



Transforming Education: Case-Based Integrated Learning Development and Implementation – A Mixed Methods Study at a Private Medical College

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Abstract

Introduction: Case-based learning (CBL) is widely used in medical education to bridge theory and practice, but traditional methods often struggle to sustain student engagement and promote critical thinking. To address these challenges, Case-Based Integrated Learning (CBIL) was developed as a novel approach combining immersive and interactive learning techniques. This study aimed to evaluate the effectiveness of CBIL in enhancing engagement, critical thinking, and clinical reasoning among medical students, and explore faculty experiences regarding the pedagogy.

Methods: An explanatory-sequential mixed-methods study was conducted in a private medical college in Pakistan. Quantitative data were collected through faculty (n=35) and student (n=122) evaluation surveys, and analyzed using descriptive statistics (mean, standard deviation, frequencies, and percentages). Qualitative data from focused group discussions (FGD) with faculty were analyzed thematically. A committee of clinical faculty and medical educationists developed four CBIL prototypes. Faculty from various clinical specialties were trained on CBIL concepts and lesson planning, and the prototypes were used to develop engaging cases for subsequent sessions. Participants included faculty from diverse disciplines and students in their third and fourth years of medical school.

Results: The faculty considered the training very effective (overall satisfaction: 5.17±0.89 out of 6), with a vast majority being very satisfied with its relevance (86%, n=30) and structure (91%, n=32). Among students, 95% (n=116) were satisfied with the developed cases. Most of them were also satisfied with the clarity (92%, n=112) and applicability of the cases (96%, n=117). In FGD, facilitators expressed satisfaction with CBIL formats as it provided opportunities for engagement, in-depth analyses, and discussions.

Conclusion: Interactive formats like CBIL can engage students by allowing opportunities for interaction, discussion, and peer-learning. This promotes improved understanding and critical thinking. Further exploration of the effectiveness and impacts on the learning of various interactive formats of case-based learning is essential.

Keywords: Education; Undergraduate; Professional education; Continuing education; Clinical clerkships

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Introduction

Case-based learning (CBL) has emerged as an effective teaching method for undergraduate medical students in both clinical and preclinical years, designed to bridge the gap between theory and practice by immersing students in authentic clinical scenarios (1). Historically, medical education relied heavily on didactic lectures during preclinical years, followed by “learning on the job” in clinical settings. Recognizing the value of early clinical integration, medical schools have increasingly adopted CBL to prepare students for clinical practice more effectively (2).

Case-based teaching has demonstrated its effectiveness across disciplines. For example, Harvard Business School (HBS) has long used case-based methods to foster critical thinking and peer learning, preparing students for professional challenges through real-life scenario discussions (3). The applicability of CBL extends into medicine, where it is crucial for tackling real-world situations. In medical education, CBL immerses students in real or simulated patient case scenarios in a classroom setting and serves to bridge basic sciences with clinical practice. However, traditional models of CBL, such as Problem-Solving Integrated Learning (PSIL), face challenges, including limited engagement and overly predictable case discussions. Students often perceive these sessions as routine rather than stimulating, and facilitators report difficulty in fostering critical thinking (4). The limited development of new cases further constrains the learning process, as the students had access to the case objectives in advance, resulting in sessions that are overly structured and progressed in a very predictable and choreographed manner, leaving little room for critical thinking. Such issues can hinder the development of essential problem-solving skills, affecting students’ readiness for real-world clinical scenarios.

To enhance the learner-to-learner, learner-to-content and learner-to-facilitator interactions, the concept of immersive learning was introduced into the case-based learning sessions. Immersive learning is highly regarded for its effectiveness because it allows for the development of relevant and realistic settings that profoundly impact a learner’s cognitive mindset leading to improved learning. This approach involves the creation of new, creative learning models that enable students to apply their theoretical knowledge in clinical contexts. This helps to integrate and solidify their foundational undergraduate concepts (5). Immersive learning is grounded in the theory of socio-constructivism which focuses on

discussion and interaction amongst peers leading to improved learning, shifting from lower-level content engagement to fostering higher cognitive levels of understanding (6). Within Immersive Learning Environments (ILEs), learners immerse themselves in experiences related to the course material which may include simulations, role plays, concept maps, and virtual learning spaces. These ILEs replicate potential real-life scenarios, engaging learners in a manner that closely resembles practical applications (7). Educators can choose from a variety of options based on their specific goals and objectives (8). Through the implementation of an ILE, teachers can revolutionize their teaching methodologies. ILEs aim to harness the group collective wisdom, fostering discussions and collaborative teaching activities that culminate in session summaries and valuable feedback provision (9).

