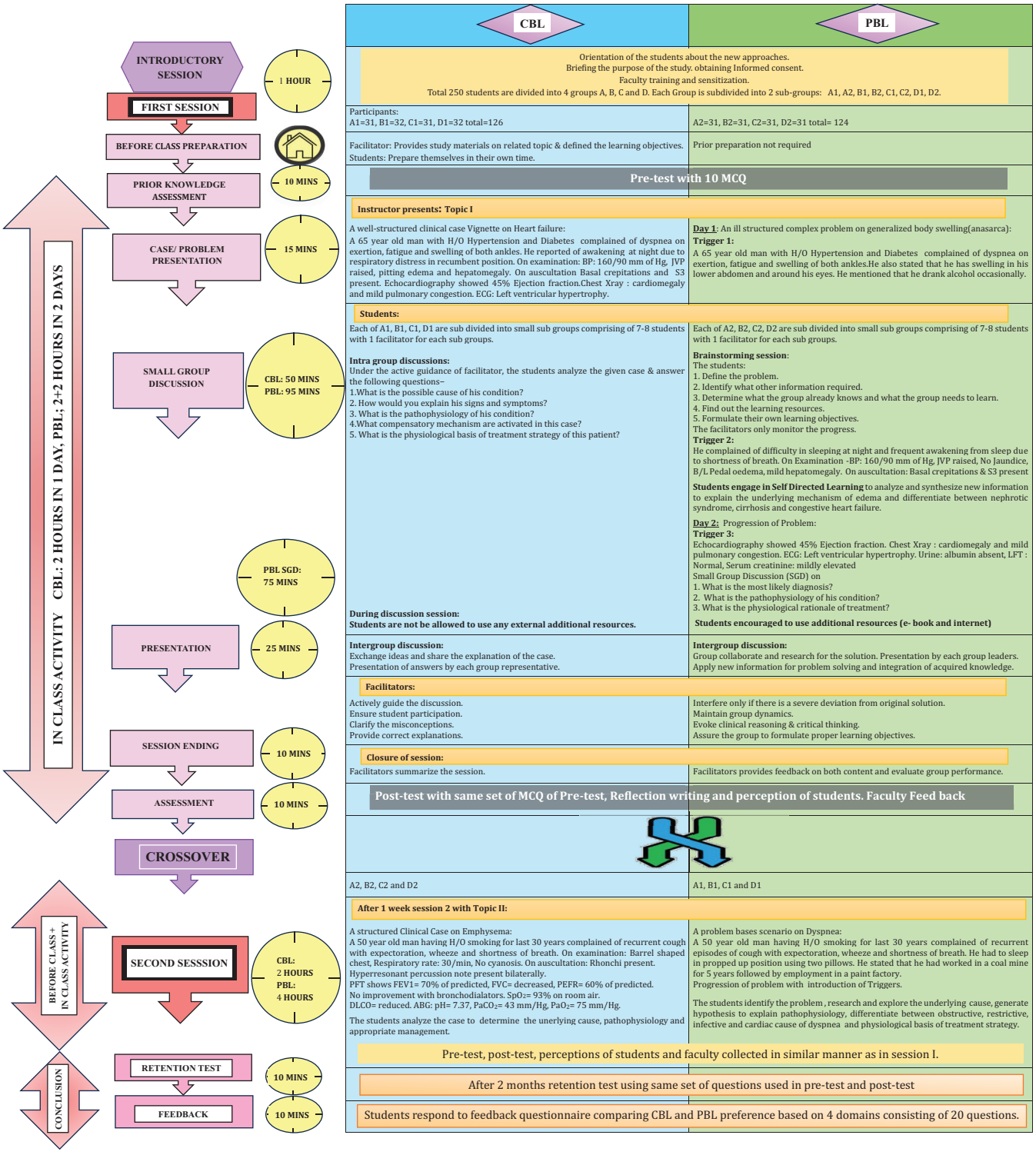


Figure 1: Flowchart of cross over study design illustrating the steps followed in Case-based Learning and Problem-based Learning methods on two topics of Physiology. CBL: Case-based learning, PBL: Problem-based learning, MCQ: Multiple choice question, PFT: Pulmonary Function Test, FEV1: Forced expiratory volume in 1 second, FVC: Forced vital capacity, PER: Peak expiratory flow rate, DLCO: Diffusing capacity of the lungs for Carbon Monoxide, ABG: Arterial Blood Gas, H/O: History of, LFT: Liver Function Test, ECG: Electrocardiogram.

to the assigned case/problem. However, the role of the instructor differed from active guidance in CBL to minimal intervention in PBL, even for extreme deviation from the correct solution. After each session, the knowledge gain of students was evaluated through a post-test, and their perception was assessed with the help of a feedback form [Appendix 1]. The feedback of 8 facilitators was also collected with the help of the same feedback form.

