

Comparing Dental Undergraduates' Perceptions Regarding Case-Based Learning and Problem-Based Learning: A Karachi Multi-Center Survey

Syed Akbar Abbas Zaidi¹, Anum Baqar², Saman Hakeem³, Farnaz Ilyas⁴, Irum Munir Raja⁵, Zafar Abbas⁶

Abstract

Objective: This study investigated and compared dental students' perceptions regarding case-based learning (CBL) and problem-based learning (PBL) in Karachi, Pakistan.

Methods: This was a cross-sectional analytical survey conducted across four institutions in Karachi from March to December 2021. The convenience sampling technique was used to extract the sample. The sample size of 384 was calculated using Openepi. The third and final-year undergraduate dental students who had experience with PBL and CBL participated. Feedback on the effectiveness & utility of PBL and CBL was gathered through a 5-point Likert scale. Results were checked for the significant association of variables under investigation through the utilization of an independent t-test. A p-value of 0.05 or less served as the benchmark for statistically significant findings.

Results: The survey was participated by 387 students, including 20.8% males and 79.1% females. Overall, 68.2% were satisfied with CBL as compared to PBL. 63.6% recommended using it as a prioritized teaching method, especially in the curriculum of clinical years of dentistry i.e. 64.3%. They praised its effectiveness in terms of decision-making, real-life application, achieving a higher level of knowledge, understanding course objectives, and managing time effectively. Students also valued PBL for enhancing their critical thinking, decision-making, and communication skills. The majority (57.4%) suggested employing it in the pre-clinical years of dentistry.

Conclusion: Dental students in Karachi favor CBL for its effective knowledge acquisition and practical application while acknowledging PBL's strengths in developing critical thinking and communication skills. However, future research exploring faculty perspectives and cross-disciplinary comparisons is recommended.

Keywords: problem-based learning, dental students, curriculum, active learning, decision-making, dental education.

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Introduction

Higher education didactics lectures are criticized for their passivity, clashing with modern learning needs, and hindering vital skills development like critical thinking and collaboration¹. In or-

der to keep pace with the global movement towards standardized international medical education while catering to the demand for diverse learning experiences, innovative curricula have integrated new teaching techniques. Not only do they impart information, but they also guide students toward the outcomes, enhance their analytical skills, promote deeper understanding and knowledge application, and thus provide lifelong learning experiences¹. These include prominent learning strategies such as problem-based learning (PBL), team-based learning (TBL), and case-based learning (CBL)².

Problem-based learning (PBL) has revolutionized medical education over the past four decades, posing contextualized questions rooted in real-life

¹ Department of Dental Education, Bahria University Medical and Dental College

² Bahria University Medical and Dental College

^{3,4} Department of Prosthodontics, Bahria University Medical and Dental College

⁵ Department of Prosthodontics, Liaquat College of Medicine and Dentistry

⁶ Department of Oral Medicine, DOW Dental College

Correspondence: Dr. Syed Akbar Abbas Zaidi
Department of Dental Education, Bahria University
Medical and Dental College

Email: akbrabbas_91@hotmail.com

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scenarios that can be either clinical or nonclinical³. This approach focuses on achieving specific goals. In small groups, students tackle real-world problems by applying their existing knowledge to form hypotheses. They then actively seek expertise from various disciplines to gain a comprehensive understanding of the issue while case-based learning (CBL) shares close ties with problem-based learning (PBL) in terms of its inquiry-based approach³. The students receive information about a patient's background or another clinical condition. Integrating data from various sources is crucial, especially the latest research findings, closely monitored vital signs, documented clinical presentations, and comprehensive laboratory findings. Ultimately, these strategies not only encourage teamwork and shared exploration but also empower students to actively formulate questions, solidify their understanding, and connect their learning across disciplines⁴⁻⁷.

One cross-sectional survey advocated that PBL is a better learning strategy since 84% of students favored PBL over CBL. In contrast, Srinivasan et al. asserted that case-based learning (CBL) necessitates advanced preparation from students compared to problem-based learning (PBL)^{7,8}. It also promotes structured learning and fosters critical thinking abilities in students, enabling them to correlate information, integrate knowledge, and collaborate effectively. Multiple studies also postulated that CBL promotes active participation, ownership of learning, critical thinking, and self-learning^{7,9,10}.

