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IMPACT OF COMPETENCY-BASED MEDICAL EDUCATION (CBME) ON CLINICAL SKILL ACQUISITION IN UNDERGRADUATE TRAINING

Muhammad Tauqeer Ehsan[1], Alia Jehan Zaib[2*], Madiha Akhwand[3], Sadaf Saleem[4], Muhammad Suleman Sadiq Hashmi[5], Muhammad Zeeshan Baig[6]

[1]Assistant Professor, Department of Dental Education, Lahore Medical and Dental College, Lahore, Pakistan
[2*]Assistant Professor, Department of Medical Education, Sardar Begum Dental College, Gandhara University, Peshawar, Pakistan
[3]Assistant Professor, Department of Medical Education, Rawal Institute of Health Sciences, Islamabad, Pakistan
[4]Assistant Professor, HoD DME, National University of Science and Technology, Islamabad, Pakistan
[5]Assistant Professor, Department of Medical Education, Shalamar Medical and Dental College, Lahore, Pakistan
[6]Assistant Professor, Department of Oral and Maxillofacial Surgery, Frontier Medical and Dental College Abbottabad, Pakistan

Corresponding author: Alia Jehan Zaib,
[*]Assistant Professor, Department of Medical Education, Sardar Begum Dental College, Gandhara University, Peshawar, Pakistan, Email: aalia.zaib96@gmail.com

ABSTRACT

Background: The traditional model of medical education in many institutions often lacks the structure and feedback necessary for consistent clinical skill development. Competency-Based Medical Education (CBME) has emerged as a learner-centered approach that focuses on observable outcomes and continuous feedback.

Objective: This study aimed to evaluate the impact of CBME on clinical skill acquisition, confidence, and satisfaction levels among undergraduate medical students compared to conventional teaching methods.

Methodology: A quasi-experimental study was conducted at Frontier Medical and Dental College Abbottabad, with ethical approval (Ref No. 4012/HNH/HR). Ninety-three undergraduate students were divided into CBME (n=52) and traditional (n=41) groups. OSCE scores, self-reported confidence (1–10 Likert scale), and satisfaction levels were assessed before and after a structured teaching intervention. Data were analyzed using SPSS version 26, with p-values <0.05 considered significant.

Results: The CBME group showed a significantly greater increase in OSCE scores (mean improvement = 18.12 points) compared to the traditional group (mean = 10.55; $p < 0.001$). Confidence levels rose significantly in both groups, with a larger improvement in the CBME group ($\Delta = 3.52$ vs. 1.46; $p < 0.001$). Satisfaction was strongly associated with the teaching model, with 53.8% of CBME students reporting high satisfaction, whereas none in the traditional group did ($p < 0.001$).

Conclusion: CBME proved to be significantly more effective than traditional methods in improving clinical skills, boosting confidence, and enhancing student satisfaction. These findings support its broader integration into undergraduate curricula, especially in resource-limited settings.

Keywords: Competency-based education, OSCE, clinical skills, medical students, undergraduate training, CBME, traditional teaching, student satisfaction, confidence, skill acquisition.

INTRODUCTION

Clinical skill acquisition is a cornerstone of medical education, particularly during undergraduate training, where students transition from theoretical learning to patient-centered care [1]. However, many traditional curricula rely heavily on passive learning with minimal hands-on practice and limited formative feedback, often leading to variability in skill proficiency [2].

Competency-Based Medical Education (CBME) offers a structured, outcomes-driven approach that emphasizes learner progression, direct observation, and continuous feedback [3, 4]. It is designed to ensure that graduates achieve a defined set of clinical competencies before entering independent practice. CBME has been adopted in various countries and specialties, showing promise in aligning educational objectives with healthcare needs [5].

International evidence supports the effectiveness of CBME. Studies from Canada, and the UK have demonstrated improved clinical performance, learner engagement, and self-confidence following CBME implementation [6, 7]. Regionally, Pakistani institutions studies by Fatima et al., 2023 and Riaz et al, 202 5have also begun to pilot CBME models with encouraging results. Despite this, many undergraduate programs continue to rely on traditional models, and there remains limited local evidence comparing these approaches in real-world academic settings[8, 9].

This study was undertaken to address this gap by evaluating the impact of CBME on clinical skill acquisition, confidence, and satisfaction among undergraduate medical students, with a focus on practical application within a Pakistani medical education context.

METHODOLOGY

This was a prospective quasi-experimental study designed to compare the effectiveness of Competency-Based Medical Education (CBME) with traditional teaching methods in enhancing clinical skill acquisition among undergraduate medical students. The study included both within-group and between-group comparisons to assess performance and confidence before and after the educational intervention.

The research was conducted at Frontier Medical and Dental College Abbottabad. The institutional environment provided access to structured clinical teaching facilities and simulation resources essential for implementing CBME modules.