A retention test after 2 months with the same MCQ was performed to assess the long-term impact of learning. A validated questionnaire using a 5-point Likert scale was administered to identify the factors affecting the choice of students for PBL or CBL [Appendix 2]. The two questionnaires on perception and feedback of students, as well as facilitators, were validated by a pilot study conducted on 30 medical students of the 2023–2024 batch.

Statistical analysis

The collected data were analysed by Statistical Package for the Social Sciences version 25 software. The Friedman test was used to compare the mean score of pre-test, post-test and retention test of students participating in CBL and PBL methods on Topics I and II. Exploratory factor analysis (EFA) and binary logistic regression were performed to find out which factors determine the preferred learning method. A $P < 0.05$ was considered statistically significant.

A pilot study on 30 students of batch 2023–2024 for testing the reliability of the perception and feedback questionnaires yielded Cronbach's alpha to be 0.86 and 0.82, respectively.

RESULTS

Of 250 Phase I M.B.B.S. students, 223 (89.2%) completed both PBL and CBL sessions on Topics I and II. The participants (age 18.71 ± 1.03 years) consisted of 83 (37.22%) female and 140 (62.78%) male students, with 94 (42.15%) and 129 (57.85%) coming from English medium and regional medium backgrounds, respectively.

Table 1 depicts the Mean ± standard deviation of pre-test, post-test and retention test scores of the students attending both sessions on both topics. The Friedman test showed statistically significant ($P < 0.0001$) improvement in scores in all three assessments (pre-test, post-test and retention test) for the two methods. Dunn's *post hoc* test revealed statistically significant ($P < 0.0001$) differences between each pair: Pre-test versus post-test, post-test versus retention test and pre-test versus retention test in both strategies.

The combined scores for the Topics I and II when compared by Mann–Whitney test showed no statistically significant difference between the pre-test scores of CBL and PBL groups ($P = 0.060$), as well as post-test scores of CBL and PBL groups ($P = 0.054$). However, comparison of retention scores demonstrated a statistically significant difference ($P = 0.043$) indicating the effectiveness of CBL in long-term knowledge retrieval.

Table 2 summarises the student perceptions of both teaching and learning methods. Most of the students favoured CBL for its easy and structured format, less time-consuming nature and long-term knowledge retention potential, providing better opportunity for participation in group discussion and greater teacher–student interaction. However, students

Table 1: Comparison of pre-test, post-test and retention test scores of students by CBL and PBL methods.

Topic	Teaching-learning method	Group	Pretest Mean±SD	Post test Mean±SD	Retention test Mean±SD	*P* value
Topic I	CBL	A1+B1+C1+D1 (*n*=116)	3.37±1.52	9.25±1.02	8.44±1.45	<0.0001
	PBL	A2+B2+C2+D2 (*n*=107)	3.06±1.70	9.04±1.25	8.02±1.87	<0.0001
Topic II	CBL	A2+B2+C2+D2 (*n*=107)	3.25±1.49	9.08±1.29	8.11±1.73	<0.0001
	PBL	A1+B1+C1+D1 (*n*=116)	3.09±1.45	8.87±1.36	7.74±1.88	<0.0001
Topic I+II	CBL	A+B + C+D (*n*=223)	3.31±1.51	9.17±1.16	8.28±1.60	<0.0001
	PBL	A+B + C+D (*n*=223)	3.08±1.57	8.95±1.31	7.87±1.88	<0.0001

n=number of students.
Total 223 students out of 250 participated in the study. The participants were divided into four Groups A, B, C and D each of which were subdivided into two: (A =A1+A2, B =B1+B2, C =C1+C2, D =D1 + D2).
P value obtained using Friedmann test by comparing pre, post and retention test scores on CBL and PBL. CBL: Case-based learning, PBL: Problem-based learning (PBL) and SD: Standard Deviation

Table 2: Comparison of student perceptions between CBL and PBL methods.