The significance of addressing these challenges extends beyond the classroom. Enhancing student engagement and critical thinking through CBIL can potentially improve clinical preparedness, foster lifelong learning habits, and ultimately elevate the quality of patient care. This study evaluates the experiences and perceptions of both students and faculty members participating in CBIL sessions, aiming to assess its effectiveness in addressing the shortcomings of traditional CBL and advancing medical education.

Methods

Study design and sampling

A design-based research methodology was adopted for developing and testing innovative educational interventions within real-world learning environments. The researchers, educators, and other stakeholders collaborated to design contextually relevant interventions. Data were collected at the AKU Medical College, Karachi Pakistan from multiple sources and an explanatory-sequential mixed-method approach was adopted.

This study utilized a comprehensive sampling strategy, involving two groups of participants:

1. **Medical Students:** A total of 122 medical students from Year 3 and Year 4 were enrolled in the study. These students were recruited through convenience sampling based on their attendance in the pilot CBIL sessions conducted across various disciplines, including Medicine, Surgery, Obstetrics and Gynecology, and Pediatrics.

2. **Faculty Members:** 35 faculty members, representing diverse clinical specialties, participated in the study. Faculty members were recruited through purposive sampling, targeting those who attended CBIL training workshops and subsequently facilitated CBIL sessions.

Duration: The study lasted 14 months commencing in December 2021 and concluding in January 2023.

Step 1: Prototype Development

A team of educationists and clinical faculty members (content experts) developed four case-based integrated learning prototypes: clinical presentation, simulation-based, guided inquiry, and investigation-based approaches to enable facilitators to engage students (Table 1). A comprehensive 90-minute lesson plan was also developed to provide structure to the teaching session (the outline of the lesson plan can be found in Supplementary Material 1). Each session included pre-reading requirements and self-assessment of knowledge through one-best questions.

Step 2: Faculty Training

Three workshops were conducted for faculty on CBIL; from August 2022 to January 2023, a total of 54 faculty members from various clinical specialties attended these workshops. During the workshops, the participants were introduced to the concept of CBIL and lesson planning. To enhance clarity, the CBIL prototypes were elucidated using healthcare examples. During these workshops, the faculty members were assigned one CBIL prototype to develop and present in small groups. The participants were provided with feedback by facilitators and peers.

Step 3: CBIL implementation

Throughout the process, the principal investigator and co-investigators provided support to help faculty develop cases on one of the prototypes best aligned to their session objectives, as well as to plan and conduct effective CBIL sessions. Subsequently, 35 faculty members

employed a CBIL session in their clinical clerkship.

Data collection

Workshop evaluation forms were completed by faculty members who participated in the faculty training workshop, using a pre-validated institutional workshop evaluation tool based on a 7-point Likert scale (0=Not done, 6=excellent). Students who participated in the CBIL sessions completed an anonymous CBIL session evaluation form at the end of the piloted sessions. The self-administered CBIL session evaluation questionnaire consisted of 21 attributes which focused on one overarching and three main subcategories: pre-session material (6 items) CBIL session (11 items) and the case (4 items). The aim was to gather opinions regarding the role of CBIL in enhancing learning and the quality of the CBIL case. The questionnaire was scored using a 5-point Likert scale including Not at all, Poor, Satisfactory, Good, and Excellent. The questionnaire was developed based on a literature review and was validated for content before administration. The newly developed evaluation form was validated by seven medical educationists along with faculty members from clinical sciences who were involved in undergraduate curriculum design and had expertise in teaching and learning. Demographic questions consisted of general information such as program of study, year of study, and gender. Of the 35 faculty members that conducted the CBIL sessions, 7 participants were selected through purposive sampling and invited for participation in the FGD. The discussion was conducted in a designated meeting room on campus, facilitated by a trained research assistant and audio recorded. The aim of the FGD was to explore their experiences of developing, implementing, and facilitating CBIL sessions (the FGD guide with probes is provided as Supplementary Material 2).