The study received ethical clearance from the Ethics Review Committee of Frontier Medical and Dental College Abbottabad. Written informed consent was obtained from all participants.

Sample size was calculated using G*Power version 3.1, based on an expected moderate effect size (Cohen's $d = 0.5$), with $\alpha = 0.05$ and power $(1–\beta) = 0.80$. The minimum required sample per group was 45. To account for potential attrition, a total of 93 undergraduate students were recruited using stratified random sampling, ensuring balanced representation across academic years and gender.

Participants were divided into two groups: CBME group ($n = 52$) received competency-based instruction using small-group sessions, clinical simulations, skill labs, and guided supervision. Traditional group ($n = 41$) received standard lecture-based teaching without structured formative feedback.

Both groups were exposed to similar clinical cases, but the method of instruction varied by group assignment.

Inclusion Criteria were undergraduate medical students in 3rd, 4th, or final year. Enrolled in the clinical skills module during the study period. Provided informed consent

Exclusion criteria were students with prior formal clinical certification (e.g., EMT, nursing diploma). Absentees in either pre- or post-intervention assessment and incomplete responses in data collection tools

Objective Structured Clinical Examination (OSCE): A structured, station-based assessment used pre- and post-intervention to objectively measure clinical skills. Confidence Questionnaire: A 10-point Likert scale completed before and after training to assess self-reported confidence in performing clinical tasks. Satisfaction Survey: A post-intervention feedback form capturing learner satisfaction with the teaching approach.

Participants first completed a pre-test OSCE and confidence questionnaire. The intervention (CBME vs. Traditional) was then delivered over 4 weeks. Following the training, all students underwent a post-test OSCE using a parallel station set, followed by the same confidence assessment and a satisfaction survey. All tools were administered under exam conditions to ensure consistency.

OSCE checklists were peer-reviewed by faculty members for content validity. Pilot testing was done on a small batch of students not included in the final sample. Internal consistency of the confidence questionnaire was confirmed with a Cronbach's alpha of 0.82. Inter-rater reliability for OSCE scores was maintained through standardized training of assessors.

Data were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were computed to summarize participant characteristics and outcome measures.

Prior to conducting inferential tests, assumptions of normality were assessed using the Shapiro-Wilk test and visual inspections (histograms and Q-Q plots) for continuous variables such as OSCE and confidence scores. The results confirmed that the data were approximately normally distributed in both groups, thereby justifying the use of parametric tests.

Inferential analyses included Independent-samples t-test to compare mean OSCE and confidence scores between the CBME and traditional groups. Paired-samples t-test to examine within-group changes from pre- to post-intervention. Chi-square test of independence to assess associations between group type and categorical outcomes such as satisfaction levels.

A p-value of < 0.05 was considered statistically significant. In addition, 95% Confidence Intervals (CI) were reported for mean differences, and effect sizes (Cohen's d and Cramer's V where applicable) were calculated to determine the magnitude of observed effects.

RESULT

The study included a total of 93 undergraduate medical students, with a nearly balanced gender distribution 46.2% male and 53.8% female. Participants were drawn from different academic years, with the highest representation from final-year students (38.7%), followed by third-year (33.3%) and fourth-year students (28.0%). Just over half (51.6%) of the students reported no prior exposure to clinical settings, while 48.4% had some clinical experience. In terms of living arrangements, 52.7% were hostelites and 47.3% were day scholars. The sample was divided into two groups: 55.9%

received competency-based medical education (CBME), while 44.1% were taught through traditional methods. These balanced baseline demographics ensured fair comparisons between the groups.

Table 1: Demographic Characteristics of the Study Participants (n = 93)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	43	46.2%
	Female	50	53.8%
Year of Study	3rd Year	31	33.3%
	4th Year	26	28.0%
	Final Year	36	38.7%
Previous Clinical Exposure	Yes	45	48.4%
	No	48	51.6%
Residence	Day Scholar	44	47.3%
	Hostelite	49	52.7%
Group Type	CBME	52	55.9%
	Traditional	41	44.1%

Before the intervention, both the CBME and traditional groups demonstrated comparable clinical performance. The mean pre-test OSCE score for the traditional group was 54.4 ± 8.5, while the CBME group scored slightly higher at 56.5 ± 7.7. However, this difference was not statistically significant ($p = 0.203$), suggesting that both groups started at a similar skill level prior to the implementation of CBME. This establishes a fair baseline for measuring post-intervention differences.