Statements		Student feedback by Likert scale					Score Mean±SD	*P* value
This method	**Teaching learning method**	**5** ***n*** **(%)**	**4** ***n*** **(%)**	**3** ***n*** **(%)**	**2** ***n*** **(%)**	**1** ***n*** **(%)**		
1. Motivates me to take interest in studying Physiology.	CBL	155 (69.51)	23 (10.31)	35 (15.70)	10 (4.48)	0	4.45±0.91	0.36
	PBL	148 (66.37)	24 (10.76)	37 (16.59)	14 (6.28)	0	4.37±0.97	
2. Helps me to gain in depth understanding of the topic and enhanced conceptual knowledge.	CBL	160 (71.75)	18 (8.07)	25 (11.21)	15 (6.73)	5 (2.24)	4.40±1.06	0.57
	PBL	154 (69.06)	21 (9.42)	28 (12.56)	12 (5.38)	8 (3.58)	4.35±1.11	
3. Helps me to integrate basic science subject with clinical subjects.	CBL	130 (58.30)	32 (14.35)	33 (14.79)	19 (8.52)	9 (4.04)	4.14±1.92	0.88
	PBL	134 (60.09)	25 (11.21)	31 (13.90)	22 (9.87)	11 (4.93)	4.12±1.25	
4. Stimulates my critical thinking, clinical reasoning, problem solving and decision making.	CBL	124 (55.60)	37 (16.59)	14 (6.28)	27 (12.11)	21 (9.42)	3.97±1.39	<0.0001***
	PBL	158 (70.85)	39 (17.49)	10 (4.48)	9 (4.04)	7 (3.14)	4.48±0.98	
5. Encourages Self-directed learning.	CBL	110 (49.33)	30 (13.45)	41 (18.39)	8 (3.58)	34 (15.25)	3.78±1.47	<0.0001***
	PBL	164 (73.54)	23 (10.31)	21 (9.42)	13 (5.83)	2 (0.90)	4.50±0.95	
6. Helps me to improve communication skill.	CBL	137 (61.44)	42 (18.83)	20 (8.97)	14 (6.28)	10 (4.48)	4.26±1.14	0.29
	PBL	141 (63.23)	50 (22.42)	15 (6.73)	11 (4.93)	6 (2.69)	4.39±0.99	
7. Provides greater opportunity to participate in group discussion	CBL	140 (62.78)	31 (13.90)	22 (9.87)	16 (7.17)	14 (6.28)	4.20±1.24	0.01*
	PBL	114 (51.12)	36 (16.14)	26 (11.66)	29 (13.01)	18 (8.07)	3.89±1.36	
8. Helps to prepares better for examination	CBL	128 (57.39)	29 (13.01)	34 (15.25)	17 (7.62)	15 (6.73)	4.07±1.28	0.26
	PBL	124 (55.60)	26 (11.66)	30 (13.45)	21 (9.42)	22 (9.87)	3.94±1.40	
9. Promotes longer retention of knowledge.	CBL	147 (65.92)	35 (15.70)	10 (4.48)	18 (8.07)	13 (5.83)	4.28±1.21	0.01*
	PBL	120 (53.81)	40 (17.94)	17 (7.62)	26 (11.66)	20 (8.97)	3.96±1.38	
10. Is structured, easy to follow and less time consuming.	CBL	136 (60.99)	21 (9.42)	18 (8.07)	23 (10.31)	25 (11.21)	3.98±1.45	<0.0001***
	PBL	75 (33.63)	18 (8.07)	16 (7.17)	28 (12.56)	86 (38.57)	2.86±1.76	
11. Facilitates better teacher student interaction with active role of teacher.	CBL	156 (69.96)	34 (15.25)	17 (7.62)	12 (5.38)	4 (1.79)	4.46±0.97	0.02*
	PBL	132 (59.20)	43 (19.28)	19 (8.52)	17 (7.62)	12 (5.38)	4.19±1.19	
12. Prepares me to manage real life situations.	CBL	138 (61.88)	28 (12.56)	21 (9.42)	25 (11.21)	11 (4.93)	4.15±1.26	0.86
	PBL	139 (62.33)	22 (9.87)	25 (11.21)	24 (10.76)	13 (5.83)	4.12±1.30	

