

Case-based learning with a twist: Testing the effectiveness of integrated case-based learning in an undergraduate dental curriculum

Taliya Sajjad^{*1}, Ayesha Younas², Laila Shakeel Abbasi³

^{*1} Senior Lecturer, Department of Medical and Dental Education, Shifa College of Dentistry, STMU, Islamabad, Pakistan

² Assistant Professor, Department of Medical and Dental Education, Shifa College of Dentistry, STMU, Islamabad, Pakistan

³ Assistant Professor, Department of Medical and Dental Education, Shifa College of Dentistry, STMU, Islamabad, Pakistan

Author's Contribution

¹ Data Collection, Manuscript Writing

² Conception of Idea, Data Collection, Manuscript Writing

³ Data Collection, Manuscript Writing

Article Info.

Conflict of interest: Nil

Funding Sources: Nil

Correspondence

* Taliya Sajjad

taliya.scd@stmu.edu.pk

Cite this article as: Sajjad T, Younas A, Abbasi LS. Case-based learning with a twist: Testing the effectiveness of integrated case-based learning in an undergraduate dental curriculum. *JSTMU*. 2023; 6(2):65-71.

A B S T R A C T

Introduction: Integrated Case-based learning (i-CBL) is a variation of traditional case-based learning in which integrated cases are developed to emulate real-life scenarios that healthcare practitioners encounter in everyday practice. This study explores the effectiveness and relative success of i-CBL pedagogy in an undergraduate dental curriculum.

Objective: To assess the impact of the i-CBL as a pedagogical strategy in an undergraduate dental curriculum..

Methodology: i-CBL was introduced in three years of a Bachelor of Dental Surgery (BDS) program. Cases based on integrated modules in the curriculum were developed and vetted by trained faculty. Students were also introduced to the i-CBL concept, and their detailed online feedback was taken on completing each i-CBL session in their academic year. Descriptive and analytic statistics were used for the Likert response data, and thematic analysis was conducted for the free text items.

Results: Eighty-three feedback questionnaires were collected from students throughout the year (18.2% first year, 47.5% second Year and 34.3% third Year). There was a significant difference in the students' perceptions regarding the conduct of the i-CBL over the three BDS years ($p=0.00$). However, there was no significant difference in their delivery by the concerned tutors ($p=0.468$) and the scenario construct ($p=0.55$). Thematic analysis of free text comments also highlighted overall student satisfaction with the i-CBL pedagogy.

Conclusion: This study highlights the value of introducing i-CBL. More focus on faculty training and the development of appropriate cases will be helpful for effective student learning.

Keywords: Case-based learning, Dental Education, Integrated learning, Integration

Introduction

Across the world, undergraduate (UG) medical and dental curriculum planners now accept the value and benefits of integrating curricular content to facilitate student learning, enhancing the motivation of the students and using critical thinking as a key to improving learning qualities typically overlooked in the formal traditional curriculum of students.¹ Integration enables students to

become active learners and critical thinkers by developing their ability to apply knowledge in realistic, life-like scenarios or cases. They need to find, evaluate and utilize relevant information.² To inculcate these traits in individual learners, an environment of active learning and critical thinking needs to be promoted among the students

at the level of UG education by promoting student-centred pedagogical techniques.³

The health education curriculum has developed and implemented Multiple small-group teaching strategies according to available resources and student needs. These strategies aim to provide a learner-centred environment to the students. Case-based learning (CBL), team-based learning (TBL), and problem-based learning (PBL) are among the popular small-group teaching methods. PBL uses a guided learning format where learning takes place through problem-solving and self-study. The facilitator usually is only present at the second meeting. CBL is an inquiry-based learning format where a structured and critical approach is encouraged to solve clinical problems. Compared to PBL, CBL is less time-consuming and draws the students' focus to crucial points of the clinical case.⁴

Similarly, PBL is more complex and demanding because the students have to solve without the help from the instructor directly. At the same time, CBL is facilitated by an instructor who is a subject specialist and helps the students throughout the session. However, the success of each approach depends on how it is implemented and must be adapted to suit the student, instructor and available resources.^{5,6}