Table 1: Case-Based Integrated Learning - Prototypes

Prototype	Classical feature	Advantage	Suitable for
Clinical Presentation Causal Prototype (CP2)	One clinical presentation with multiple short cases featuring different diagnosis (For example; A young man with persistent diarrhea).	Students can learn about diverse diagnoses of various causes from same clinical presentation.	Multiple diagnosis of same clinical presentation.
Investigation based Case-Based learning	Multiple vignettes of different diseases featuring differentiating points on investigation (For example; Chest X-ray).	Students can learn about diverse diagnoses based on investigation findings.	Multiple diagnosis of same clinical presentation based on investigation findings.
Simulation Based Integrated Learning	Facilitates the simulation of a clinical scenario through the use of mannequins, simulated patients, etc. (For example; a child with difficulty in breathing).	Offers the opportunity to simulate authentic scenarios and engage in patient interactions.	Situations requiring practical experience, to enhance communication skills, and foster the development of psychomotor skills.
Guided Discovery Based Learning	Comprehensive exploration of a clinical presentation through a step-by-step disclosure of case information. (For example; a patient presenting with right upper abdominal pain).	In depth study of single disease.	Diseases with classical features.

Informed written consent was obtained from both groups of participants before their inclusion in the survey and FGD, respectively. All data were anonymized to respect the participants' privacy. Ethical approval was obtained from the AKU Ethical Review Committee (AKU ERC#: 2022-7021-20858).

Data analysis

Quantitative data were analyzed using SPSS version 20. For quantitative data, descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated for the faculty workshop and CBIL session evaluations to summarize participant responses and overall satisfaction levels. For qualitative analysis, audio recordings from the FGDs were transcribed verbatim. The transcripts underwent thematic analysis, which was conducted independently by two investigators. Verbatim

quotes from the discussions were coded, and these codes were subsequently grouped into sub-themes and overarching themes to identify the patterns and insights regarding experiences with CBIL.

Results

Faculty feedback on training workshops

Thirty-five faculty members completed the evaluation form. The feedback for the workshops was positive, with an overall average satisfaction rating of 5.17 ± 0.89 out of 6. Participants agreed that the workshop effectively met general expectations and provided new knowledge. The content and objectives were well-received, with most participants finding them relevant (86%, $n=30$) and logically structured (91%, $n=32$). Logistics, including group activities and administrative support, were also well-acknowledged, with a mean satisfaction rating of 5.21 ± 1.00 out of 6 (Table 2).

Table 2: Evaluation of the faculty training workshops and learning outcomes (N=35)