Since several Pakistani healthcare institutions are actively adopting CBL and PBL learning methods following the medical council's integrated curriculum push¹¹. Although multiple studies have investigated learners' perceptions about CBL and PBL at the institutional level, this study appeared to be the first to compare students' perceptions within diverse institutions across Karachi^{8,10,11}. Moreover, it will also discern its impact in relation to year of study. Thereby, it could help in preliminary data generation regarding which teaching method should be given more hours in the curriculum. The primary objective of this study was to evaluate the opinions of dental students at the undergraduate level on the utility of CBL and PBL. Additionally, the study aimed to assess students' preferences to be incor-

porated into the dental curriculum was the secondary motive of this work.

Methodology

This cross-sectional analytical survey was conducted across four institutions in Karachi, two private and two public sectors, from March to December 2021. The convenience sampling technique was used to extract the sample. The sample size 384 was calculated using the open-epi formula, i.e. $n = [DEFF * Np(1-p)] / [(d^2/Z^2(1-\alpha/2)^2 * (N-1) + p*(1-p)]$ where N is Population size (for finite population correction factor): 1000000, p is Hypothesized % frequency of outcome factor in the population: 50% +/- 5, d is Confidence limits as % of 100 (absolute +/- %): 5%, Deff is Design effect (for cluster surveys-DEFF): 1. The 3rd and final-year undergraduate dental students pursuing their BDS degree in institutions of Karachi and willing to provide their verbal consent were included in the study. Preclinical undergraduates of 1st and 2nd-year students, participants absent on the day of data collection, and dental house officers were excluded from this survey. This proposal received ethical clearance from the institutional review board with reference no.: ERC 72/2020.

The researcher conducted a thorough literature analysis to identify the questions for a self-designed, closed-ended questionnaire, which served as the study instrument. Following development, the questionnaire was examined by five experts in medical education. Each item was rated as relevant, useful but not relevant, or not relevant by experts. The majority of "not relevant" scores on a question were changed or eliminated. The medical education experts evaluated the questionnaire once again after it had been changed. On 10% of the sample size, a pilot study was conducted. The results obtained from the pilot research were used to modify the questionnaire. Following that, this survey was digitally formatted. Students were given a brief explanation of the study's goals and objectives prior to the questionnaire being given out. The online questionnaire and consent were given to the students, who were then asked to complete it. SPSS version 24.0 was used to enter the data once it

was collected from each institution listed.

The statistical analysis was both descriptive and inferential. For descriptive analysis, frequency and proportion were calculated for each variable. An independent T-test was applied to check the significant association of students' perceptions related to CBL and PBL, and the Chi-square test was used to evaluate students' perceptions among different colleges. A p-value of 0.05 or less served as the benchmark for statistically significant findings.

Results

Of the 387 students, 81 were males, and 306 were females. There were 190 third-year students and 197 fourth-year students. (Figure 1)

In a survey of 387 dental students, a majority of students 201 (57.4%) found CBL was an interesting teaching strategy, 239(68.2%) were satisfied with CBL as a teaching strategy. Thus, 228(65.1%) recommended that it should be included more frequently in the curriculum. Upon further elaboration, 201(57.4%) students suggested that PBL should be included in the pre-clinical curriculum of dentistry, while 225(64.3%) recommended implementing CBL in the clinical year of dental education (Table 1).

When used as a teaching strategy, CBL was found efficient in achieving higher levels of knowledge 179(51.2%), reduced the amount of time needed for self-study 217(62%), encouraged learning about practical cases and scenarios 209 (59.7%), helped in understanding course objectives 203(58.1%), accelerated decision-making potential 179(51.2%), and provided contextual knowledge to real-life situations in dentistry 220(62.8%). It also helped students manage their time effectively 228(65.1%) (Table1).

