E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.589

Research Article

# Impact of Formative Quizzes on Long-Term Knowledge Retention among Medical Students

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Received: 07.03.2026, Revised: 26.05.2026, Accepted: 05.06.2026

## ABSTRACT

**Background:** Formative assessment is a crucial part of medical education since it enables constant acquisition of knowledge, self-evaluation and correction of gaps. Formative quizzes could be used to enhance learning through repeated revision and active recall but more studies are required to evaluate the effect of such quizzes on long-term retention of medical students' learning.

**Objective:** To assess the impact of formative quizzes on long-term knowledge retention among medical students.

**Methodology:** The study was Comparative quasi-experimental that was done at Kabir Medical College, Peshawar from January 2025 to June 2025. All 72 medical students were included and the students in this study were split into two groups of 36 each: formative quiz group and control group. The teaching content was the same for both groups. Both formative and control groups were given regular quizzes, but the control group was not given any structured quizzes that provided any feedback. Pre-test was used to gain baseline knowledge. Short term was assessed by immediate post-test, and long term was assessed by 8 weeks delayed post-test. The results of the final examination and students' perception were also obtained. The results obtained were analyzed by SPSS version 26, with p value ≤ 0.05 being statistically significant.

**Results:** The mean pre-test scores were comparable between the formative quiz group and control group. The formative quiz group achieved significantly higher mean immediate post-test scores than the control group (78.6 ± 7.9 vs. 70.4 ± 8.6; $p<0.001$). Long-term retention was also significantly better in the quiz group, with a higher delayed post-test score compared with the control group (72.3 ± 8.4 vs. 61.7 ± 9.2; $p<0.001$). Final examination performance was also higher in the formative quiz group (76.1 ± 7.5 vs. 67.8 ± 8.9; $p<0.001$).

**Conclusion:** Formative quizzes significantly improved immediate learning, long-term knowledge retention, and final examination performance among medical students. Regular low-stakes quizzes with feedback should be incorporated into medical teaching to promote active learning and sustained academic performance.

**Keywords:** Formative Assessment, Formative Quizzes, Medical Students, Knowledge Retention, Active Recall, Medical Education.

## INTRODUCTION

Medical education demands the students to learn, understand and memorize a huge amount of scientific and clinical knowledge. Memory is crucial as medical students need to use previously acquired concepts when they are required to make clinical judgements, make clinical decisions in their diagnosis, and to interact with patients. In the traditional teaching, however, the students are used to passive learning in which they listen

to lectures and make revisions mainly before an examination. This can drive up short-term performance, but is not always effective for long-term knowledge retention (1-3).

Evaluation is an integral part of medical education. Summative assessment is for the evaluation of final performance, while formative assessment is to help learning in the process of learning. Formative assessment gives students chances to track their learning, pinpoint gaps, and enhance learning prior to summative assessment. Quizzes are an easy-to-use, practical and simple type of formative assessment, which can be done in classrooms, small groups or online settings (4-6).

Formative quizzes are brief tests without significant consequences, which may be completed either during or at the conclusion of a teaching session. They provide students with opportunities to recall from memory, a way to improve memory better than passive reading. This is called active recall. Repeated quizzes over time provide students with spaced retrieval, an approach that can minimize forgetting and increase long-term retention. Furthermore, the feedback following quizzes enables students to rectify misconceptions and target their revision on weaker aspects (7-9).

Medical students are easily neglected in memorizing basic science and clinical knowledge for longer periods in medical colleges. What is acquired during one exam can be forgotten before the next; in later years of school or in practice. As such, it is essential to make sure that teaching methods promote long-term retention. Formative quizzes can support students' learning to establish regular study habits, to stay focused while teachers are lecturing, and to study constantly rather than studying the night before (10).

The literature cited above indicates that regular testing and feedback can enhance learning outcomes of students. The impact of formative quizzes could be different, however, depending on the frequency of the quizzes, the quality of feedback, student motivation and the nature of the questions. Within local medical education environments, it remains to be seen if it is possible to enhance delayed knowledge retention and academic outcomes of medical students using structured formative quizzes (11).

This study was conducted to assess the impact of formative quizzes on long-term knowledge retention among medical students at Kabir Medical College, Peshawar. The study compared students who received regular formative quizzes with students who received routine teaching without structured quizzes. The main outcome was delayed post-test performance after 8 weeks, while immediate post-test scores and final examination scores were also assessed.

## METHODOLOGY

This study was conducted at Kabir Medical College, Peshawar, from January 2025 to June 2025. The objective of the study was to assess the impact of formative quizzes on long-term knowledge retention among medical students. A comparative quasi-experimental study
was used, in which students were divided into two groups: a formative quiz group and a control group. The formative quiz group received regular quizzes during the teaching period, while the control group received routine teaching without structured formative quizzes.