Item	Not Done 0	Poor 1	Fair 2	Satisfactory 3	Good 4	Very Good 5	Excellent 6	Average Satisfaction Level
General								
Expectations from the workshop were met.	0	0	0	3	3	19	10	5.03±0.84
I gained new knowledge.	0	0	0	4	0	15	16	5.23±0.93
Workshop provided me basic understanding.	0	0	0	1	7	16	11	5.06±0.79
Workshop was well-paced.	0	0	0	3	4	15	13	5.09±0.91
I would recommend the workshop to others.	0	0	0	2	5	12	16	5.20±0.89
The workshop was useful.	0	0	0	1	4	15	15	5.26±0.77
I shall be able to apply the concepts in my teaching practices.	0	0	0	1	4	17	13	5.20±0.75
Overall Average for General Expectations								5.15±0.85
Workshop Objectives and content								
Objectives were clearly stated.	0	0	2	3	3	14	13	4.94±1.14
Content matched the objectives.	0	0	0	2	5	16	12	5.09±0.84
Topics presented were relevant to my work.	0	0	0	5	2	13	15	5.09±1.02
Sessions were structured in a logical way.	0	0	0	3	4	13	15	5.14±0.93
Overall Average for objectives & Content								5.06±0.99
Presentations								
Concepts were clearly explained.	0	0	0	2	6	13	14	5.11±0.89
Opportunities for active participation were provided.	0	0	0	1	2	14	18	5.40±0.73
Faculty participation during workshop was appropriate.	0	0	0	1	8	11	15	5.14±0.87
Questions/clarifications were adequately addressed.	0	0	0	2	2	18	13	5.20±0.79
Students were actively engaged during group activity & discussion session.	0	0	0	1	2	15	17	5.37±0.72
Overall Average for Presentations								5.25±0.81
Logistics								
Group activity during workshop was well-planned.	1	0	0	1	4	15	14	5.09±1.16
Admin support was available.	0	0	0	2	1	15	17	5.34±0.79
Overall Average for logistics								5.21±1.00
Overall Average								5.17±0.89

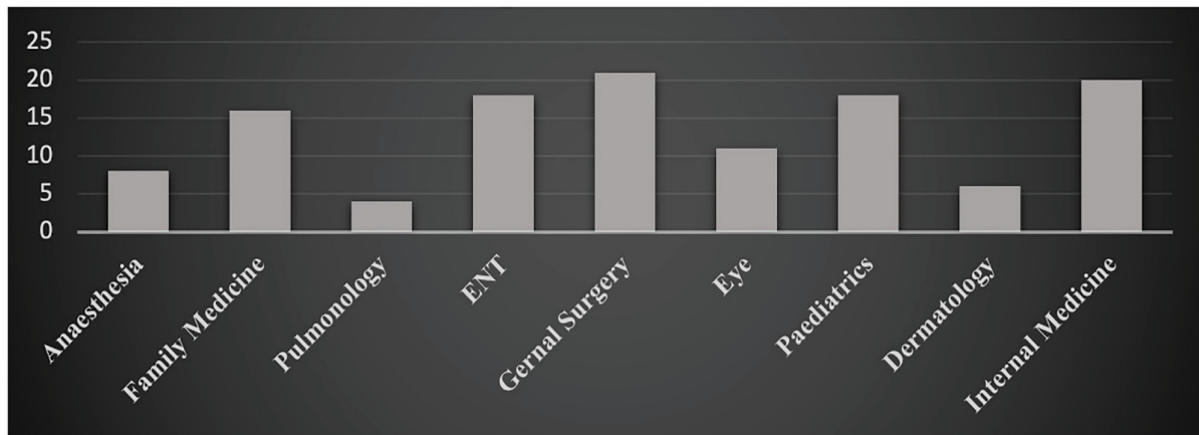


Figure 1: Number and distribution of participating students across different clinical rotations in the study

Table 3: Student feedback of the CBIL sessions (n=122)