Case-based learning (CBL) is a student-centred learning approach designed around a clinical problem through which students identify their learning requirements, enquire, and correlate theory and practice.⁶ Active participation of the students in case-based learning sessions enhances their ability to clinically apply their knowledge and become better prepared for patient treatment in workplace settings.^{7,8} CBL has emerged as a powerful tool in reforming traditional teaching methods with its group discussion-styled teaching approach. However, although CBL is a commonly used teaching modality in many institutions across the globe, cases developed by faculty are usually discipline-specific and may not adequately represent real-life scenarios.^{9,10}

The full benefits of integration can only be achieved when various teaching and learning activities within a curriculum are also developed and implemented consciously, keeping in perspective the integrated

approach which may have been used to align the curricular content.¹¹ In line with this view, Integrated case-based learning (i-CBL), an innovation of CBL, seems to be a more suitable pedagogy for student learning. In i-CBL, cases are developed, emulating real-life scenarios where health professionals may face many problems in a single case.¹²⁻¹⁴ Although much information exists on traditional discipline-focused case-based learning, we could not find much literature supporting the use of integrated case-based learning in UG Health Professions Education. The few studies that reported its use documented that i-CBLs provide students with a learning environment like actual practice with reality-based situations. Thus improving their professional encounters with their patients.^{12,13}

This study aims to evaluate the overall effectiveness of i-CBL as a pedagogy in undergraduate dental education and compares the success of i-CBL across basic, preclinical and clinical years in a UG dental program in Pakistan.

Methodology

Ethical approval for this study was taken from the Institutional Review Board (IRB) of the Shifa Tameer-e-Millat University (STMU) with approval number IRB # 093-22. All study participants provided their informed consent before participating in the study.

Study design:

A cross-sectional descriptive study was carried out using a self-administered questionnaire. The duration of the study was 8 months after the approval of the Institutional Review Board, Shifa International Hospital.

Study Setting:

The college where our study was conducted was established in 2020. The Bachelor of Dental Surgery (BDS) program at the college is a four-year undergraduate program with curriculum content integrated horizontally and vertically across the years. The curriculum content is integrated based on body systems and diseases, with separate integrated modules covering each component. In line with this vision and keeping in view the design of the curriculum, it was decided to introduce integrated case-based learning (i-CBL)

throughout the four curricular years to ensure the development of students' problem-solving and critical thinking abilities. To ensure that i-CBL was effectively implemented, faculty members were initially trained to develop i-CBL scenarios and conduct and evaluate an i-CBL session. After training, i-CBL scenarios were created by the faculty and reviewed by the Department of Medical Education. Introductory sessions about the i-CBL methodology and its implementation were held with students each academic year.

The i-CBL sessions were then conducted in various integrated modules in the three running years of the BDS program throughout the Academic Year 2022. Each integrated module had two separately dedicated i-CBL sessions placed near the completion of the module. i-CBL session 1 introduced the students to the case under discussion, provided them with the learning objectives and resources, and encouraged them to utilize their self-study skills. i-CBL session 2 focused on students discussing their proposed solutions to the case and addressing their queries. After the i-CBL session II, the students evaluated the entire i-CBL process by filling in an online feedback questionnaire focused on the three aspects covered in the faculty training session.

Participants

Dental students in the first three years of the BDS program who attended the i-CBL sessions at the end of each teaching module for the Academic Year 2022 were invited to provide feedback via an online questionnaire. Convenient sampling was used for the study. The inclusion criteria included:

1. Students willing to participate in the study.
2. All students who attend both i-CBL sessions during a particular module.

The exclusion criteria were as follows:

1. Students not willing to participate
2. Students who were not present in both i-CBL sessions.

Sample size: The sample size was not calculated as all participants meeting the inclusion criteria and providing informed consent were requested to participate.

Data collection:

The post i-CBL questionnaire consisted of 9 items divided into three sections related to the i-CBL scenario, i-CBL conduction and i-CBL tutor preparedness. Participants were also asked to fill in free text fields at the end of each section with suggestions for improvements in the scenario and conduct of the i-CBL, along with their feedback on the tutor.

