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Original Research Article

USING CASE BASED LEARNING TO FOSTER CRITICAL LEARNING IN MEDICAL BIOCHEMISTRY

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Abstract: *The interventional study was conducted in the Department of Biochemistry, Nishtar Medical Hospital, from January 2021 to January 2022 to analyze the impact of case-based learning on first-year biochemistry students' critical thinking skills and creative abilities. The study was conducted on 1st year MBBS students who had undergone CBL. A total of 60 students were included in the study. Study participants were randomly divided into a study group (n=30) and a control group (n=30). Pre-test questionnaires were administered to both groups; the control group was then seated in a separate room, and the study group was randomly subdivided into subgroups I, II, and III. Sub-groups were asked to design study cases on given topics and discuss the designed case with each other. The control group was asked to study the same topics individually. All participants then underwent a post-test. Responses were recorded. Results showed that the pre-test score (out of 20) in the study group ranged from 8.5-16.5 and in the control group from 9-17, which means that there was no significant difference between both groups before intervention (P>0.05). Post-test scores in the control group ranged from 8-17 and in the study group from 12-19, and this difference between the scores was statistically significant. Results showed that case-based learning increases students' critical thinking skills and enables them to consider alternatives, imagine possibilities, and seek solutions.*

Keywords: Biochemistry, Medicine, Case-Based Learning, Critical Thinking

Introduction

Case-based learning (CBL) is used in medicine to teach students using case scenarios (Yusuf and Ahmad, 2020). This develops critical thinking as students learn to evaluate knowledge, seek different possibilities, clarify concepts and consider alternatives. Case-based learning more effectively increases performance compared to other delivery methods (Felszeghy et al., 2019). It is because students can recognize the link between theory and practice. Critical learning skills help them to develop an easy understanding of the underlying process.

Moreover, using thinking strategies and progressive knowledge development make students confident and autonomous problem solvers (Niemi and Kousa, 2020). Critical thinking is important for evidence-based medical practice. It garners medical professionals with skills in doing evidence-based practice. Critical thinking lays the ground for analysis, evaluation, sequencing, comparing, reasoning, inferring, questioning, hypothesizing, and generalizing (Santhosam, 2018).

Creative capacity in medicines implies the ability of a medical professional with sufficient competence and knowledge to adapt to a situation using the necessary expertise (Vani et al., 2022). This encompasses refining concepts for discovering possibilities, acting on intuition, and designing new theories. Creative thinking can take the form of complex representations, investigations, digital output, or virtual reality. "Making stuff" in a controlled environment prepares students for uncomfortable failures that do not malign their professional identity. Doing so also increases resilience and the ability to solve vexing questions Ashcroft et al., 2021). A study reported that including CBL activities in biochemistry

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classes consolidates learning and establishes alignment and links between theoretical concepts, assessment items, and practical experiences. CBL activities increase student satisfaction and improve performance (Santhosam, 2018). This study analyzes the impact of case-based learning on first-year biochemistry students' critical thinking skills and creative abilities.

Methodology

The interventional study was conducted in the Department of Biochemistry, Nishtar Medical Hospital, from January 2021 to January 2022. The study was conducted on 1st year MBBS students who had undergone CBL. A total of 60 students were included in the study. Informed consent of the participants was taken. The ethical board of the hospital approved the study. Students were exposed to case-based learning. The staff of the department was sent a questionnaire for peer review. Study participants were randomly divided into a study group (n=30) and a control group (n=30). A Pre-test questionnaire, including questions on the biochemical basis, pathophysiology, reference ranges, and management in specific cases, was given to both groups. Participants were briefed about the project.

The questionnaire aimed to test students' knowledge due to CBL activities (group discussions on case studies). After completing the questionnaire, control group participants were separated and brought to another room. The study group was randomly subdivided into three subgroups, I, II, and III, of 10 participants each. These subgroups had a mix of participants in terms of pre-test scores and gender. Subgroups were provided supplemental study material and asked to design three cases on obstructive jaundice, Fe deficiency anemia, and type II diabetes mellitus. 3 participants from all subgroups were asked to sit together and discuss the cases. This process was supervised by a facilitator who ensured the active participation of all students. Students were guided to design a case consisting of i) an introduction (history and presenting complaints, ii) a body (investigations and laboratory findings), and iii) five questions relevant to the case. The control group was provided with the same study material and asked to go through the topics on which the study group designed cases. Facilitator also guided the control group. Both study groups were then given the same questionnaire as a post-test. The responses were recorded for analysis. After completion of the activity, the designed cased were discussed with the control group. SPSS version 23.0 was used for data analysis. Quantitative variables were represented as mean and standard deviation. Both groups ' pre-test and post-test scores were compared using the student t-test. Improvement in scores of both groups after the Wilcoxon assessed the intervention signed rank test.