In total, 72 medical students participated in the study. A non-probability sampling technique "consecutive sampling" was used in selecting the students. The participants were split into two groups, one a formative group for a quiz (n=36) and one as a control group (n=36). The students who were enrolled in the selected academic session, attended the teaching module and agreed to participate were included in the study. Students that had not been present for baseline assessment, or had not attended key teaching sessions, or failed to attend the delayed post-test were not included in the final analysis.

Prior to the teaching intervention, a pre-test was taken by both groups to establish a baseline of knowledge. The pre test was a structured multiple choice questions about the teaching content selected. The both groups were then taught the same academic subject with a similar teaching method, learning goals and learning material. This was done to account for any difference in knowledge retention being primarily due to the formative quiz intervention, as opposed to variation in the teaching content.

The students in the formative quiz group were given regular quizzes during the study period. The quizzes were given after the teaching sessions and consisted of multiple-choice questions related to the topic covered in the teaching session. The aim of the quizzes was primarily to encourage active recall, frequent

revision, and to highlight weak points. Feedback was given for each quiz to help students understand their errors and progress their learning. The control group had the same teaching sessions without the use of structured formative quizzes throughout the intervention period.

A short-term learning test was administered immediately at the end of the teaching module to both groups to record short-term learning. It was ensured that equal level of difficulty was maintained in the questions of the post-test for both groups so as to compare the two groups fairly. A delayed post-test after 8 weeks was used to test long-term knowledge retention. This was a delayed assessment and main outcome measure of knowledge retention. The final exam grades were also captured to see if there was an impact from participating in quizzes during class on overall academic achievement.

A structured proforma has been used to gather the data. The proforma contained details of age, gender, academic year, attendance, previous academic performance etc. Academic outcome variables were pre-test score, immediate post-test score, delayed post-test score, score decline over time, formative quiz score and final examination score. In addition, student perception of the use of formative quizzes was also investigated based on brief structured questionnaires containing items related to regular study habits, confidence, identification of weak areas and usefulness of formative quizzes in learning.

The data collected were entered and analyzed by SPSS version 26. For quantitative variables (age, pre-test score, immediate post-test score, delayed post-test score and final examination score), the means and standard deviations were presented. Qualitative variables (gender, distribution of the group, student response) were discussed in terms of frequency and percentage. Mean scores of two groups (formative and control) were compared using the independent sample t-test. Pre-test and post-test scores were compared with each other within the same group using the paired sample t-test. For categorical variables, the chi-square test was used. The relationship among the scores of the formative quizzes and long-term retention scores was determined using Pearson correlation. The p value of $\leq 0.05$ was considered to be statistically significant.

## RESULTS

A total of 72 medical students were included in the study. The students were split into two groups, 36 students in the formative quiz group, and 36 in the control group. Students' mean age was 21.4 ± 1.6 year. Overall, 40 (55.6%) were female and 32 (44.4%) were male. The baseline characteristics of both groups were compared to make sure that before intervention both groups are similar. The mean ages, gender distribution, attendance, and previous academic performance of the formative quiz group and the control group were similar. The groups were similar at baseline as there was no statistically significant difference observed.

Table 1: Baseline Characteristics of Study Participants

| Variable | Formative Quiz Group n=36 | Control Group n=36 | p-value |
|---|---|---|---|
| Age, years | 21.5 ± 1.5 | 21.3 ± 1.7 | 0.598 |
| Male | 16 (44.4%) | 16 (44.4%) | 1.000 |
| Female | 20 (55.6%) | 20 (55.6%) | 1.000 |
| Attendance ≥75% | 33 (91.7%) | 32 (88.9%) | 0.692 |
| Previous academic score | 68.9 ± 7.4 | 67.8 ± 7.8 | 0.542 |

A pre-test was used to measure baseline knowledge prior to the intervention. The mean pre test score was 45.8 ± 8.7 for formative quiz group and 44.9 ± 9.1 for the control group. There was no statistically significant difference between the two groups as their pre-teaching intervention knowledge levels were similar (p = 0.671).

Table 2: Comparison of Baseline Pre-Test Scores

| Assessment Variable | Formative Quiz Group n=36 | Control Group n=36 | p-value |
|---|---|---|---|
| Pre-test score | 45.8 ± 8.7 | 44.9 ± 9.1 | 0.671 |

Immediate Post-test scores were higher for both groups following the teaching sessions. Yet, that was an improvement in the formative quiz group. The mean score of the formative quiz group at the post test was 78.6 ± 7.9, while the mean score of the control group was 70.4 ± 8.6. This difference was statistically significant ($p < 0.001$) and demonstrated that formative quizzes were effective in enhancing immediate learning.