PBL, on the other hand, was found to be more effective in enhancing critical thinking 198(56.6%) and problem-solving skills 198(56.6%), challenging students in a way that confronts them in achieving the best learning outcomes (54.3%), and improved communication skills 220(62.8 %)as compared to CBL. However, PBL claimed to require more learning resources as compared to CBL 190(54.3%) (Table1).

However, students' perception of the impact of both PBL and CBL on learning attitudes ($p=0.549$), self-directed learning ($p=0.603$), prior knowledge activation ($p=0.569$), and textbook reading ($p=0.180$) showed no significant difference, suggesting mixed reactions. (Table 1)

Table 2 shows no significant differences in students' perceptions across the universities.

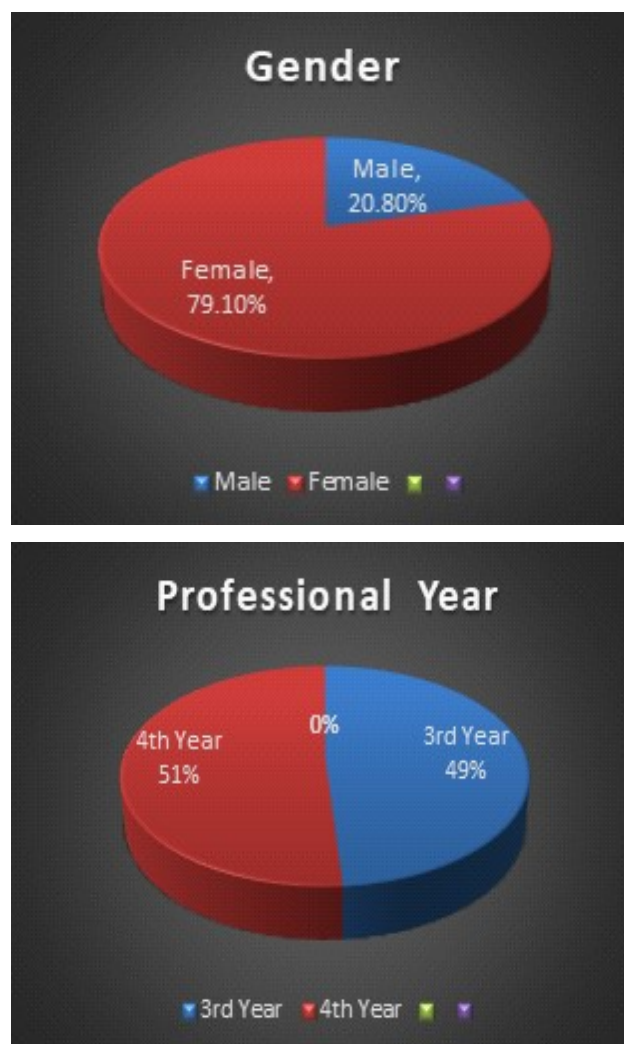


Fig 1. Demographics of the undergraduates' dental students

Table 1. Multi- faceted comparison of students' perceptions on CBL and PBL

Parameters	Mean	Frequency		Percentage (%)		Independent t-test
		CBL	PBL	CBL	PBL	
1. An interesting teaching strategy and helps in gaining adequate knowledge.	1.43	201	149	57.4	42.6	.000
2. The teaching method enhances learning and helps in achieving higher level of knowledge.	1.49	179	171	51.2	48.8	.001
3. The teaching method reduces the amount of time needed for self-study.	1.38	217	133	62	38	.000
4. The teaching method enhances higher order thinking (analyzing, synthesizing & evaluating theory into practical or real-life scenarios).	1.57	152	198	43.4	56.6	.000
5. The teaching method challenges you more to achieve the best learning outcomes.	1.54	160	190	45.7	54.3	.000
6. The teaching method has positive impact on your learning attitudes.	1.45	193	158	55	45	.549
7. The teaching method is most effective for learning.	1.37	220	130	62.8	37.2	.000
8. The teaching method you will recommend.	1.35	228	122	65.1	34.9	.000
9. The teaching method should be conducted more frequently in curriculum.	1.36	223	127	63.6	36.4	.000
10. The teaching method you are most satisfied with.	1.32	239	111	68.2	31.8	.000
11. The teaching method promotes more reading of the textbook?	1.47	187	163	53.5	46.5	.000
12. The teaching method has better result in terms of learning practical cases and scenarios.	1.4	209	141	59.7	40.3	.000
13. The method helps better in understanding course objectives	1.42	203	147	58.1	41.9	.000
14. The teaching method in which real life situations in dentistry are explained better.	1.37	220	130	62.8	37.2	.000
15. The teaching method needs more learning resources. (Like books, journals, elaborate).	1.54	160	190	45.7	54.3	.000
16. The method which activates prior knowledge.	1.46	190	160	54.3	45.7	.603
17. The method helps you to enhance your ability to find more information using materials other than books and lecture notes	1.5	174	176	49.6	50.4	.016
18. The method helps you to manage time effectively.	1.35	228	122	65.1	34.9	.038
19. The method improves your communication skills.	1.63	130	220	37.2	62.8	.569
20. The teaching method improves decision making skills.	1.49	179	171	51.2	48.8	.000
21. The teaching method improves problem-solving skills.	1.57	152	198	43.4	56.6	.000
22. The teaching method enhances self-directed learning.	1.48	182	168	51.9	48.1	.003
23. The teaching method should remain in the pre-clinical year of dentistry.	1.57	149	201	42.6	57.4	.000