Items	Rating (%)					Mean±SD
	Not at all	Poor	Satisfactory	Good	Excellent	
Clear instructions for the sessions were communicated.	1	7	28	47	17	3.72±0.87
Pre-session Assignments						
The pre-reading material was shared timely.	0	6	18	53	23	3.93±0.80
The pre-reading material was optimum/adequate.	3	6	22	44	25	3.81±0.98
The pre-reading was relevant to the case.	2	7	20	52	20	3.81±0.89
The quiz was relevant to the pre readings.	2	5	20	48	25	3.91±0.89
The quiz helped me to clarify my concepts.	2	4	18	52	25	3.93±0.86
The quiz was appropriate to my level of understanding.	2	2	15	58	23	3.98±0.79
Overall rating of pre-session assignments						3.90±0.87
CBIL Session						
I was able to apply the knowledge gained from pre readings in the session.	2	2	16	50	30	4.05±0.84
CBIL helped me to apply basic science concepts into clinical practice.	2	3	16	48	31	4.03±0.87
The CBIL session promoted active engagement and learning.	1	2	14	43	40	4.19±0.83
The session promoted interaction between learner and facilitator.	0	2	12	46	40	4.25±0.73
Discussion during CBIL provided opportunities for conceptual learning and reinforcement.	2	2	16	46	34	4.10±0.85
It helped me to develop critical thinking.	2	1	18	45	34	4.10±0.84
Through CBIL I was able to develop understanding.	0	3	13	48	34	4.15±0.77
Time allotted for the session was adequate.	0	2	15	48	34	4.15±0.76
The assignment/ quiz after discussion of the case was relevant.	1	4	17	49	29	4.01±0.84
The assignment valuable in reinforcing the concepts.	0	2	14	52	32	4.13 ± 0.74
The environment was conducive to learning.	0	2	13	48	37	4.19±0.75
Overall rating of CBIL session						4.12±0.80
Cases						
The case was engaging.	1	1	19	43	37	4.14±0.81
The case was relevant to real life situations.	0	2	13	43	41	4.23±0.77
The case was appropriate to my level and learning needs.	0	0	17	51	32	4.15±0.69
Overall rating of Cases						4.16±0.70
Overall rating						4.17±0.74

Student feedback of CBIL sessions

A total of 122 students were included in the analysis, with 52% (n=64) males and 48% (n=58) females. Regarding the year of study, 63% (n=77) were in the third year and 37% (n=45) in the fourth year of undergraduate medical education. The distribution of participants across different disciplines included General Surgery, Family Medicine, ENT, Pediatrics, Eye, Anesthesia, Pulmonology, Dermatology, and Internal Medicine (Figure 1).

Results of the students' survey showed that most of the participants (92%, n=112) were satisfied with the clarity of the instructions provided during the CBIL session. Participants' feedback on the pre-session assignments, which included preparatory materials and quizzes, revealed that most participants had positive perceptions, especially regarding timely sharing of the pre-reading material (97%, n=119) and the relevance of the quiz (73%, n=88), with 75% (n=92) stating that the examination helped clarify their concepts. Most participants also had positive perceptions of the CBIL session. A large proportion, 96% (n=117), reported that they could apply the knowledge gained from pre-readings effectively during the session. Moreover, 95% (n=116) of participants believed that the CBIL session helped them bridge basic science concepts with clinical practice. Feedback regarding the specific cases used in the study showed that the majority of participants found it engaging and relevant to real-life situations (98%, n=120). The study participants' feedback revealed an overall satisfaction with the innovative educational strategy. The overall satisfaction score, calculated

by averaging the mean scores across all aspects assessed, was 4.17 ± 0.74 , reflecting a high level of satisfaction with the educational program (Table 3). The rotation-specific case ratings are shown in Figure 2.

Qualitative Results of the Focus-Group Discussion

The FGD was conducted among seven faculty members from the medical college, who had attended the faculty development workshops and subsequently facilitated the CBIL sessions. Analysis of the faculty's perspectives revealed three overarching themes: Improved Student Learning, Navigating Change: Student Reactions to Innovative Teaching Models, and Embracing Educational Evolution. Overall, the discussion revealed that the implementation of CBIL had a positive impact on learning, engagement, and clinical reasoning. Faculty observed enhanced student participation, attention, and interaction, all of which being vital for effective learning. However, the discussion also highlighted the significant effort required from the faculty members to develop and sustain this innovative teaching model. Despite these challenges, the benefits of CBIL in fostering a more dynamic and engaging learning environment were evident, and with continued refinement and support, it holds promise for the enhancement of medical education.