Table 3: Comparison of Immediate Post-Test Scores Between Groups

| Assessment Variable | Formative Quiz Group n=36 | Control Group n=36 | p-value |
|---|---|---|---|
| Immediate post-test score | 78.6 ± 7.9 | 70.4 ± 8.6 | <0.001 |

A delayed post test was administered 8 weeks after instruction to determine long term knowledge retention. The mean score for the formative quiz group was 72.3 ± 8.4 and for the control group, it was 61.7 ± 9.2. This difference was statistically significant at $p < 0.001$, signifying that formative quizzes had a positive impact on longterm knowledge retention.

Table 4: Comparison of Delayed Post-Test Scores between Groups

| Assessment Variable | Formative Quiz Group n=36 | Control Group n=36 | p-value |
|---|---|---|---|
| Delayed post-test score after 8 weeks | 72.3 ± 8.4 | 61.7 ± 9.2 | <0.001 |

Students in the intervention group got an average score of 74.8 ± 8.2 on their formative quizzes. Formative Quiz Score was found to be positively correlated with the delayed post test score. Students' performance in the formative quizzes was correlated with their long term retention scores and correlation was positive. The correlation was statistically significant ($r = 0.62$, $p<0.001$).

Table 5: Comparison of Score Decline from Immediate Post-Test to Delayed Post-Test

| Variable | Formative Quiz Group n=36 | Control Group n=36 | p-value |
|---|---|---|---|
| Score decline after 8 weeks | 6.3 ± 3.1 | 8.7 ± 3.8 | 0.004 |

The relationship between formative quiz scores and delayed post-test scores was assessed to determine whether better quiz performance was associated with long-term knowledge retention. A moderate positive correlation was found between formative quiz score and delayed post-test score ($r = 0.62$, $p < 0.001$), indicating that students who performed better in formative quizzes also achieved higher long-term retention scores.

Table 6: Correlation between Formative Quiz Score and Long-Term Retention Score

| Variables Compared | Correlation Coefficient (r) | p-value |
|---|---|---|
| Formative quiz score and delayed post-test score | 0.62 | <0.001 |

The final examination performance was also compared between the two groups. The mean final examination score was significantly higher in the formative quiz group (76.1 ± 7.5) than in the control group (67.8 ± 8.9), with a statistically significant difference ($p < 0.001$). Good academic performance was observed in 30 students (83.3%) in the formative quiz group compared with 22 students (61.1%) in the control group ($p = 0.034$).

Table 7: Comparison of Final Examination Performance between Groups

| Variable | Formative Quiz Group n=36 | Control Group n=36 | p-value |
|---|---|---|---|
| Final examination score | 76.1 ± 7.5 | 67.8 ± 8.9 | <0.001 |
| Good academic performance | 30 (83.3%) | 22 (61.1%) | 0.034 |

Students' perception was evaluated in the formative quiz group. The majority of students mentioned that the formative quizzes made them improve their confidence level before exams, made them make changes often and made them know their weak points. More students were positive about the value of using formative quizzes in learning.

Table 8: Student Perception Regarding Formative Quizzes

| Perception Variable | Positive Response n=36 | Percentage | p-value |
|---|---|---|---|
| Quizzes helped in regular revision | 31 | 86.1% | <0.001 |
| Quizzes helped identify weak areas | 29 | 80.6% | <0.001 |
| Quizzes improved confidence before examination | 28 | 77.8% | 0.001 |

In general, the results indicated that the use of formative quizzes significantly increased the short-term learning, decreased knowledge decay over time, increased long-term knowledge retention, and increased the performance of final examinations for medical students.

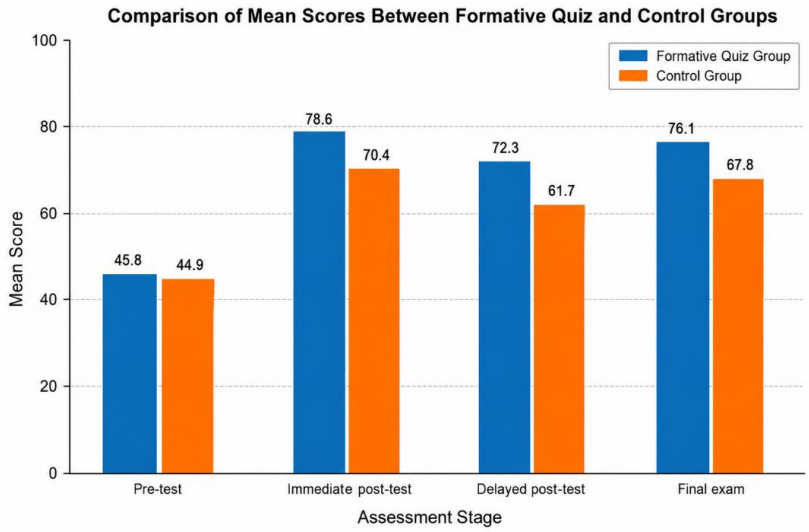


Figure 1: Comparison of mean scores between the formative quiz group and control group across pre-test, immediate post-test, delayed post-test, and final examination stages. The formative quiz group showed higher mean scores in post-test, delayed retention, and final examination, indicating improved long-term knowledge retention among medical students.