24. The teaching method should remain in the clinical year of dentistry.	1.36	225	125	64.3	35.7	.180

Table 2. An Independent T-Test analysis revealing comparison of CBL and PBL in terms of learner's attributes

Questions	Methodology	G	G	P	P	Chi-Square p-value
		Institute 1	Institute 2	Institute 3	Institute 4	
1. An interesting teaching strategy and helps in gaining adequate knowledge	CBL	57.1%	50.6%	68%	45%	.011
	PBL	42%	49.4%	32%	55%	
2. The teaching method enhances learning and helps in achieving higher level of knowledge.	CBL	52.1	47	57.6	41.7	.182
	PBL	47.9	53	42.4	58.3	
3. The teaching method reduces the amount of time needed for self-study.	CBL	63	62.7	59.2	65	.870
	PBL	37	37.3	40.8	35	
4. The teaching method enhances higher order thinking (analyzing, synthesizing & evaluating theory into practical or real-life scenarios).	CBL	43.7	39.8	49.6	35	.245
	PBL	56.3	60.2	50.4	65	

5.	The teaching method challenges you more to achieve the best learning outcomes.	CBL	46.2	42.2	50.4	40	.506
		PBL	53.8	57.8	49.6	60	
6.	The teaching method has positive impact on your learning attitudes.	CBL	55.5	49.4	63.2	45	.076
		PBL	44.5	50.6	36.8	55	
7.	The teaching method is most effective for learning.	CBL	63.9	62.7	62.4	61.7	.992
		PBL	36.1	37.3	37.6	38.3	
8.	The teaching method you will recommend.	CBL	66.4	61.4	68.8	60	.569
		PBL	33.6	38.6	31.2	40	
9.	The teaching method should be conducted more frequently in curriculum.	CBL	64.7	63.9	61.6	65	.954
		PBL	35.3	36.1	38.4	35	
10.	The teaching method you are most satisfied with.	CBL	69.7	62.7	72	65	.489
		PBL	30.3	37.3	28	35	
11.	The teaching method promotes more reading of the textbook?	CBL	43.7	44.6	36.8	50	.354
		PBL	56.3	55.4	63.2	50	
12.	The teaching method has better result in terms of learning practical cases and scenarios.	CBL	60.5	59	60.8	56.7	.952
		PBL	39.5	41	39.2	43.3	
13.	The method helps better in understanding course objectives	CBL	59.7	54.2	61.6	53.3	.610
		PBL	40.3	45.8	38.4	46.7	
14.	The teaching method in which real life situations in dentistry are explained better.	CBL	64.7	66.3	56	68.3	.276
		PBL	35.3	33.7	44	31.7	
15.	The teaching method needs more learning resources ? (Like books, journals, elaborate).	CBL	47.1	42.2	48	43.3	.823
		PBL	52.9	57.8	52	56.7	
16.	The method which activates prior knowledge.	CBL	54.6	50.6	57.6	51.7	.758
		PBL	45.4	49.4	42.4	48.3	
17.	The method helps you to enhance your ability to find more information using materials other than books and lecture notes.	CBL	49.6	43.4	60	36.7	.013
		PBL	50.4	56.6	40	63.3	
18.	The method helps you to manage time effectively.	CBL	66.4	67.5	59.2	71.7	.341
		PBL	33.6	32.5	40.8	28.3	
19.	The method improves your communication skills.	CBL	37	32.5	48.8	20	.001
		PBL	63	67.5	51.2	80	
20.	The teaching method improves decision making skills.	CBL	52.1	47	57.6	41.7	.182
		PBL	47.9	53	42.4	58.3	
21.	The teaching method improves problem-solving skills.	CBL	43.7	38.6	51.2	33.3	.095
		PBL	56.3	61.4	48.8	66.7	
22.	The teaching method enhances self-directed learning.	CBL	52.9	41	66.4	35	.000
		PBL	47.1	59	33.6	65	
23.	The teaching method should remain in the pre-clinical year of dentistry.	CBL	43.7	44.6	36.8	50	.354
		PBL	56.3	55.4	63.2	50	
24.	The teaching method should remain in the clinical year of dentistry.	CBL	65.5	63.9	63.3	64.3	.990
		PBL	34.5	36.1	36.0	36.7	