Table 2: Comparison of Pre-Test OSCE Scores between CBME and Traditional Groups

Group	Mean ± SD	95% CI of Mean	p-value
Traditional Curriculum	54.4 ± 8.5	51.69 – 57.04	0.203
CBME Curriculum	56.5 ± 7.7	54.38 – 58.66	

After the training intervention, a marked difference was observed in clinical performance between the two groups. Students in the CBME group achieved a significantly higher mean post-test OSCE score (74.6 ± 8.5) compared to those in the traditional group (64.9 ± 8.4), with a p-value of <0.001. This statistically significant improvement indicates that the CBME approach had a stronger impact on enhancing clinical skill acquisition.

Table 3: Comparison of Post-Test OSCE Scores between CBME and Traditional Groups

Group	Mean ± SD	95% CI of Mean	p-value
Traditional Curriculum	64.9 ± 8.4	62.27 – 67.56	<0.001*
CBME Curriculum	74.6 ± 8.5	72.26 – 77.01	

When comparing pre- and post-test scores within each group, both showed statistically significant improvement. The traditional group improved by an average of 10.55 points ($p < 0.001$), while the CBME group demonstrated a greater mean improvement of 18.12 points ($p < 0.001$). The confidence intervals further supported these findings, with non-overlapping ranges. This suggests that while both teaching methods contributed to skill development, the CBME model led to a more substantial gain in clinical competence.

Table 4: Within-Group Comparison of Pre- and Post-Test OSCE Scores

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	95% CI of Difference	p-value
Traditional Curriculum	54.4 ± 8.5	64.9 ± 8.4	10.55	9.48 – 11.62	<0.001*
CBME Curriculum	56.5 ± 7.7	74.6 ± 8.5	18.12	17.18 – 19.06	<0.001*

There was a strong association between the type of educational method and student satisfaction levels (Pearson Chi-Square = 49.980, df = 3, $p < 0.001$; Cramer's V = 0.733). Over half of the students in the CBME group (53.8%) reported being highly satisfied, and none reported dissatisfaction. In contrast, the traditional group had no students reporting high satisfaction, and 14.6% were dissatisfied, with another 39% feeling neutral. These results highlight the favorable perception of CBME among students, suggesting it is more engaging and better aligned with their learning needs.

Table 5: Student Satisfaction with Training Approach (n = 93)

Satisfaction Level	Traditional (n = 41)	CBME (n = 52)	p-value	Values
Highly Satisfied	0 (0.0%)	28 (53.8%)		Pearson Chi-Square = 49.980
Moderately Satisfied	19 (46.3%)	24 (46.2%)		df = 3
Neutral	16 (39.0%)	0 (0.0%)		p < 0.001
Dissatisfied	6 (14.6%)	0 (0.0%)	<0.001*	Cramer's V = 0.733

Students in both groups showed significant increases in self-reported confidence following training ($p < 0.001$ for both). However, the CBME group experienced a notably larger improvement, with confidence scores increasing from 4.15 ± 0.80 to 7.67 ± 1.00 (mean difference = 3.52). The traditional group improved from 4.00 ± 0.89 to 5.46 ± 1.05 (mean difference = 1.46). These findings reinforce the effectiveness of CBME not only in skill acquisition but also in building learners' self-assurance in clinical settings.

Table 6: Self-Reported Confidence Scores Before and After Training (n = 93)

Group	Pre-Confidence Mean ± SD	Post-Confidence Mean ± SD	Mean Difference	95% CI of Difference	p-value
Traditional Curriculum	4.00 ± 0.89	5.46 ± 1.05	1.46	1.30 – 1.62	<0.001*
CBME Curriculum	4.15 ± 0.80	7.67 ± 1.00	3.52	3.38 – 3.66	<0.001*

Figure 1 illustrates the comparative mean OSCE scores between students exposed to Competency-Based Medical Education (CBME) and those under the traditional curriculum. Both groups show improvement from pre-test to post-test, with the CBME group demonstrating a more pronounced increase.

The chart clearly shows a significant gain in OSCE performance following the CBME intervention. While the traditional group's mean score improved from 54.4 to 64.9, the CBME group's scores increased from 56.5 to 74.6. This nearly 18-point jump in the CBME group compared to a 10-point gain in the traditional group reflects the superior effectiveness of CBME in enhancing clinical competencies.

