COMPARISON OF CASE-BASED LEARNING AND TRADITIONAL TEACHING TO EVALUATE LEARNING AND ACADEMIC OUTCOME OF FIRST-YEAR MBBS STUDENTS IN BIOCHEMISTRY CURRICULUM

KAVINDRA BORGAONKAR[1]* , RANJIT PATIL[2]

[1]Department of Biochemistry, Government Medical College, Latur, Maharashtra, India. [2]Department of Biochemistry, S.S.R. Medical College, Belle Rive, Mauritius.
*Corresponding author: Kavindra Borgaonkar; Email: kavindra.borgaonkar.21@gmail.com

ABSTRACT

Objectives: Competency-based medical education (CBME) is an outcome-based teaching method in which gain the knowledge of competencies for early clinical exposure. Case-based learning (CBL) is one of the approaches of CBME which makes learning more effective and interesting. In this backdrop, the present study was conducted to compare the outcome of CBL and the traditional method of teaching in the biochemistry curriculum.

Methods: This cross-sectional study was conducted on 130 MBBS 1st year students and was divided into two groups, Group A (n=65) was allocated to CBL, and Group B (n=65) underwent a traditional teaching module. The pre- and post-test scores were compared between the groups and $p < 0.05$ was considered significant.

Results: The students were exposed to two lectures and for lecture 1 the post-test scores were significantly higher in CBL as compared traditional learning module (55.42 ± 10.72 vs. 51.32 ± 9.43; p=0.02). Similarly in lecture 2, the post-test scores were significantly higher in CBL as compared traditional learning module (58.87 ± 10.76 vs. 53.12 ± 8.28; p=0.01).

Conclusion: CBL is a remarkable and efficient method for teaching biochemistry and it was positively perceived by students.

Keywords: Competency-based medical education, Case-based learning, Traditional method concepts, Medical biochemistry.

INTRODUCTION

Competency-based medical education (CBME) was originally introduced in 1978 by McGhahie [1]. The CBME curriculum is structured based on competencies with defined knowledge goals, instructing students in fundamental quantifiable tasks, advancing in incremental stages, and reducing the focus on time-based training by providing formative feedback [1]. The curriculum is focused on outcomes and learners, as opposed to the typical structured instruction common in many medical schools [2]. Carraccio *et al.* [2] and Leung [3] were the first to develop the elements of competencies, identify performance levels, and create assessment and evaluation methodologies along with guidelines for criterion-based pass criteria. Globally various CBME programs are implemented such as the US (ACGME 2001), UK (GMC competency framework 1993), Scotland (Scottish Doctor), Canada (CanMed), Australia, and the Netherlands (National undergraduate framework) are all founded on CBME [4]. The ACGME emphasizes the attainment of milestones as a means to progress from a beginner to an expert in graduate medical programs [5].

CBME requires learners to acquire a certain set of skills that combine several areas of knowledge, abilities, attitudes, and communication within cultural and social environments [6]. It emphasizes emotional and mental aspects and fosters leadership skills in skilled doctors. Levine and Shorten [7] introduced a "hybrid time" model with a fixed time frame in their study on anesthesia trainees, which differs from the usual de-emphasized time-based training. The competencies are evaluated using Miller's pyramid, incorporating formative assessments, feedback, and an assessment matrix that links each assessment to the corresponding competencies [8].

The Medical Council of India (MCI), responsible for standardizing medical education, proposed graduate medical education regulations. The main aim of these regulations is to implement sufficient knowledge among the medical students with respect to public health rights, and government health policies and to apply them during their clinical practice. The competency-based undergraduate medical curriculum/ education is recognized and has been gradually implemented for the new undergraduate batch that joined in 2019 [9]. The document states that a foundation course will be included in the 1st year of the MBBS program to introduce students to skills related to cognition, communication, and ethics, among others. Early clinical exposure is crucial for developing abilities in CMBE through horizontal and vertical integration.