Improved Student Learning

The faculty highlighted several facets of student engagement and performance. They repeatedly emphasized how CBIL led to a higher level of student engagement. One participant

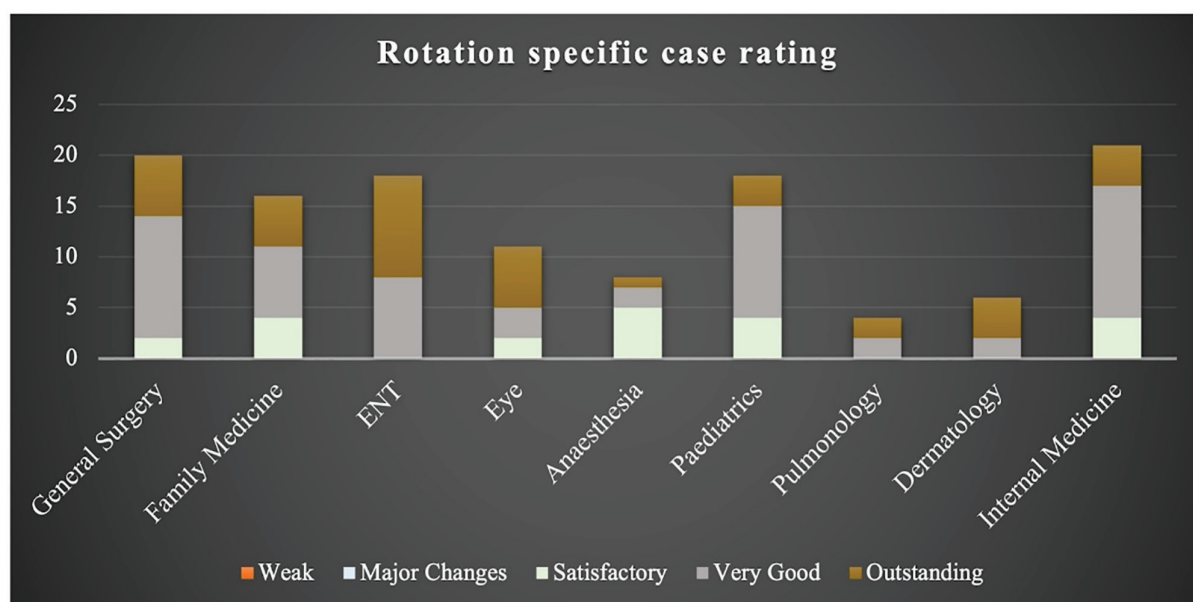


Figure 2: Distribution of CBIL case ratings across clinical rotations based on student feedback and evaluations

shared, *“The transfer of knowledge was much better than before and the groups also enjoyed it more,”* indicating a perceived improvement in the assimilation of knowledge compared to traditional pedagogical approaches, and suggesting that the shift from passive learning to more interactive, case-based activities resulted in enhanced student attention and enthusiasm, which are critical elements for deeper learning. Additionally, the subtheme of Group Interaction emerged, where the faculty praised CBIL’s ability to foster collaboration among students. This collaborative dynamic appeared to encourage critical thinking and collective problem-solving.

“It was a good interaction; there was a lot of brainstorming and healthy discussions between the peers.”

An important aspect of this improved learning was the Better Attention Span observed during CBIL sessions. Faculty members noticed that students remained more attentive throughout the sessions, with one stating, *“In almost all the CBIL sessions, the student’s involvement was improved, and their attention span was considerably increased.”* This observation reinforces the notion that interactive and case-based approaches help sustain students’ attention, contributing to a more effective learning environment compared to traditional lecture formats.

Navigating Change: Students’ Reactions to Innovative Teaching Models

The faculty noted how students adapted to and benefited from CBIL, particularly in contrast to traditional methods like PSILs. Enhanced Student Participation was observed, with one member stated, *“Once they were hooked up with the activity, their participation, their attitude, and their presentation improved a lot. As compared to before from what I have seen, this was much better.”* This underscores how students became more engaged and confident in their presentations, with CBIL serving as a catalyst for increased involvement. Furthermore, CBIL enabled students to approach clinical cases from Multiple Dimensions, a significant advantage compared to the more linear structure of PSIL.

“Finally, I believe the whole activity was better than PSILs as it helped clear their concepts. In PSILs, there is only one case, while in CBIL we can teach a single topic in multiple directions and causes and reasons.”

