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# Impact of Formative Assessment with Immediate Feedback on Academic Performance in Undergraduate Medical Students

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## Abstract

Formative assessment with immediate feedback has emerged as a vital pedagogical tool to enhance learning outcomes in medical education. This experimental study aimed to evaluate the impact of formative assessments accompanied by immediate feedback on the academic performance of undergraduate medical students at a tertiary medical institution. A total of 300 second-year medical students were randomly allocated into two groups: Group A received conventional teaching with formative assessments and delayed feedback, while Group B underwent formative assessments integrated with immediate verbal and written feedback during the learning process. Academic performance was assessed through standardized multiple-choice question (MCQ) tests administered pre-intervention and post-intervention over a 12-week period. Group B demonstrated statistically significant improvement in mean test scores (mean ± SD: 78.5 ± 6.2) compared to Group A (72.1 ± 7.5; $p < 0.001$). Moreover, student engagement and self-reported confidence in clinical reasoning improved markedly in Group B. These findings indicate that formative assessment with immediate feedback significantly enhances knowledge acquisition and academic

performance in undergraduate medical students. This study advocates for the incorporation of structured formative assessments with real-time feedback to optimize learning outcomes and competency development in medical curricula.

**Keywords:** Formative Assessment, Immediate Feedback, Medical Education

## Introduction

Academic performance among undergraduate medical students is influenced by a multitude of factors, including the effectiveness of teaching methods and assessment strategies. Traditional summative assessments, while essential for evaluating knowledge retention, often fail to provide timely information that can guide ongoing learning. Formative assessment, characterized by its continuous nature and ability to inform both students and instructors about learning progress, has gained prominence as an essential component in medical education. Immediate feedback in formative assessment enables learners to identify errors, misconceptions, and gaps in understanding promptly, which can facilitate corrective actions and reinforce learning1–3.

Recent educational theories emphasize active learning and formative evaluation as cornerstones for competency-based medical education4. The concept of immediate feedback aligns with cognitive load theory, which posits that timely information helps optimize the working memory capacity, leading to better encoding of knowledge5. Studies have demonstrated that formative assessments coupled with immediate feedback enhance knowledge retention, clinical reasoning skills, and self-regulated learning among medical students6–8. However, implementation remains inconsistent, particularly in resource-limited settings, due to challenges such as faculty time constraints and lack of training in feedback delivery9.

The existing literature indicates a positive association between formative assessment and academic success but varies widely in methodological rigor and contextual applicability10,11. Therefore, it is imperative to conduct context-specific studies evaluating the efficacy of formative assessments with immediate feedback in improving academic outcomes. This study aims to fill this gap by investigating the impact of structured formative assessments with immediate feedback on the academic performance of undergraduate medical students at a major teaching hospital.

## Methodology

This prospective study was conducted over 12 weeks at a Sialkot Medical College in collaboration with KMDC, KMU. Ethical approval was obtained from the institutional review board, and written informed consent was obtained from all participants. The sample size was calculated using Epi Info software with a confidence interval of 95%, power of 80%, and an expected effect size of 0.5 for improvement in academic scores, resulting in 150 students per group (total n=300).

Inclusion criteria were second-year medical students enrolled in the foundational medical sciences course, who consented to participate. Exclusion criteria included students repeating the year or those with prior exposure to formative assessment programs. Participants were randomly allocated into two groups using a computer-generated randomization list. Group A (control) received standard lectures and periodic formative assessments with feedback provided after a delay of one week. Group B (intervention) participated in identical formative assessments but received immediate verbal and written feedback during the same session.

Formative assessments comprised weekly MCQs aligned with course objectives. Immediate feedback was structured to highlight correct responses, explain reasoning for answers, and address misconceptions. Academic performance was evaluated using standardized MCQ tests administered at baseline and after 12 weeks. Secondary outcomes included student engagement, measured by attendance and participation, and self-reported confidence assessed via validated Likert-scale questionnaires.

Data were analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation (SD). Paired and independent t-tests compared pre- and post-intervention scores within and between groups, respectively. Statistical significance was set at $p < 0.05$.

## Results

**Table 1: Baseline Demographic and Academic Characteristics of Study Participants**

| **Characteristic** | **Group A (n=150)** | **Group B (n=150)** | **p-value** |
|---|---|---|---|
| Mean Age (years) | 20.4 ± 1.1 | 20.3 ± 1.2 | 0.67 |

| **Characteristic** | **Group A (n=150)** | **Group B (n=150)** | **p-value** |
|---|---|---|---|
| Male (%) | 55.3 | 53.3 | 0.74 |
| Baseline MCQ Score (%) | 65.2 ± 5.8 | 64.9 ± 6.1 | 0.63 |

No significant differences in baseline characteristics were observed between groups.

**Table 2: Academic Performance Before and After Intervention**

| **Assessment** | **Group A (n=150)** | **Group B (n=150)** | **p-value (between groups)** |
|---|---|---|---|
| Pre-intervention (%) | 65.2 ± 5.8 | 64.9 ± 6.1 | 0.63 |
| Post-intervention (%) | 72.1 ± 7.5 | 78.5 ± 6.2 | <0.001 |
| Mean Improvement (%) | 6.9 ± 3.2 | 13.6 ± 4.1 | <0.001 |

Group B showed significantly higher improvement in MCQ scores after intervention ($p < 0.001$).

**Table 3: Secondary Outcomes – Engagement and Confidence Scores**

| **Outcome** | **Group A (n=150)** | **Group B (n=150)** | **p-value** |
|---|---|---|---|
| Attendance (%) | 88.5 ± 6.3 | 94.2 ± 4.5 | <0.001 |
| Participation Score (1–5) | 3.2 ± 0.8 | 4.1 ± 0.7 | <0.001 |
| Confidence Score (1–5) | 3.0 ± 0.9 | 4.3 ± 0.6 | <0.001 |

The intervention group demonstrated significantly better attendance, participation, and self-reported confidence.

**Discussion**

This study provides compelling evidence supporting the effectiveness of formative assessments with immediate feedback in enhancing academic performance among undergraduate medical students. The significant improvement in MCQ scores in Group B corroborates prior findings that real-time feedback accelerates learning and knowledge retention12,13. Immediate feedback

enables learners to promptly correct misconceptions, thereby reducing the cognitive load associated with delayed error recognition14.

Enhanced engagement, reflected by higher attendance and participation scores in the intervention group, suggests that immediate feedback fosters motivation and active involvement in learning activities15. These elements are critical in competency-based medical education, where self-directed learning and reflection are essential16. Moreover, the elevated confidence scores indicate that immediate feedback positively influences students' self-efficacy, a known predictor of academic success17.

Comparisons with previous studies show consistency with international evidence emphasizing feedback immediacy as a determinant of formative assessment efficacy18. The structured feedback approach, combining verbal and written components, may have amplified the educational impact19. Faculty training and standardized feedback protocols are recommended to maintain the quality and consistency of formative assessments20.

Limitations of this study include its single-institution setting, which may limit generalizability. Further multi-center studies with long-term follow-up could elucidate the sustained effects of formative assessment strategies on clinical competence and professional development21. Additionally, qualitative analyses exploring student perceptions could enhance understanding of the feedback process22.

## Conclusion

Formative assessment integrated with immediate feedback significantly improves academic performance, engagement, and confidence among undergraduate medical students. The findings advocate for the systematic incorporation of real-time feedback mechanisms within medical curricula to enhance learning outcomes. Future research should explore the longitudinal impact of such interventions on clinical skills and patient care competencies.

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