A wide range of studies has been published based on CBME, but only limited literature is available for its efficacy [10]. Meanwhile, traditional methods of teaching give importance to knowledge gaining, and less training to motor skills, meanwhile soft skill training related to attitude and communication is provided in the final year of the curriculum and thus hinders the ability to provide holistic healthcare during real-life situations among the graduates [11]. Hence, the present study was conducted to compare the outcome of traditional teaching and CBME in biochemistry learning among MBBS students.

METHODS

This was a cross-sectional conducted on 130 MBBS 1st year students at the Department of Biochemistry, Government Medical College, Latur, Maharashtra, for 9 months (April 2022–December 2023). The study was conducted after obtaining approval from the Institutional Ethical Committee. The students were explained about the study and were informed to sign the informed consent for the study.

Inclusion criteria

Students who were present during the session and provided informed consent were enrolled in the study.

Exclusion criteria

Students who were absent during the session and not willing to participate were excluded from the study.

A total of 130 students were selected for the study and the students were divided into two groups as per the odd and even register numbers. Group A (n=65) was allocated to case-based learning (CBL) and Group B (n=65) was subjected to traditional teaching modules respectively. The topic planned for 1st lecture teaching was glucose metabolism and the enzymes involved. The even register numbers were allocated to CBL and the odd numbers were allocated to traditional teaching. The topic registered for second lecture was lipid metabolism and the same pattern of teaching was applied as like first lecture. Multiple choice questions (MCQ) based pre-test was given to all the students in both groups before the lecture session to evaluate whether there was a significant improvement in knowledge among the students in both groups. A post-test MCQ was administered to the students after both case-based approach and traditional lectures and the efficacy of teaching methods was analyzed. In addition, the perception of students, based on feedback toward CBL was collected through a Google Form questionnaire.

Data analysis

The data were shown as mean±SD. The comparison of pre- and post-scores within the groups was compared using the paired Student t-test. The comparison of the post-test between the groups was done using an independent Student t-test. A p<0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The perception of students about case-based learning and traditional teaching is shown in Table 1. In this study, 81.26% of students felt that the CBL method of teaching was easy for a student. About, 80.2% of the students responded that the CBL method of teaching creates interest in the topic, 83.5% of the students stated that CBL was helpful to achieve high scores in exams and 79.4% of students stated that CBL covers the MCQ aspects of the syllabus.

The comparison of pre- and post-test scores within the traditional teaching and CBL for lecture module 1 is shown in Table 2. In this study, for both the traditional teaching and CBL method (44.12±8.65 vs. 51.32±9.43; p=0.01) and CBL (45.38±9.54 vs. 55.42±10.72; p=0.01) there was a significant improvement in post-test scores when compared to pre-test scores.

The data were shown in mean±SD. The pre- and post-test comparison within the group was done using a paired Student t-test. *denotes significant p<0.05.

The comparison of pre- and post-test scores between traditional teaching and CBL for lecture module 1 is shown in Table 3. In this

study, there was no significant difference in the pre-test scores between traditional teaching and CBL method (44.12±8.65 vs. 45.38±9.54; p=0.01) and CBL (45.38±9.54 vs. 55.42±10.72; p=0.01). The post-test scores were higher in CBL method when compared to the traditional teaching method and it was significant (55.42±10.72 vs. 51.32±9.43; p=0.02).

The comparison of pre- and post-test scores within the traditional teaching and CBL for lecture module 2 is shown in Table 4. In this study, for both the traditional teaching and CBL method (46.54±9.87 vs. 53.12±8.28; p=0.01) and CBL (46.94±9.35 vs. 58.87±10.76 p=0.01) there was a significant improvement in post-test scores when compared to pre-test scores.

The comparison of pre- and post-test scores between traditional teaching and CBL for lecture module 2 is shown in Table 5. In this study, there was no significant difference in the pre-test scores between traditional teaching and CBL method (46.54±9.87 vs. 46.94±9.35; p=0.01) and CBL (53.12±8.28 vs. 58.87±10.76; p=0.01). The post-test scores were higher in the CBL method when compared to the traditional teaching method and it was significant (58.87±10.76 vs. 53.12±8.28; p=0.01).