A five-point Likert scale from strongly agree to disagree strongly was developed and divided into three sections, each with three more items. Each section also had a free text question at the end. The three educationists reviewed the questionnaire for face validity before administration to the participants. Pilot testing of the questionnaire was done on a sample of students from different academic years to ensure reliability.

After conducting the second i-CBL session, these questionnaires were shared with the students through Google Forms and data was collected online. All participants were requested to provide informed consent before completing the questionnaire.

No selection bias was identified. All students who agreed to participate and satisfied the eligibility criteria were included.

Data analysis:

The Likert scale responses for each variable were analyzed individually using descriptive statistics through SPSS (ver. 23.0; SPSS inc, Chicago, IL, USA). The sum of the responses for each of the three categories was also analyzed similarly. Pearson's chi-square test was performed to determine any statistical significance in the student responses for the three categories related to the construct of the i-CBL scenario, their conduction, and their delivery by the i-CBL tutors across the BDS years. Two authors (TS and LSA) analyzed the free text comments using open coding to generate initial codes. The codes were reviewed to identify and develop themes through further discussion between the same authors (TS and LSA).

Results

Quantitative Results:

Across the academic year 2022, 14 i-CBLs were conducted. A total of 183 participants filled in the feedback questionnaires, of which 18.2% were in the first year, 47.5% were in 2nd year, and 34.3% were in third Year BDS. The responses were anonymous, and descriptive data of the participants was not collected. The feedback survey was sent to all students who attended the i-CBL sessions. Students were repetitively invited to provide feedback after each i-CBL session they attended so that each i-CBL could be evaluated independently. The number of responses for each i-CBL session across the years can be seen in Figure 1.

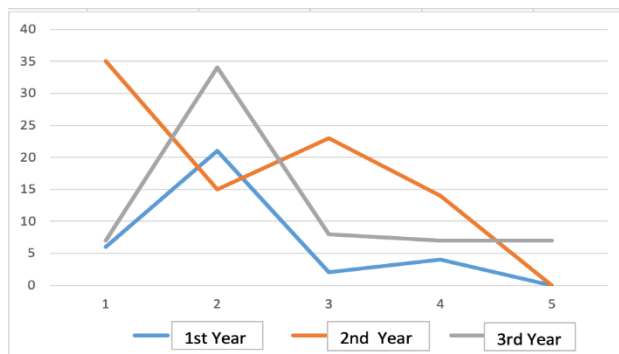


Figure 1: Number of responses received for each i-CBL session across 3 years of the BDS program.

Our results showed that in all three years of the BDS program, students were overall satisfied with the i-CBL pedagogy. Table 1.1 presents the mean and standard deviation values for student responses related to the construct of the i-CBL scenarios. Students from the 1st Year ($M= 4.24 \pm .867$) were slightly less satisfied with the elaborateness of the i-CBL scenario as compared to the 2nd ($M= 4.51 \pm .834$) and 3rd years ($M=4.59 \pm .557$). This is also reflected in the response of the 1st year students regarding ease of discussion for the scenario ($M=4.30 \pm .585$).

Table 1.2 presents mean and standard deviation values for student responses related to the conduction of the i-CBL sessions. 1st-year students again felt that they were provided less time for preparation of i-CBL sessions ($M= 3.76 \pm 1.347$) compared to other years, while 2nd and 3rd years seemed satisfied not only with the preparation time for the i-CBL sessions but also the time provided for discussion during the i-CBL session itself.

Table 1.3 represents the mean and standard deviation values for the students' responses related to facilitation skills by the tutor. Responses showed high means regarding the encouragement of student participation ($4.60 \pm .703$), maintaining the direction of the session ($4.6 \pm .680$) and providing timely feedback ($4.55 \pm .754$) from all three years.