Discussion

Inquiry-based teaching methods foster enhanced learning abilities. Student-directed learning puts students in the driver's seat, enabling them to define their goals, set learning objectives, and actively seek resources. Case-based and problem-based learning then act as bridges, seamlessly connecting theoretical knowledge to the practical world, enriching understanding, and preparing students for real-world applications^{9,12}.

Overall, the results of this study explored the students' preference for CBL as a more effective

learning strategy. They perceived it as more engaging than PBL and, hence, recommended incorporating CBL into the curriculum instead of traditional methods. Students perceived CBL to be significantly better than PBL at improving their conceptual understanding, knowledge acquisition, real-world application, and discipline-specific learning objectives. Furthermore, a comparison of student perceptions across various teaching institutions yielded similar results for the majority of the investigated aspects. However, Srinivasan M. et al. demonstrate an interesting exception in their study. The researchers conducted a comparison of the utility of

two learning methods: Problem-Based Learning (PBL) and Case-Based Learning (CBL) at two prestigious California institutions: UCLA and UCD⁷. Interestingly, the study revealed significant variations in how each institution perceived both the teaching methods⁷. Another study conducted in medical schools that switched their doctoring courses from PBL to CBL formats. Ten months later, students and faculty who had gained experience in both modes of instructional methods completed a 24-item questionnaire about their perceptions. It revealed that CBL is more effective in learning inter-professional curriculum through CBL as compared to PBL. In addition to this, it showed improved student satisfaction with this learning style¹³.

Another work also showed an overwhelming majority of students and faculty, representing 89% and 84% respectively, expressed their proclivity for CBL over PBL. This sentiment was consistent both at faculty and learner levels¹⁴. One of the study compared the effectiveness of three instructional strategies such as lectures, CBL and PBI, the results showed that CBL outperformed traditional learning modes in terms of enhancing performance, yet it fell short of problem-based learning in its effectiveness⁷. A study was conducted to assess the efficacy of CBL in Prosthodontics education among dental interns. A purposive sample of 45 dental interns was recruited for the study. The overall findings demonstrated a favorable perception towards CBL effectiveness¹⁵.

Proponents of case-based learning like Singh P. argued that it's a superior strategy to problem-based learning for boosting various cognitive skills and fostering a positive learning environment through knowledge retention, reasoning and problem-solving skills, the ability to make objective judgments, identify relevant issues, recognize multiple perspectives, and awareness of ethical issues, inculcates positive attitudes among faculty and students, increases class attendance, and enhances learning outcomes¹⁶. Although our study findings are parallel with all the mentioned traits except developing critical thinking and problem solving skills where PBL

was found to be more efficient. However, Setia S et al, in consistent with our study, explored the fact that CBL is also capable in improving student's clinical reasoning, diagnostic interpretations, and logical thinking skills¹⁷.