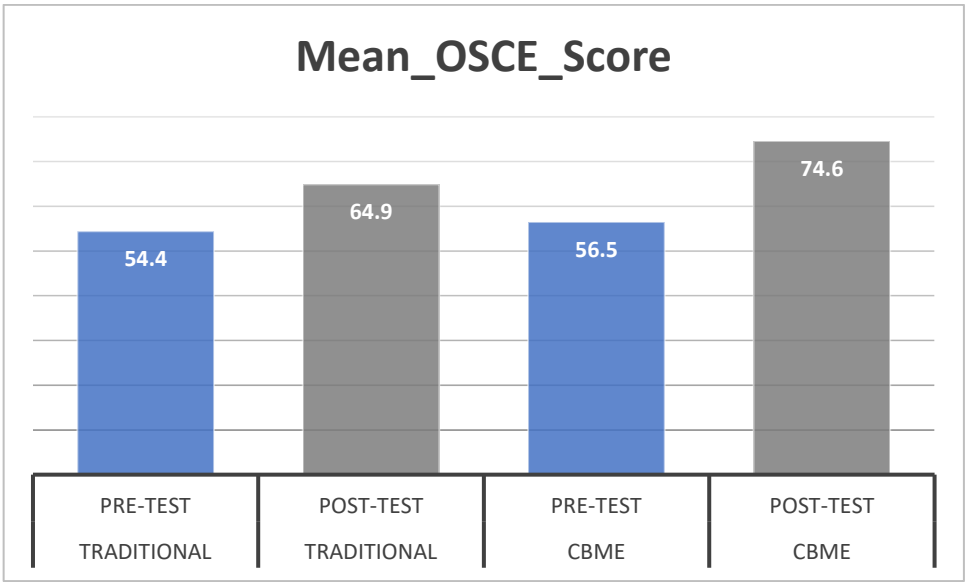

Figure 1: Comparison of Mean OSCE Scores in CBME and Traditional Groups (Pre- and Post-Test)

DISCUSSION

The results of this study provide robust evidence that Competency-Based Medical Education (CBME) significantly improves clinical skill acquisition and learner confidence among undergraduate medical students compared to traditional instructional approaches. The significant post-test OSCE score improvement observed in the CBME group (mean gain of 18.12 points) as opposed to the traditional group (mean gain of 10.55 points) highlights the clear advantage of structured, learner-centered, and feedback-driven methodologies.

This outcome is consistent with the findings of Kj et al., 2025, who emphasized that CBME ensures accountability and structured progression toward defined competencies, especially in clinical skill performance [10]. Similarly, Chaney et al, 2021 noted that CBME frameworks improve educational outcomes by focusing on outcomes-based learning, supervised practice, and frequent feedback [11].

A comparative study by S. Gupta & Menon, 2022 reported that medical learners exposed to CBME environments demonstrated improved clinical judgment, procedural skills, and diagnostic reasoning, supporting our findings of significant OSCE score gains[12]. Furthermore, Baynouna AlKetbi et al., 2024 conducted a study in postgraduate settings and found that learners in CBME tracks outperformed their peers in traditional models in terms of assessment readiness and procedural independence [13].

In the present study, student satisfaction was strongly associated with the instructional method. Over half of the CBME group reported high satisfaction, whereas none in the traditional group did so. This pattern aligns with Sahadevan et al, 2021, who reported that CBME learners showed higher engagement and perceived relevance of training [14]. Similarly, Ai Li et al., 2023 found that integrating CBME elements led to improved learner satisfaction due to clarity of expectations and alignment between instruction and assessment [15].

The observed improvement in self-reported confidence in the CBME group also reflects findings from Thakuria et al, 2024), who showed that CBME interventions enhance not only objective clinical performance but also learner self-efficacy [16]. In another study, (Perugu et al, 2024 concluded that CBME fosters sustained professional identity development and boosts learner autonomy, especially when paired with timely feedback and supervised clinical exposure [17].

Moreover, Lee & Chiu, 2022 highlighted that when learners are evaluated using authentic performance-based assessments (like OSCEs), they develop both competence and confidence more effectively [18]. Our study's findings are also in line with Nagar et al., 2024, who proposed that CBME's emphasis on formative feedback, simulation, and direct observation builds core clinical skills more reliably than didactic-only models [19].

From a regional perspective, recent evidence from Pakistan by Abdullah et al., 2025 and Parveen et al, 2023 showed that early implementation of CBME in some institutions led to significant

improvements in students' communication skills and clinical confidence [20, 21]. These findings underscore the relevance and adaptability of CBME even in low- to middle-income countries, consistent with our study conducted in a resource-limited but academically active setting.

Despite these strengths, our study does have limitations. It was restricted to a single institution, which may limit generalizability. Additionally, long-term skill retention and actual bedside performance were not assessed. Examiner bias during OSCE evaluation is also a possible source of variation. Future studies should consider multi-institutional sampling, long-term follow-up, and incorporation of workplace-based assessments.

CONCLUSION

This study demonstrates that Competency-Based Medical Education offers a superior instructional model compared to traditional teaching, particularly in developing clinical competence and confidence among undergraduate medical students. Statistically significant improvements in OSCE scores, high satisfaction levels, and increased self-reported confidence in the CBME group confirm its effectiveness. These findings support broader integration of CBME into undergraduate curricula and highlight its potential to enhance the clinical readiness of future physicians, even in resource-constrained settings.

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