Table 1.1: Mean and Std. Deviation values for the construct of the i-CBL scenario

Academic Year	1st Year	2nd Year	3rd year	Overall Score
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
The scenario was elaborate and had all the relevant information	4.24 \pm 0.86	4.51 \pm 0.83	4.59 \pm 0.55	4.49 \pm 0.76
The scenario was concise and clear	4.48 \pm 0.56	4.49 \pm 0.77	4.68 \pm 0.53	4.56 \pm 0.66
The scenario was easy to discuss	4.30 \pm 0.58	4.54 \pm 0.80	4.59 \pm 0.58	4.51 \pm 0.70

Table 2.2: Mean and Std. Deviation values for the conduct of the i-CBL session

Academic Year	1st Year	2nd Year	3rd year	Overall Score
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Enough time was given for the preparation of i-CBL	3.76 \pm 1.34	4.41 \pm 0.99	4.62 \pm 0.55	4.37 \pm 0.99
Adequate time was available for discussion of i-CBL	4.00 \pm 1.25	4.63 \pm 0.74	4.51 \pm 0.71	4.48 \pm 0.87
The discussions facilitated learning and integration of concept	4.12 \pm 0.89	4.55 \pm 0.74	4.65 \pm 0.51	4.51 \pm 0.72

Overall responses show that the participants were satisfied with the facilitator and their preparedness. Students felt that the tutors not only encouraged equal participation of all students but also maintained the direction of the session and provided timely feedback. However, the participants reported that the i-CBL scenarios were not elaborate and needed improvement. Pearson's chi-square test was applied to determine any

statistical significance in the student responses for the three categories related to the construct of the i-CBL scenario, their conduction, and their delivery by the i-CBL tutors across the BDS years.

Table 3.3: Mean and Std. Deviation values for Facilitation by the i-CBL tutor

Academic Year	1st Year	2nd Year	3rd year	Overall Score
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Encouraged equal participation of all students in discussion	4.55 ± 0.83	4.60 ± 0.75	4.63 ± 0.54	4.60 ± 0.70
Maintained the direction of the session	4.45 ± 0.79	4.63 ± 0.73	4.62 ± 0.52	4.60 ± 0.68
Provided timely feedback during the discussion	4.33 ± 0.99	4.62 ± 0.73	4.56 ± 0.61	4.55 ± 0.75

Our results show that there was a significant difference in the perceptions of the students regarding their conduct over the three BDS years. However, there was no significant difference in their delivery by the concerned tutors and the scenario construct, as shown in Table 2.

Table 4: Percentage agreement values and statistical relationship in each of the three categories across the three years of the BDS program

Academic Year	1 st Year	2 nd Year	3 rd year	Chi-square Value	df	Asymptomatic significance
Construct of the i-CBL Scenario	86.6	90.2	92.2	3.045 (LR= 4.327)	4	0.55 (0.364)
Conduct of i-CBL session	79	90.6	91.8	27.622 (LR= 23.65)	4	0.00 (0.000)
Facilitation by the i-CBL tutor	88.8	92.2	92	3.563 (LR= 4.719)	4	0.468 (0.395)

Qualitative Results:

Two researchers (TS and LSA) analyzed the qualitative data manually. Codes were selected as words/statements., which gave concepts of the participant's perceptions. Similar codes were combined to develop themes. The main themes the participants highlighted were "Increase the number of i-CBL sessions"

and "Facilitation by the i-CBL tutor". A few participant quotes are mentioned below in Table 3.

Discussion

Integrated case-based learning as a pedagogy has been well received by students studying in an undergraduate dental curriculum. Like any other pedagogy, the factors that aided in implementing i-CBLs successfully in our context were planned faculty trainings.^{15, 16} However, all the faculty were trained at the same level. Students in our program's first year experienced some difficulty understanding and discussing the integrated cases compared to students in preclinical and clinical years. This is understandable, as students in their first year usually adapt to a new, professionally-oriented curriculum and take time to grasp more contemporary pedagogies.^{17, 18} Interestingly However, first-year students had difficulties regarding the i-CBL cases and conduct. They were delighted with their tutors. Therefore, in the coming years, we proposed to review the i-CBL cases and adapt them to cater to the level of our learners.

Our thematic analysis of student comments showed that most participants were satisfied with the i-CBL sessions. The participants were more eager to have i-CBL sessions than traditional teaching methodologies. Participants also indicated their satisfaction with the tutors involved in the i-CBLs, as they motivated them to have

discussions and ask questions. The teacher's preparedness was reflected in the participant's responses, and their tutors answered most of their queries and difficulties during the discussions.