n=number of students, Total number of students responded=223 P value obtained using Wilcoxon Signed-Rank test by comparing student perception ratings on CBL and PBL. ****P*<0.001 and **P*<0.05. Likert scale: 5 = Strongly agree, 4=agree, 3=neutral, 2=disagree and 1=strongly disagree.
CBL: Case-based learning, PBL: Problem-based learning, SD: Standard Deviation

appreciated PBL for promoting critical thinking and encouraging SDL ($P < 0.0001$***).

The present study on 223 students showed 172 (77.13%) students favoured CBL, while 51 (22.87%) leaned toward PBL. EFA using 'Principal axis factoring' extraction method with 'Promax' rotation performed on 20 perception items is represented in Table 3. Kaiser–Mayer Olkin measure of sampling adequacy being 0.77, and a significant Bartlett's test of sphericity (χ^2 = 2594, df = 190 and $P < 0.001$) confirmed data suitability for factor analysis. The four extracted factors were – Factor I: Faculty guided structured content, II: Group Discussion related comfort/anxiety/stress, III: Time management and cognitive workload and IV: Effectiveness and clinical relevance.

Binary logistic regression analysis was carried out on Factors I, II, III, IV and academic performance (1st Internal Assessment results) to identify the predictors that influence the student preference of CBL over PBL. Factor I ($\beta = 2.01$, Odds ratio [OR] = 7.47, $P < 0.001$) and Factor II ($\beta = -0.84$, OR = 0.43, $P = 0.003$) obtained as the significant predictors of CBL preference are shown in Table 4. Moreover, academic performance demonstrated a significant negative association with CBL ($\beta = -0.04$, OR = 0.96, $P < 0.001$), indicating that meritorious students having high academic scores enjoyed open-ended self-directed inquiry-based PBL sessions.

The feedback of 8 facilitators on PBL and CBL sessions is shown in Figure 2. The perception of facilitators regarding

Table 3: Exploratory factor analysis (EFA) of feedback from 223 students.

