



## Original Article



## Perceptions of Undergraduate Medical Students on Quiz-based Formative Assessment with Immediate Feedback in Integrated Clinical Biochemistry Teaching-learning sessions

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## ABSTRACT

Historically, medical education has used quizzes to provide knowledge assessments and feedback. This study investigates the impact of a quiz-based formative assessment with instantaneous feedback on the learning experiences of medical students, specifically focusing on retention, comprehension, and engagement. **Objective:** To examine the impact of quizzes on medical students' comprehension of material, focusing on their perception of the effectiveness of a questionnaire-based pre and post-quiz evaluation approach and its effects on psychological factors like motivation, self-confidence, critical thinking, and receptive capacity. **Methods:** Quantitative data were collected from 100 second-year MBBS students through a cross-sectional survey. Expert input and suggested modifications were implemented in conjunction with a modified validated questionnaire. Data were analyzed using descriptive statistics, with frequencies and percentages reported. **Results:** The study indicated that approximately 63.2% of students felt quizzes helped them focus on relevant material and save study time. Additionally, approximately 55% found quizzes beneficial for understanding metabolic processes in clinical contexts, while approximately 54% reported that quizzes encouraged deeper research and increased engagement. However, some students raised concerns about anxiety and time pressures. **Conclusion:** Overall, formative evaluation via quizzes enhances students' engagement and comprehension and can be optimized based on feedback to improve medical education.

## INTRODUCTION

Faculty-centered didactic lectures, which involve a passive transfer of information from teachers to students, were Pakistan's most commonly used methods of teaching in undergraduate medical colleges [1]. Medical education is transforming, shifting its focus from faculty-centered to learner-centered through the development of diverse educational tools and mediums [2]. Students' learning and comprehension can be enhanced by assessment [3]. They encourage student engagement and regularly enhance self-evaluation. Additionally, they provide a sense of healthy competitiveness, while post-assessment conversations facilitate peer-assisted learning [4]. These evaluations improve student performance through better

retention of medical knowledge and bring satisfaction to students as well as teachers [5]. Immediate feedback can support future learning, performance, and outcomes using present and previous assessment information [6]. Little attention is paid to developing active learning in undergraduate medical education by adopting learning techniques centered on assessment [7]. Applying basic concepts of biochemistry to clinical practice and diagnostic testing is a daunting task for undergraduate students. With rapid advancements in technology quizzes in the form of multiple-choice questions on Google Forms can be employed as an immediate and quick tool for formative assessment [8]. Often, teachers do not



administer these evaluations during teaching sessions but rather incorporate them into a summative examination that takes place during or after the module [9].

The primary objective of the present research was to investigate the influence of incorporating quiz-based formative assessment along with immediate feedback in teaching sessions, allowing for a comprehensive evaluation of the aforementioned advantages.

## METHODS

This study employed a cross-sectional survey. Quantitative data were collected by using a modified validated questionnaire. The validation of the questionnaire was done in two steps; first, an opinion was taken by two experts and recommended changes were incorporated. Later questionnaire was piloted on a group of 8 students from second-year MBBS. The sample size was calculated using OpenEpi, targeting a 95% confidence level, 5% margin of error and 50% population proportion, resulting in 80 participants from a population of 100 MBBS Students. Inclusion Criteria encompassed all second-year students enrolled in the relevant courses, with the exclusion of incomplete responses. The questionnaire was given to 100 students of second-year MBBS as a Google Form. Incomplete forms were excluded from the study. Response rate was 87%. The study relies on descriptive statistics, reporting frequencies, and percentages to summarize students' perceptions of quiz-based formative assessments. The analysis focused on response distribution across Likert scale items, highlighting trends without statistical significance. Under the relevant guidelines and regulations of the revised Declaration of Helinski, the study was conducted at Shifa College of Medicine (STMU) in Islamabad in 2024 for the Gastrointestinal and Nutrition (GIN) program, which lasted for seven weeks. After obtaining IRB approval, the study was projected to continue for three months (May- July). Ethics approval was obtained from the Institutional Review Board and Ethics Committee of STMU, (IRB Reference no 218-24). The capacity of students to critically assess arguments and evidence. The critical thinking ability of the participants will be assessed using a standardized critical thinking questionnaire, with scores ranging from 0 (no critical thinking) to 100 (high critical thinking ability). Multiple-choice questions: (MCQs) are a type of assessment in which students select the correct response from a variety of options. The performance of students will be assessed by the percentage of correct responses to Multiple-Choice Questions (MCQs) in this study. Each question will have five options. Receptive Capacity: The capacity to comprehend and assimilate novel information. The perceived ability of students to comprehend lecture