A recent systematic review on the effectiveness of case-based learning in Chinese dental education lists 21 studies that utilized case-based learning in various dental courses or specialities.¹⁹ Almost all these studies

elucidate the benefits of case-based learning in independent or separate specialities but do not provide evidence of developing integrated cases. It must be noted that the aim of any undergraduate health professions education degree is usually to produce a general practitioner, and general practitioners are exposed to patients with an array of complaints which fall in the domain of multiple specialities. Thus, an undergraduate program requires students to be exposed to various integrated real-life scenarios or cases that can better prepare them for practice. Our results are similar to the few studies on i-CBL,^{12, 20} that we could find in the literature. We feel that this study will be helpful for educators planning to introduce i-CBL in undergraduate Health Professions education curricula. One of the aims of modern-day professional education is to ensure that future professionals develop self-directed and lifelong learning skills, and the i-CBL pedagogy can also be a valuable aid in achieving this aim in all phases of undergraduate education.

Table 5: Qualitative quotes by the participants

Domain	Participant quotes
Increase the number of i-CBL sessions.	"There should be more CBLs in one module."
	"We want more CBLs in the module...."
	"Consider more CBLs for better presentations."
Facilitation by the i-CBL tutor	"Provides all information concisely and clearly."
	"Asked thought-provoking questions and provided enlightening information."
	"Allowing all students to speak comfortably while also asking relevant questions."
	"Cooperative, helpful understanding and has full knowledge of the topic."
	"Maintained discipline and encouraged participation."
	"She had good communication, motivation, enthusiastic, friendly and encouraged independence."

We advocate that further implementation and research on the i-CBL pedagogy in undergraduate health professions curricula will benefit students and better prepare them to become active and self-directed learners.

Conclusion

This study provides evidence of the effectiveness of the i-CBL pedagogy in the undergraduate dental curriculum. Curriculum planners and faculty involved must also ensure that i-CBL cases are planned and developed keeping in view the curriculum structure and context, along with the level for learners for which they are intended. The authors acknowledge that the main limitation of our study is that it is a single-centre study. However, our integrated dental curriculum based on our i-CBL strategy is unique yet implemented only in our institution.

We also acknowledge that since our students were asked to provide feedback on the same questionnaire throughout the year, they may have been affected by repetition bias regarding the conduct of the i-CBL sessions. This study shall be helpful for the medical teachers in planning and implementing i-CBLs, keeping in mind the aspects reported by the students to have halted their learning and preparedness for the sessions. The teachers can be given training mainly focusing on constructions of i-CBL scenarios for smooth implementation and effective student learning.

Acknowledgements

The Authors would like to acknowledge the participants of the study, who took time and shared their valuable experiences.

References

1. Bin Abdulrahman KA, Mennin S, Harden RM, Kennedy C. Routledge International Handbook of Medical Education. Routledge International Handbook of Medical Education. Taylor and Francis Inc.; 2015. 1-377 p.
2. Mennin S. Integration of the sciences basic to medicine and the whole of the curriculum. In: Routledge International Handbook of Medical Education. Taylor and Francis Inc.; 2015. p. 171-87.
3. Linton DL, Pangle WM, Wyatt KH, Powell KN, Sherwood RE. Identifying key features of effective active learning: The effects of writing and peer discussion. *CBE Life Sci Educ*. 2014; 13(3):469-77. DOI: <https://doi.org/10.1187/cbe.13-12-0242>
4. van Diggele C, Burgess A, Mellis C. Planning, preparing and structuring a small group teaching session. *BMC Med Edu*. 2020; 20(2):1-8. DOI: <https://doi.org/10.1186/s12909-020-02281-4>
5. Pinto BL. Distinguishing between Case Based and Problem Based Learning. *Int J High Educ*. 2023; 7(3):246-56. DOI: <https://doi.org/10.1080/24711616.2022.2111286>