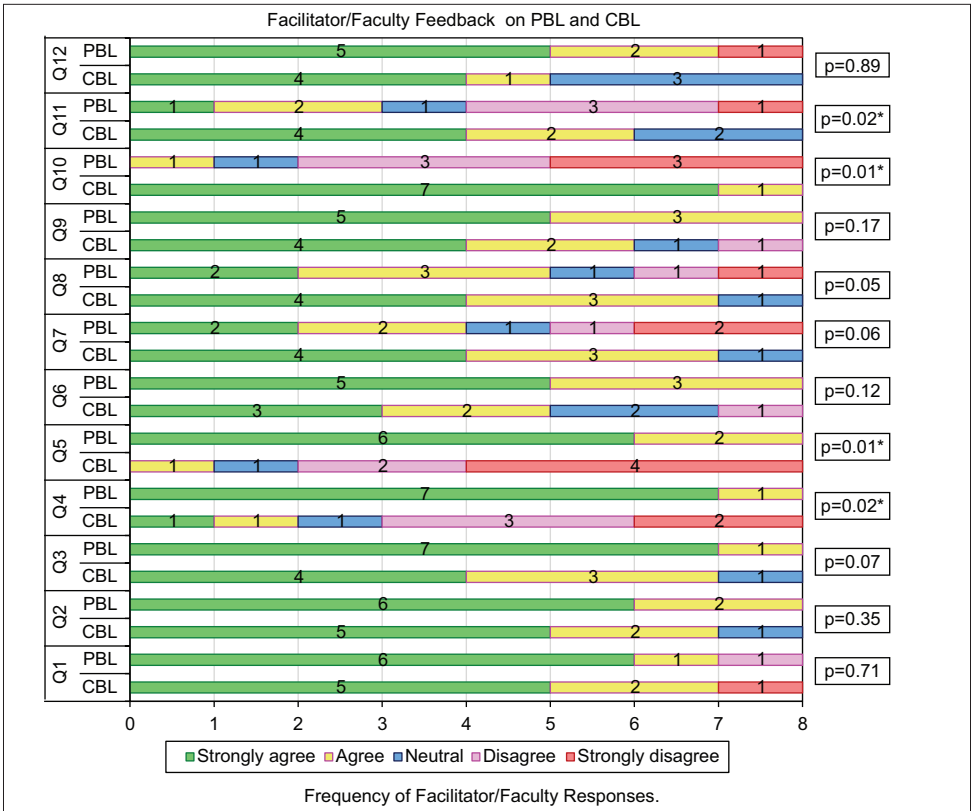
Items	Factor loading				Uniqueness
	1	2	3	4	
S. Faculty guided structured content and learning style:					
S1. I prefer structured learning with clear objectives under faculty guidance over open ended problem solving.	**0.85**				0.26
S2. I feel uncomfortable when I have to solve the problem independently through self-directed learning.	0.83				0.32
S3. CBL is more engaging than PBL.	0.77				0.41
S4. The structured nature of CBL improves my conceptual clarity and in-depth knowledge.	0.79				0.38
S5. I feel more motivated to prepare for CBL session in comparison to PBL session.	0.74				0.45
G. Group discussion related comfort/anxiety/stress:					
G1. I feel peer discussion improves my learning than faculty led discussion.		0.75			0.39
G2. I find it challenging in collaborating in a group due to unequal participation.		**0.88**			0.24
G3. I feel anxious in solving the clinical cases through interactive student led discussion.		0.83			0.34
G4. I feel confident in expressing my ideas and clearing my doubts in group discussion.		0.69			0.45
G5. PBL is better than CBL in improving communication skills and developing leadership qualities.		0.79			0.36
T. Time management and cognitive workload:					
T1. PBL sessions are time consuming and difficult to follow.			**0.96**		0.11
T2. I struggle with SDL concepts of PBL.			0.94		0.15
T3. I prefer learning method that require minimum preparation outside the class.			0.52		0.68
T4. PBL sessions are stressful as they require additional effort to explore resources.			0.56		0.67
T5. I feel satisfied with direct explanation provided by the faculty.			0.55		0.71
E. Effectiveness and clinical relevance					
E1. CBL helps me to perform better in exams compared to PBL.				0.76	0.41
E2. PBL is more effective in developing critical thinking, clinical reasoning and analytical skill in future than CBL.				**0.77**	0.39
E3. PBL encourages understanding of underlying concepts and integration of basic and clinical subjects.				0.70	0.50
E4. CBL helps long term retention of knowledge than PBL.				0.74	0.48
E5. CBL prepares me to apply knowledge for managing real life situations.				0.61	0.62

Principal axis factoring extraction method was used in combination with a Promax rotation for exploratory factor analysis, factor loadings below < 0.4 are not shown. Four factors: 1, 2, 3 and 4 were extracted accounting for 58.5% of total variance. The overall Cronbach's alpha for the questionnaire was 0.75 indicating acceptable internal consistency. The highest factor loading in the items are shown in bold. CBL: Case-based learning, PBL: Problem-based learning, SDL: Self Directed Learning.

Table 4: Binary logistic regression analysis of factors predicting students' preference for case-based learning (CBL) over problem-based learning (PBL).

Predictor	Beta coefficient(β)	Odds ratio (OR)	*P* value	95% confidence interval (CI) for OR
Factor 1	2.01	7.47	<0.001***	4.04 — 13.82
Factor 2	− 0.84	0.43	0.003**	0.25 — 0.75
Factor 3	− 0.05	0.95	0.81	0.62 — 1.45
Factor 4	0.11	1.12	0.63	0.70 — 1.80
Academic Performance	− 0.04	0.96	<0.001***	0.94 — 0.98

***P<0.001, **P<0.01. Binary logistic regression analysis gives the P value by SPSS software. It denotes the significance. Factor I: Faculty guided structured content. Factor II: Group Discussion related comfort/anxiety. Factor III: Time management and cognitive workload. Factor IV: Effectiveness and clinical relevance. Academic Performance: Based on results of First Internal Assessment.