The MCI, managed by the board of governors, has published three volumes of the curriculum framework for the proposed competency-based education. The rapid transformations of the modern world have presented the higher education system with a multitude of obstacles. The use of effective teaching and learning strategies is crucial for educational systems. Therefore, educators must focus on learners and the learning strategy and also they should strive to adopt new teaching approaches [12]. The purpose of this study was to compare the effectiveness of CBL and traditional approaches among the 1st year MBBS students in the Biochemistry curriculum.

This new CBL module is specifically designed to seamlessly integrate with the current curriculum structure, making its implementation effortless. The clinical correlations commence at the onset of the course, in accordance with the subjects discussed in the lectures. Through this methodology, students will acquire knowledge by actively engaging in the learning process, rather than simply memorizing information. They will also develop critical thinking skills and take ownership of their own learning. Furthermore, they cultivate problem–solving abilities, clinical discernment, and self-evaluation skills while also honing their ability to use biochemical knowledge in real-world medical scenarios. Employing several instructional methods will facilitate a comprehensive comprehension of the subject matter without any significant alteration in the teaching methodology. The students embraced the more contemporary methods of instruction and acquisition of knowledge with heightened enthusiasm and active engagement [13].

In the present study, majority of the students stated that the CBL method of teaching was easy to understand, creates interest in the topic, helps to achieve good scores in exams, and covers all the MCQs

Table 1: Students perception about case-based learning and traditional teaching

Question	Traditional (%)	Case-based learning (%)
The teaching module is easy to understand	78.45	81.26
The concept is clearly understandable since the teaching covers the main aspects of the topic	73.1	76.2
The teaching method creates interest in a topic	65.6	80.2
The teaching module covers all the questions for the examinations precisely	75.6	74.6
The mode of teaching is simple to understand	67.5	75.2
Teaching methods contribute to achieving high scores in exams	79.5	83.5
The topics covered in the teaching module are more than sufficient for examinations	72.8	71.7
Teaching methods aid in addressing all competencies	79.3	77.5
The teaching module covered the aspects of MCQ	62.7	79.4
Teaching facilitates a comprehensive exploration of a topic from multiple perspectives	59.2	75.8

MCQ: Multiple choice questions

Table 2: Comparison of pre- and post-test scores within the traditional teaching and CBL for lecture module 1

Teaching method	Pre-test score (Mean±SD)	Post-test scores (Mean±SD)	p-value
Traditional method	44.12±8.65	51.32±9.43	0.01*
Case-based learning	45.38±9.54	55.42±10.72	0.01*

CBL: Case-based learning, SD: Standard deviation, *Denotes significant p<0.05.

Table 3: Comparison of pre- and post-test scores between traditional teaching and CBL method for lecture module 1

Teaching method	Pre-test score (Mean±SD)	Post-test scores (Mean±SD)
Traditional method	44.12±8.65	51.32±9.43
Case-based learning	45.38±9.54	55.42±10.72
p-value	0.87NS	0.02*

CBL: Case-based learning, SD: Standard deviation, The data were shown in mean±SD. The pre- and post-test comparison between the groups was done using an independent Student's t-test. *Denotes significant p<0.05. NS: Non-significant

Table 4: Comparison of pre- and post-test scores within the traditional teaching and CBL for lecture module 2

Teaching method	Pre-test score (mean±SD)	Post-test scores (mean±SD)	p-value
Traditional method	46.54±9.87	53.12±8.28	0.01*
Case-based learning	46.94±9.35	58.87±10.76	0.01*

CBL: Case-based learning, SD: Standard deviation, The data were shown in mean±SD. The pre- and post-test comparison within the group was done using the paired Student's t-test. *Denotes significant p<0.05

Table 5: Comparison of pre- and post-test scores between traditional teaching and CBL method for lecture module 2

Teaching method	Pre-test score (mean±SD)	Post-test scores (mean±SD)
Traditional method	46.54±9.87	53.12±8.28
Case-based learning	46.94±9.35	58.87±10.76
p-value	0.87NS	0.01*