Results

Facilitators reported in-depth discussions about the clinical presentation, laboratory findings, and treatment modalities. Pre-test scores (out of 20) in the study group ranged from 8.5-16.5 and in the control group from 9-17, which means that there was no significant difference between both groups before intervention (P>0.05) (Table I). Post-test scores in the control group ranged from 8-17 and in the study group from 12-19, and this difference between the scores was statistically significant (Table II). A comparison of intra-group scores in both groups is shown in Table III. The mean post-test score in both groups was greater than the mean pre-test score. There was a significantly higher difference between the two scores in the study group (P<0.001) compared to the control group (P=0.018), which shows the effectiveness of the intervention.

Based on the pre-test score, participants were divided into low-score groups (<10), average scores (10-14.5), and high scores (15-20). Wilcoxon signed-rank test assessed score improvement in all three groups (Table IV). In the study group, there was a significant improvement in the post-test ($P \leq 0.0001$), while the improvement in the control group was insignificant. The Facilitator reported better interaction, high student engagement, and better time utilization during case preparation.

Table I Comparison of mean pre-test scores between both groups

	Mean pre-test score	P value
Control group	12.24 ±2.10	0.83
Study group	12.34±2.02	

Table II Comparison of mean post-test scores between both groups

	Mean post-test score	P value
Control group	12.54± 2.21	<0.001
Study group	15.15± 1.62	

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Table III Intra-group comparison of pre-test and post-test score

	Mean score	P value
Control group		
Pre-test score	12.24 ±2.10	P=0.018
Post-test score	12.54± 2.21	
Study group		
Pre-test score	12.34±2.02	P<0.001
Post-test score	15.15± 1.62	

Table IV Score improvement after intervention

	Mean pre-test score	Mean post-test score	P value
Control group			
Low scorers	9.1	9.4	Non-significant
Moderate scores	11.3	12.1	
High scorers	15.4	15.4	
Study group			
Low scorers	9.4	14.1	<0.0001
Moderate scorers	12.1	15.4	
High scorers	15.4	17.4	

Discussion

The study asked participants to design cases and work in a team to analyze the activity's impact on critical thinking skills. A previous study found that CBL in medical biochemistry effectively improves performance (Hu et al., 2019). CBL positively impacts understanding, concept retention, and clinical application of the subject. In our study, students worked in teams to design case histories. L. Michelsen developed team-based learning to increase student engagement. It was concluded that it promotes learning, frequent feedback, and student accountability (Chen and Yang, 2019). These findings are in line with the results of our studies. Creative thinking and critical thinking are two independent and strongly linked traits. Case-based learning includes various innovative methods. In this study, the case design stage was used. A previous study reported that students' involvement in developing learning material increases their learning ability (Chiu, 2021). Similarly, a study reported that compared to individual case studies, case study discussion more effectively enhances critical thinking and the ability of students to reflect upon their learning(Mahdi et al., 2020). These findings are consistent with the results of our study.

A study conducted on clinical teaching blended learning (CTBL) showed that it increases the students' self-efficacy and competency (Wu et al., 2020). Another useful intervention is flipped classroom, which embraces active learning and a traditional introduction to the topic (Gillispie, 2016). Active learning enhances student engagement and retention of information. Distance learning is a new area that gained popularity during COVID-19. It involves the use of technology to deliver information from a distance. A previous study reported that open-ended questions and allowing students to present their solutions increase creativity (Majumder et al., 2019). Similarly, a method orientation/decision/do/ discuss/reflect (OD3R) has also increased critical thinking, comprehension, and interpretation (Anwar et al., 2018). Clinical reasoning and critical thinking skills can be nurtured through the active participation of students in the learning process. Medical educators should encourage questioning, interaction, and reflective learning and motivate students to search for answers (Sahoo and Mohammed, 2018). The limitation of this study is the small sample size; a larger multi-centered study is recommended for further analysis.

Conclusion

Case-based learning increases students' critical thinking skills and enables them to consider alternatives, imagine possibilities, and seek solutions. It increases their competency to deal with challenging clinical scenarios.

Conflict of interest

The authors declared the absence of a conflict of interest.

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