Questions:-
This method:
Q1. Motivates to take interest in studying Physiology.
Q2. Helps to gain in depth understanding of the topic and enhanced conceptual knowledge.
Q3. Helps to integrate basic science subject with clinical subjects.
Q4. Stimulates critical thinking, clinical reasoning, problem solving and decision making.
Q5. Encourages Self Directed Learning (SDL).
Q6. Helps to improve communication skill.
Q7. Provides greater opportunity to participate in group discussion.
Q8. Helps to prepare better for examination.
Q9. Promotes longer retention of knowledge
Q10. Is Structured, easy to follow and less time consuming
Q11. Facilitate better teacher student interaction with active role of teacher
Q12. Prepares to manage real life situations.

Figure 2: Bar chart showing faculty feedback responses (in numbers) to different questions in the Likert scale. CBL: Case based learning, PBL: Problem based learning, *n* = number of faculties. *P*-value obtained using Wilcoxon Signed-Rank test by comparing faculty perception ratings on CBL and PBL (*$P < 0.05$).

the pros and cons of PBL and CBL was similar to the views of the students.

DISCUSSION

The extensive and meticulous planning of PBL and CBL sessions on two topics of Physiology (PY. 5.13 and PY. 6.7) was carefully designed to implement ECE in a classroom setting successfully, teach applied physiology and integrate basic science subjects with clinical discipline. The improvement in post-test scores from pre-test scores portrayed enhanced understanding of physiological concepts of the Phase I medical students in both approaches, which corroborated the previous studies.[6,9-14] The higher retention score in CBL in comparison to PBL, a new finding in this study, could be attributed to the structured design of CBL along with facilitator-guided discussion, helping the students to apply theoretical knowledge of basic science subjects to real-world clinical scenarios.

The immense preference of students for CBL 172 (77.13%) in contrast to PBL 51 (22.87%) as observed in this study is substantiated by the prevalent literature.[6,10,12,16-18]

Binary logistic regression analysis determined two statistically significant predictors of students' choice of CBL over PBL out of the four key factors identified by EFA. The structured format under the active supervision of a facilitator and equal opportunity for participants to take part in group discussion were the reasons for rating the CBL method positively. PBL could not prove to be appealing for the majority of the students due to stress, discomfort and anxiety in group collaboration and lack of confidence in peer discussion. Nevertheless, meritorious students with high academic scores were more inclined towards PBL as it emphasised SDL, autonomy and flexibility. They might have favoured PBL as it helped to develop critical thinking, clinical reasoning, problem solving, leadership qualities and decision-making skills essential for confronting real-life situations. The predictors obtained in the study affecting the student preferences provide a new insight that has not been previously documented.

The students as well as the faculty acknowledged the advantage of the PBL session. However, it posed a great challenge for 1st year students who had to take sole responsibility of finding resources and study materials to solve the problem independently, occasionally leading to incorrect knowledge acquisition and misconceptions.[6] Besides intricate planning, time-consuming session and rigorous training of facilitators required for PBL hinders its effective implementation. Thus, the CBL method promotes in-depth conceptual understanding in a structured environment, efficient utilisation of time, engagement of quiet/shy students in faculty-led group discussion and long-term knowledge retention is a more suitable approach for Phase I students.

In the opinion of students and the facilitators, both CBL and PBL promoted integration across the various disciplines, enhanced in-depth knowledge, improved communication skills and fostered examination readiness. Therefore, the benefits of both strategies are leading towards the development of a newer teaching-learning tool involving a combined PBL-CBL approach for preparing the students to manage real-world scenarios.[19,20]

Limitations

The study was performed in a single institution with a small sample size, a limited number of sessions and variable facilitator supervision, which might affect the generalisability of the outcomes.

CONCLUSION

These findings suggest that CBL is appropriate for 1st year M.B.B.S. students as it aligns well with the cognitive level and capability of transferable skills of beginners and bridges the gap between basic and clinical subjects. PBL can be gradually introduced in later years of the M.B.B.S. course when the students become accustomed to SDL and have gained sufficient knowledge of different disciplines. A blended approach incorporating both PBL and CBL methods may be implemented for the most comprehensive learning experience for Phase I undergraduate medical students.

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Ethical approval: The research/study was approved by the Institutional Review Board at Calcutta National Medical College, Kolkata, approval number EC-CNMC/601/2025, dated 8th February 2025.

Declaration of patient consent: The author certifies that they have obtained all appropriate patient consent.

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