## DISCUSSION

The present study evaluated the impact of formative quizzes on long-term knowledge retention among medical students at Kabir Medical College, Peshawar. The findings showed that students who participated in regular formative quizzes achieved better scores in the immediate post-test, delayed post-test, and final examination compared with students who received routine teaching without structured quizzes. Both groups had almost similar baseline pre-test scores, indicating that the initial level of knowledge was comparable before the intervention. Therefore, the improvement observed in the formative quiz group can be linked to repeated testing, active recall, timely feedback, and regular revision encouraged by the quiz-based learning approach (12-14).

One of the important findings of this study was the higher immediate post-test score in the formative quiz group. This indicates that the formative quizzes proved to assist students to grasp and to consolidate the content that was taught, early on after lessons. Quizzes are used to prompt students to remember and recall, rather than just read notes and listen to lectures. This process of retrieval reinforces learning and enables students to identify gaps in learning. For medical students who need to know a fair amount of theory and clinical knowledge, regular (low-

stakes) quizzes can be used to facilitate ongoing learning and to lessen reliance on last-minute exam preparation (15, 16).

Long-term knowledge retention was also significantly better among students exposed to formative quizzes. The formative quiz group had higher delayed post test score than the control group after 8 weeks. This discovery shows that quizzes are not only effective for the short-term, but they are also effective for the long-term. The second finding that the quiz group had less knowledge fade between the immediate post test and delayed post test further verifies the effect of repeated testing in minimizing the fading of knowledge. This is especially important for medical students since the retention of knowledge is crucial to clinical reasoning, problem solving, and future care (17).

The study also revealed that there was a significant positive correlation between the Score of Formative Quiz and the Long-term Retention Score. Those students who were successful in formative quizzing were more likely to obtain higher delayed post test scores. This could be because the regular quizzes encourage students to revise more often, increase attention during teaching time, and foster disciplined reading habits to study. Also, feedback following quizzes allows learners to make corrective errors before they set in. Feedback is a key part of the formative assessment process as it transforms the quiz from a testing tool into a learning tool (18).

The scores at the end of the exams were also higher in the formative quiz group. This indicates that formative quizzes could be a factor in enhancing overall academic achievement. Assessment can help to encourage students to work through the module regularly, rather than waiting till the end of the module to prepare for it. Students' perception was also good with majority saying that they revisited regularly, identified weak areas with the help of quizzes and gained confidence before the examination. The results indicate that formative quizzes are palatable to students and that they can be implemented as low-stakes assessments in the regular teaching process without causing extra academic burden (19, 20).

The results of this study are of practical significance to medical colleges. The formative quizzes are easy to use, cheap to run and simple to apply in classroom or online setting. They may follow lectures, small groups, practicals or at the end of a module. They can help increase student engagement when used in combination with feedback and can positively impact learning when combined with feedback. Quizzes, however, must be carefully planned in relation to the learning objectives and the questions must be aimed at demonstrating understanding and application and not factual recall. Training is also crucial for faculty to make sure that formative quizzes are used effectively and constructively.

There are some limitations to this study. It was done in a single medical college and the number of students enrolled was relatively small (72 students), which might not make the results representative of the wider population. The study investigated retention for 8 weeks only and the impact of formative quizzes on very long-term retention beyond this time was not assessed. The findings might have been influenced by student motivation, self-study time and previous study habits. The study does offer some interesting evidence that frequent, low-stakes, formative quizzes will enhance medical student knowledge retention and academic performance despite these limitations.

## CONCLUSION

The study concluded that formative quizzes had a positive impact on long-term knowledge retention among medical students. Students who received regular formative quizzes showed better immediate learning, higher delayed post-test scores, lower knowledge decline over time, and improved final examination performance compared with students who received routine teaching alone. The findings suggest that formative quizzes promote active recall, regular revision, self-assessment, and timely correction of learning gaps.

Formative quizzes should be incorporated into medical teaching as a routine educational strategy. They are simple, practical, and effective tools for improving sustained learning among medical students. Future studies with larger sample sizes, multiple institutions, and longer follow-up periods are recommended to further evaluate the long-term educational benefits of formative quiz-based learning.

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