CBL: Case-based learning, SD: Standard deviation, The data were shown in mean±SD. The pre- and post-test comparison between the groups was done using an independent Student's t-test. *Denotes significant p<0.05. NS: Non-significant

in the syllabus. Similarly, Patil *et al.* [14] reported that CBL enhances deep learning and fosters critical thinking, reasoning, and diagnostic interpretation, hence enhancing information acquisition. Further, 77% of students acknowledge that CBL facilitates self-directed learning and boosts confidence. In addition, 85% of participants expressed a high level of satisfaction with these learning sessions, which effectively enhanced their interest and enjoyment of the subject matter.

In this study, post-test scores for lecture (p=0.01) and lecture 2 (p=0.02) were significantly improved in CBL method as compared to the traditional method. Likewise, in a study done by Sabharwal [15], the test scores were significantly in CBL as compared to the didactic method of teaching after 4 weeks (7.16 vs. 4.01; p<0.0001). Further, the CBL was positively perceived among the students and stated that it helped them to learn the biochemistry concepts. CBL involves students in the examination of particular scenarios that closely mirror authentic clinical cases. Students are given clinical vignettes that include comprehensive information about a clinical situation. They are expected to progressively make decisions, suggest remedies, and identify crucial criteria related to the condition of the clinical case. This method is student-centered, with students taking on a more active

role in resolving clinical problems, whereas teachers assume a more passive supporting role in challenging and guiding students. CBL is a rigorous exchange and deliberation among student groups, who are assigned the responsibility of collectively applying and expanding their knowledge to suggest strategies for effectively handling the designated clinical situations. The teacher facilitates the debate of subjects chosen by the students, while also emphasizing the predetermined learning objectives for the CBL sessions.

Instructions and illustrations on how to organize, arrange, and execute group-oriented CBL (including lesson plans and case studies) in undergraduate medical education can be located in other sources. After the session concludes, the clinical case is typically reviewed and discussed with the teacher to solidify important lessons and the most significant findings. CBL is a flexible approach where the teacher takes on a less active role and instead focuses on assisting students to independently find solutions to their questions and facilitating discussions on important learning objectives.

CBL involves students in integrating the theoretical concepts of basic science and principles of clinical management into their clinical practice. Its purpose is to facilitate learning through clinical cases, which is especially important for medical education since the medical profession plays a significant role in handling patient cases [16,17]. While CBL encompasses all the learning domains according to the revised Bloom's taxonomy, it places a significant emphasis on the "evaluate" and "create" domains, which receive less attention in traditional teaching methods such as didactic lectures [18]. These areas are crucial in the educational development of medical students as they provide them with the necessary skills and knowledge to meet the clinical requirements of their future employment, while also fostering the abilities that are essential for their competence and effectiveness [19].

The CBL not only incorporated the relevant fundamental sciences and clinical medicine but also crucially connected to the students' expanding knowledge of theory into clinical practice. Students highly appreciated CBL as their initial exposure to clinical skills, as it provided a non-threatening setting that boosted their confidence for their first interactions with actual patients. Traditional teaching methods are incongruent with the overarching constructivist nature of the case-based approach to learning and teaching. Inadequately planned assessment poses the risk of erroneously directing students' attention toward superficial learning abilities, such as memorizing through repetition. Given that assessment is a key driver of learning, it is essential to incorporate the learning process into the assessment scheme. Failing to do so would downplay important aspects of the process, such as problem–solving ability, teamwork, and communication [20].

CONCLUSION

The analysis of student performance in biochemistry subjects using both traditional and CBL methods showed that students who participated in CBL had better problem–solving skills and a deeper understanding of the material. The discussion on the effectiveness of each method in preparing students for clinical practice revealed that CBL better-equipped students to apply their knowledge in real-world scenarios. Therefore, it is recommended that educators implement CBL in biochemistry education to enhance student learning outcomes and better prepare them for future clinical practice.

CONFLICTS OF INTEREST

None to declare.

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