The ability to explore various clinical presentations within a single case reflected the versatility of CBIL and its potential to deepen students’ understanding of medical scenarios through a multi-faceted approach. The faculty also

pointed out the effectiveness of Activity-Based Learning in CBIL, noting how CBIL’s emphasis on hands-on, participatory learning fostered a more engaging and enjoyable experience for students, leading to better knowledge retention and understanding.

“I thought that transfer of knowledge was also better, as compared to PSIL. Since it was an activity-based learning, the groups also enjoyed it more.”

Embracing Educational Evolution

The discussion also revealed the challenges and opportunities faculty members encountered and perceived in adapting to and sustaining the CBIL model. While faculty acknowledged the advantages of CBIL, they also discussed the significant time commitment and effort required for its development, which highlighted the substantial preparatory work involved in designing effective CBIL cases, and underscored the need for additional support and resources to ensure sustainability.

“I had to do extensive editing on my part to get the knowledge across while also trimming it down to an hour-long read, so it was very time-consuming on my end.”

The subtheme of Diligence also emerged, with faculty noting the effort and creativity required to craft new learning materials. One participant stated, *“It was very cumbersome to design a new format,”* capturing the challenge of transitioning from traditional teaching methods to a more integrated and interactive model. Yet, despite the challenges, the faculty noted that students were committed to engaging with the material, with one mentioning, *“My students read all the material that was sent out,”* suggesting that the comprehensive nature of CBIL assignments motivated students to be better prepared for discussions and activities.

Looking forward, the faculty expressed concerns about maintaining the novelty of CBIL and ensuring the Future of the model. One faculty member voiced apprehension, stating,

“I think it could end up like PSILs and there can be an element of monotony. We have to continue making new cases regularly; otherwise, it might become repetitive.”

This concern illustrates the need for ongoing innovation in case design to prevent stagnation and ensure the long-term success of CBIL. However, it was acknowledged that such persistent innovation would demand greater and continuous support from the administration and department heads in terms of allotted time and resources.

Discussion

Medical education has been subject to extensive research undergoing a significant evolution in the past few decades. CBL has been in use for a long period with some early evidence of its uses dating back to 1912 (10). It is known to be an effective learning approach for groups of medical students at undergraduate level education as well as for professional development (11). CBL has undergone significant changes over the years, and the purpose of this study was to propose a new model that facilitated innovative learning and creative student-faculty interactions termed CBIL.

This study addressed the use of the newly proposed CBIL model and gathered feedback from the students and faculty involved in developing the sessions and participating in them. The feedback gathered gave insight into the challenges faced, benefits provided, and the effectiveness of the teaching model employed. Most of the feedback after these successful CBIL sessions was positive by both facilitators and students alike with most participants recognizing its effectiveness in the application of knowledge, reinforcement of concepts, and interactive learning, emphasizing the importance of this teaching method in clinical education. This is in line with the findings of other similar studies conducted around the world reporting that CBL allows students to develop a collaborative, team-based approach to their education and their profession. It is intended to foster learning for competence and deep level understanding (12). A vast majority of students confirmed their understanding of the new innovative technique being implemented which helped to develop the study. Reading material shared in advance allowed the use of class time for in-depth discussion with peers and facilitators (13). They found the pre-session activities conducive to learning, helping them to strengthen the core concepts. Students also reported that pre-session activities helped them apply knowledge in a more streamlined fashion. This allowed an engaged student-faculty interaction, which both the student and faculty agreed. The sessions were characterized by heightened engagement, the encouragement of critical thinking, and, on the whole, cultivation of an environment more conducive to learning. These findings are in the same line with similar studies highlighting that the use of the CBL format empowered students to articulate queries and make comments more effectively during class activities. As a result, the entire learning process was more gratifying (14).

Another aspect of the sessions was the use of concise, aptly made cases adapted to the level of

the students. The students found them engaging and relevant to real-life situations, emphasizing the practicality and applicability of the case to their clinical practice. Additionally, a significant proportion of students found the case appropriate to their level and learning needs, further evidencing the successful alignment of the case with the participants' educational requirements. A similar study also reported that the use of cases helped improve clinical reasoning, diagnostic interpretations, and the ability to think logically among students with CBL (15).