6. Kaur G, Rehncy J, Kahal KS, Singh J, Sharma V, Matreja PS, et al. Case-Based Learning as an Effective Tool in Teaching Pharmacology to Undergraduate Medical Students in a Large Group Setting. *J Med Educ Curric Dev.* 2020; 7:238212052092064. DOI: <https://doi.org/10.1177/2382120520920640>
7. McLean SF. Case-based learning and its application in medical and healthcare fields: a worldwide literature review. *J Med Educ Curric Dev.* 2016; 3:JMECD-S20377. DOI: <https://doi.org/10.4137/JMECD.S20377>
8. Beck J, Rooholamini S, Wilson L, Griego E, McDaniel C, Blankenburg R. Choose Your Own Adventure: Leading Effective Case-Based Learning Sessions Using Evidence-Based Strategies. *MedEdPORTAL.* 2017; 13:10532. DOI: https://doi.org/10.15766/mep_2374-8265.10532
9. Williams B. Case-based learning—a literature review: is there scope for this educational paradigm in prehospital education?. *Emerg Med J.* 2005; 22(8):577-81. DOI: <https://doi.org/10.1136/emj.2004.022707>
10. Thistlethwaite JE, Davies D, Ekeocha S, Kidd JM, MacDougall C, Matthews P, et al. The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. *Med Teach.* 2012; 34(6):e421-44. DOI: <https://doi.org/10.3109/0142159X.2012.680939>
11. Garvey MT, O'Sullivan M, Blake M. Multidisciplinary case-based learning for undergraduate students. *Eur J Dent Educ.* 2000; 4(4):165-8. DOI: <https://doi.org/10.1034/j.1600-0579.2000.040404.x>
12. Afaghi A, Mohamadi AAHA, Sarchami R, Ziaee A. Effect of an integrated case-based nutrition curriculum on medical education at Qazvin University of Medical Sciences, Iran. *Glob J Health Sci.* 2012; 4(1):112. DOI: <https://doi.org/10.5539/gjhs.v4n1p112>
13. Malau-Aduli BS, Lee A, Cooling N, Catchpole M, Jose M, et al. Retention of knowledge and perceived relevance of basic sciences in an integrated case-based learning (CBL) curriculum. *BMC Med Educ.* 2013; 13(1):1-8. DOI: <https://doi.org/10.1186/1472-6920-13-139>
14. Chan WP, Hsu CY, Hong CY. Innovative" Case-Based Integrated Teaching" in an undergraduate medical curriculum: development and teachers' and students' responses. *Ann Acad Med Singap.* 2008; 37(11):952.
15. Daher AM, Singh HJ, Kutty MK. Differentiating case-based learning from problem-based learning after a two-day introductory workshop on case-based learning. *Australasian Med J.* 2017; 10(12). DOI: <https://doi.org/10.21767/AMJ.2017.3142>
16. Das S, Das A, Rai P, Kumar N. Case-based learning: Modern teaching tool meant for present curriculum: A behavioral analysis from faculties' perspective. Vol. 10, *Journal of Education and Health Promotion.* *J Educ Health Promot;* 2021. DOI: https://doi.org/10.4103/jehp.jehp_1265_20
17. McLean SF. Case-Based Learning and its Application in Medical and Healthcare Fields: A Review of Worldwide Literature. *J Med Educ Curric Dev.* 2016; 3:JMECD.S20377. DOI: <https://doi.org/10.4137/JMECD.S20377>
18. Kulak V, Newton G. A guide to using case-based learning in biochemistry education. *Biochem Mol Biol Educ.* 2014; 42(6):457-73. DOI: <https://doi.org/10.1002/bmb.20823>
19. Dong H, Guo C, Zhou L, Zhao J, Wu X, Zhang X, et al. Effectiveness of case-based learning in Chinese dental education: a systematic review and meta-analysis. *BMJ Open.* 2022; 12(2):e048497. DOI: <https://doi.org/10.1136/bmjopen-2020-048497>
20. Abu Farha RJ, Zein MH, Al Kawas S. Introducing integrated case-based learning to clinical nutrition training and evaluating students' learning performance. *J Taibah Univ Med Sci.* 2021; 16(4):558-64. DOI: <https://doi.org/10.1016/j.jtumed.2021.03.005>