content will be assessed through a Likert-scale survey, with scores ranging from 1 (extremely low) to 5 (extremely high). Self-confidence: The conviction that one is capable of accomplishing academic objectives. A self-report questionnaire will be used to evaluate students' self-confidence in completing quiz-based tasks. Students will be asked to rate their confidence on a scale of 1 (low confidence) to 5 (high confidence). Survey Question Rationale: The survey questions were categorized to align with the study's objectives, thereby ensuring a comprehensive evaluation of quiz-based formative assessments. a. Learning Effectiveness: This section assesses the degree to which quizzes enhance the retention, comprehension, and focus of relevant content in medical education. b. Engagement and Motivation: This section evaluates the impact of quizzes on the motivation and interest of students in in-depth study topics. c. Psychological Impact: This section evaluates emotional responses, including anxiety and self-assurance that are linked to quiz performance. d. Assessment Quality: This section examines the perceptions of quiz design, complexity, and integration into the curriculum to ensure the efficacy of assessments. e. Formative vs. Summative: The purpose of this section was to determine the student preferences regarding the use of quizzes as either formative feedback or summative evaluation. f. Support: This section assesses the effectiveness of quizzes during the learning process about the support provided by faculty and peers. g. Technical Challenges: This section outlines the logistical and technical obstacles that may affect the overall learning experience during quizzes.

## RESULTS

Participants responded to the survey questions using a 5-point Likert scale to indicate their level of agreement with each statement. The scale was defined as follows:

1= Strongly Disagree

2= Disagree

3= Neutral

4= Agree

5= Strongly Agree

**Table 1:** Perception of Medical Students Regarding the Effectiveness of Pre and Post Session Quizzes Based on a Likert Scale

S. No.	Perception of Medical Students	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
1	The Quizzes Helped me Connect Metabolic Processes to Clinical Practice.	5.7%	8%	31%	44.8%	10.3%

2	Pre and Post-Session Quizzes Enabled me to Focus on more Relevant Content of the Topic.	5.7%	9.2%	21.8%	42.5%	20.7%
3	Pre and Post-Session Quizzes effectively Reduced the Time Required for Learning the Topic	9.2%	17.2%	29.9%	28.7%	14.9%
4	Pre and Post-Session Quizzes Enabled me to have a Better Understanding of Topics	4.6%	12.6%	24.1%	46%	12.6%
5	Pre and Post-Session Quizzes brought Interest to the Topics	9.2%	9.2%	31%	37.9%	12.6%
6	Pre and Post-Session Quizzes helped in End-Of-Module Summative Assessment	6.9%	18.4%	27.6%	35.6%	11.5%
7	Pre and Post-Session Quizzes were Managed Properly at the given Time of the Large Group Interactive Session(LGIS)/ Small Group Discussions (SGD) /Journal Club	16.1%	10.3%	26.4%	39.1%	8%
8	Pre and Post-Session Quizzes were Challenging.	5.7%	10.3%	41.4%	33.3%	9.2%
9	I believe the Quizzes would be more Effective if they Included Clinical Scenarios	4.6%	3.4%	24.1%	49.4%	18.4%
10	Pre and Post-Session Quizzes Intrigue me to study Topics in Detail.	3.4%	16.1%	26.4%	44.8%	9.2%
11	Pre and post-session quizzes helped me to clear concepts of basic subjects of MBBS.	4.6%	11.5%	33.3%	39.1%	11.5%
12	Pre and Post-Session Quizzes Shattered my Confidence	11.5%	27.6%	28.7%	16.1%	16.1%