Interpersonal skills are another essential trait for a healthcare professional¹⁸. Majority students in our study reported that their communication skills significantly improved in PBL as compared to CBL. This is in harmonious with the Setia S and Salman SM studies^{17,18}. This may probably due to the fact that PBL, being an unguided inquiry approach, demands more independent approach to learning than CBL. Conversely, there are some studies which support CBL in terms of developing communication skills claiming that since it is a guided learning approach in which facilitator has an additional influence on learner, besides his peers, to encourage him to play his role in group discussion^{15,19}.

The present study revealed that CBL is an interesting learning strategy that fosters high level of knowledge and thus, helps in understanding the coarse objectives better than PBL does. However, it is in contrast to the study did by Salman A et al who revealed that students perceived PBL learning approach as more stimulating and engaging than the CBL strategy due to its ability to evoke situational interest, which consequently heightened their motivation to achieve specific learning objectives¹⁸. Similarly, Among Nigerian participants, a substantial number expressed a strong preference for PBL. They perceived it as more effective in accomplishing learning objectives, fostering a deeper understanding of facts, and encouraging active student engagement in the learning process²⁰.

In the present study, the participants agreed that both types of inquiry-based learning were equally effective in fostering positive learning attitudes, encouraging self-regulated learning, stimulating baseline knowledge, and sparking curiosity that prompted learners to utilize learning resources other than textbooks and lectures to tackle the task diligently. Shigli et al. Haley et al. and Tawfik AA regarded CBL as the one that majorly relies on

the learner's existing knowledge, whereas PBL identifies the knowledge gap more efficiently^{15,21,22}. Moreover, Pinto BL et al. argued that PBLs, because of its multifaceted nature, empower learners to take ownership of their learning process. In this regard, it also encourages learners to use websites and other reading material, including textbooks²³.

While this study focused solely on dental students' perceptions of CBL and PBL within Karachi, its adequate sample size and multi-institutional approach enhanced the generalizability of its findings to a broader dental student population. Additionally, reliable and accurate data capturing was ensured through a self-constructed questionnaire, which was developed by the institutional dental education experts undertaking local cultural needs and demands and, finally, refined through a pilot study.

An analysis of learner perceptions across different teaching institutions revealed variations in their evaluations of their learning experiences. Notably, these variations were not statistically significant for most aspects. However, some exceptions emerged, including the perceived effectiveness of teaching strategies in fostering interest, developing communication skills, promoting independent learning, and utilizing diverse learning resources beyond traditional resources like textbooks and lectures.

It is recommended that several avenues offer intriguing prospects for further research. Incorporating faculty input alongside student perceptions could grant a better holistic understanding of the effectiveness & utility of both learning methods. Furthermore, comparative studies involving other healthcare disciplines like MBBS and other allied health sciences could offer valuable insights into potential differences in learning preferences and outcomes across disciplines. Ultimately, qualitative research methods could delve deeper into the underlying reasons behind the preliminary findings, revealing the "why" beyond the "what" observed in this study.

Dental students in Karachi favor CBL for its effective knowledge acquisition and practical application while acknowledging PBL's strengths in develo-

ping critical thinking and communication skills. However, future research exploring faculty perspectives and cross-disciplinary comparisons is recommended.

Conclusion

The majority of dental undergraduates across various dental institutions expressed a strong preference for CBL as a better learning strategy, particularly for acquiring clinical science knowledge. They strongly recommend CBL for its effective use in solving real-life scenarios, which fosters qualities like decision-making skills and time management and enhances knowledge by supporting course objectives achievement. While PBL is recognized by many students for its effectiveness in sharpening critical thinking, problem-solving, and communication skills, its resource-intensive nature makes it more suitable for seeking basic science subjects. However, future research exploring faculty perspectives and cross-disciplinary comparisons is recommended.

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