Despite the many positive aspects, a major challenge highlighted by the facilitators was the amount of time it took to develop quality teaching materials. This included collecting reading materials from a various sources and tailoring them to short, concise, easy-to-digest packets. Clinically relevant cases that were both thought-provoking and appropriate for the student level had to be constructed. The latter was supported by conducting workshops for capacity building. A similar problem has been reported in literature where the faculty identified difficulty in producing concise and thought-provoking material for new teaching/learning methods, as well as finding the time to do so (16). However, our study found that both students and faculty involved agreed that this teaching modality was an effective way of learning in the context of our institution.

The literature supports observations by students in our study, with one study suggesting that interactive CBL promotes the ability of active thinking in students along with applicable problem-solving skills in real-life scenarios. The format was also felt to encourage students to review knowledge from their basic science education (17). Another study proposed that the implementation of CBL surpassed its predecessor models in enhancing the students' capacity to pose questions while fostering a more enjoyable learning experience. This evolution is regarded as an effective upgrade over conventional teaching methods (18). With innovations always on the horizon, it has become increasingly difficult to future-proof an effective study model. However, according to a recent study, the use of online integration in CBLs has also proven to be successful, especially for future usage in remote areas (19).

We anticipate that the use of this approach enhances student engagement and keeps them motivated to learn by completing pre-readings, participate actively in discussion, role play and use simulation and other engaging strategies. We feel that it will help augment problem-solving and critical-thinking skills. Furthermore, it is hoped that the creation of an immersive learning

environment will support active learning in the classroom, aligning teaching and learning with the vision and mission of the university.

The study has several limitations that should be considered. First, there is a risk of response bias due to the reliance on self-reported feedback from the study's participants. Second, the single-center design and moderate sample size limit the generalizability of the findings to other institutions, particularly those with differing resources, student demographics, or cultural contexts. Additionally, the 14-month duration of the study may not have captured the long-term impacts of CBIL on clinical competence or sustained engagement. The potential for variability in facilitators' implementation of CBIL prototypes could also introduce inconsistencies in the outcomes.

Moreover, while the CBIL teaching model received positive feedback, we must acknowledge that it remains in its nascent stages of development, and its refinement must be ensured through participant feedback in order to further align the pedagogical approach with the diverse learning needs of individuals as well as address institutional constraints. Future studies should explore strategies to enhance efficiency in content preparation, address scalability across institutions, and include follow-up evaluations to assess the long-term impact of CBIL on critical thinking, clinical reasoning and professional development. Despite these limitations, the findings provide valuable insights into the feasibility and potential benefits of CBIL in medical education.

Conclusion

Student engagement is the key factor in improving student learning, promoting interaction, and enhancing attention spans. Ongoing faculty commitment and development remain essential for cultivating an optimal learning environment. For sustainability, mechanisms should be developed for periodic review, and any challenges or hindrances in implementation should be addressed promptly. Ongoing evaluation and development of new cases are pivotal for success, and faculty retreats may provide a platform for the development and review of cases. Future research should explore the long-term impact of CBIL on clinical competence and its role in fostering critical thinking and problem-solving skills in real-world settings. Additionally, studies assessing the scalability and adaptability of CBIL in other medical schools with varying resources and contexts are warranted.

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Authors' Contribution

RA, AA, and SK conceptualized the idea. AA, SSh, SK, and SS contributed to the development of the prototypes. RA, AA, SSh, AS, SB, JR, SK, and SS conducted faculty development workshops. RA, SSh, AS, SB, and SS contributed to data collection. RA, AA, SSh, AS, SB, JR, MSQ, and SS made significant contributions to data analysis. MGRM contributed to the development of the study tables and figures, and the interpretation of the data. RA and MGRM contributed to drafting of the manuscript. AA, SSh, AS, SB, JR, MSQ, SK, and SS participated in manuscript review. All authors read and approved the final manuscript and agree to be personally accountable for all parts of the work.

Conflict of Interest

The authors declare no conflicts of interest.

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