13	Pre and Post-Session Quizzes were a Waste of Time	11.5%	29.9%	27.6%	20.7%	10.3%
14	Pre and Post-Session Quizzes should be Practiced Regularly in Every Module	11.5%	11.5%	27.6%	35.6%	13.8%
15	The Level of Complexity of Pre and Post-Session Quizzes should be Increased	9.2%	18.4%	39.1%	24.1%	9.2%
16	Incorporating Quizzes into Practicals could Enhance Learning. I Believe Quizzes should be part of Practical Sessions	10.3%	20.7%	32.2%	19.5%	17.2%
17	Practice of Pre and Post-Session Quizzes was Encouraged by Fellow Students.	5.7%	12.6%	42.5%	31%	8%
18	Faculty Endowment (contribution) was Adequate during Pre and Post-Session Quizzes.	3.4%	1.1%	44.8%	36.8%	13.8%
19	During Online Pre and Post-Session Quizzes Technical Issues were Faced.	4.6%	16.1%	34.5%	29.9%	14.9%
20	The number of Multiple-Choice Questions (MCQs) in each Quiz was Sufficient for my Learning Needs	2.3%	5.7%	33.3%	46%	12.6%
21	Pre and Post-Session Quizzes Over burdened me	9.2%	23%	36.8%	20.7%	10.3%
22	Pre and Post-Session Quizzes reduced the Time for other Activities of the Session.	5.7%	10.3%	40.2%	31%	12.6%
23	Pre and Post-Session Quizzes Helped me in Integrating and understanding different Aspects of the Module.	1.1%	6.9%	37.9%	39.1%	14.9%

24	Pre and Post-Session Quizzes should be Summative rather than Formative.	40.2%	17.2%	24.1%	12.6%	5.7%
25	I Felt more Anxious during the Quizzes Compared to Regular Class Activities	9.2%	13.8%	40.2%	21.8%	14.9%

Table 2 presents the distribution of student responses to survey statements on the effectiveness of pre- and post-session quizzes, highlighting different levels of agreement from "Strongly Disagree" to "Strongly Agree."

**Table 2:** Overall Response Distribution to Survey Statements on Pre and Post Session Quizzes

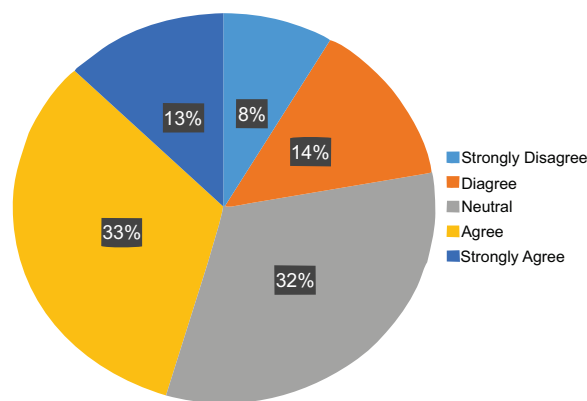
Response Distribution	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Marked Responses	184%	297%	702%	719%	272%
Total Responses	2175%	2175%	2175%	2175%	2175%
Percentage	8.45%	13.65%	32.27%	33.05%	12.50%

Table 3 provides a summary of students' perceptions of quiz effectiveness, encompassing focus on relevant content, comprehension of metabolic processes, increased engagement, reduced study time, and overall positive feedback.

**Table 3:** Summary of Students Perception on the Effectiveness of Quizzes

Effectiveness of Quizzes	Percentage of Students
Helped Focus on Relevant Content	63.2%
Beneficial for Understanding Metabolic Processes	55.0%
Encouraged Deeper Study and Engagement	54.0%
Reduced Learning Time	28.7%
Overall Positive Perception	79.5% (Agree + Strongly Agree)

This pie chart illustrates the percentage distribution of student responses to survey statements about the effectiveness of pre- and post-session quizzes. It visually represents how students perceive the impact of these quizzes on their learning experiences, highlighting levels of agreement or disagreement across various statements (Figure 1).



**Figure 1:** Pie Chart Representing the Percentage Distribution of Student Responses to Survey Statements on Pre- and Post-Session Quizzes

## DISCUSSION

The study aims to ascertain how medical school students view efficacy and the effect of formative quizzes on various factors, like motivation, self-confidence, critical thinking, and receptive capacity. Results showed that approximately 63.2 percent thought quizzes improved their ability to concentrate on the didactic lecture's more pertinent material (Questions 2 and 11), which shortened the time to study and grasp the material (Question 3). A descriptive study on 151 medical students showed that quizzing as a teaching-learning technique increased awareness, interest, and application of knowledge among them [10]. Another study revealed that quizzing fostered a more flexible use of material by forcing students to apply, assess, and synthesize concepts and discoveries efficiently [11]. In terms of the application of metabolic processes to clinical practice, approximately 55% (Table 1) of the students thought that this strategy proved beneficial (Questions 1 and 9). This finding was consistent with Cramer and Mahoney's (2001) research, which found that formative assessment enhances learning objectives by enhancing comprehension and application of evidence-based medicine concepts [12]. The efficacy of Google Form-based MCQ tests in improving students' understanding of biochemistry was demonstrated in a study conducted by Panchbudhe S et al in 2024. Our findings, which showed that 55.1% of students agreed that the quizzes helped them connect metabolic processes to clinical practice, were consistent with the effectiveness of MCQs in reinforcing applied learning [13]. The pre- and post-quizzes, according to approximately 54% of respondents (Table 1), were an effective way to spark students' interest in closely studying the subject (Questions 10 and 23). Shivaraju et al., 2017 further support the majority of students' belief that pre- and post-quizzes were helpful tools for learning and gaining new information [14, 15]. A study by Ranganath R et al., 2013 found that post-quizzes typically provide students with immediate feedback regarding their level of understanding of the lecture topic, and multiple-choice questions (MCQs) also prepare students for in-depth learning of the subject.

The majority of respondents agreed that this evaluation method, as a whole, stimulates and motivates them to study by instantly revealing their performance level in the class itself (Questions 4 and 5) [16-17]. Maximum students believed that the degree of complexity, format, and variety in the number of questions was enough for the pre-and post-quizzes (Questions 8, 15, and 20). Most students believe that all modules should incorporate these quizzes into their practicals and demonstrations (Questions 14, 16, and 17). Talsania N et al., 2015 reported similar findings, recommending that the university hold quizzes more regularly [18]. Although there was consensus regarding the effectiveness and advantages of quizzes for improving comprehension of academic material, feedback from students indicated that they increased anxiety (36% of them) and made them feel like a burden (approximately 56%). (Questions 21 and 25.) These comments were acknowledged and should be taken into account when developing quizzes for modules. Students acknowledged that the assistance and engagement of the faculty during quiz sessions was adequate (Question 18), although they had issues with their internet connections when taking the quizzes (Question 19), resulting in time wastage (Question 13). To increase the effectiveness of these kinds of tests, this should be taken into account and improved. Dhengri C et al., 2021 supported this by stating that the format of the quiz can be altered to accomplish specific aims based on the target audience and the teacher's desired outcome [19]. The study successfully achieved its primary aim of determining students' opinions about the effectiveness of quizzes in boosting drive, self-assurance, critical thinking, and receptive ability. The encouraging and favorable results reinforce the idea of adding quizzes to modules and taking into account student feedback about technological difficulties, structure, difficulty, and quiz frequency. Our research demonstrated that the implementation of Google Forms for assessments was effective in that it enabled educators to concentrate on teaching rather than manual grading by delivering immediate, organized feedback through auto-generated spreadsheets. This tool improves the efficiency of student progress tracking, reduces paper consumption, and contributes to an environmentally friendly approach. These results were consistent with prior research that emphasizes the reliability and feasibility of Google Forms in the context of MCQ-based assessments, as well as their beneficial effects on exam management and student engagement [20]. Since most students agreed that quizzes during the gastrointestinal module were helpful, it makes sense to suggest adding formative quizzes to curriculum design committees and the Department of Medical Education at institutes. This was because pre- and post-quizzes make educational programs more effective. Additionally, this method will improve students' comprehension, attention span, and cognitive skills. The limitations of the study include the reliance on a self-reported questionnaire, which may

introduce bias, potentially affecting the accuracy of the findings. Additionally, the study was limited to second-year MBBS students, restricting the generalizability of the results to other student cohorts or academic years. Moreover, the study's results may have been impacted by the technical difficulties that students encountered during the online quizzes, which could have impacted their responses and their overall learning experience.

## CONCLUSIONS

Quiz-based learning was more dynamic and engaging for pupils. Students' engagement, curiosity, and desire to learn all rise as a result. The results supported the desired benefits of enhanced student motivation, self-confidence, critical thinking, and receptive capacity. The format, content, and degree of difficulty of quiz-based learning can all be adjusted to the requirements, strengths, and weaknesses of the students to make it more dynamic and flexible. Additionally, students' comments on the problems encountered when implementing quizzes in modules should be solicited continuously.

## Authors Contribution

Conceptualization: SM

Methodology: SG, AJ

Formal analysis: SG

Writing, review and editing: AJ, SG, SR

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

All the authors declare no conflict of interest.

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