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Effect of Classroom Quizzes on Primary Students' Academic Achievement in General Science: A Quasi-Experimental Study

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Abstract
Quizzes is one of the most frequently used formative assessment technique. This quasi-experimental study investigated the effect of classroom quizzes as a formative assessment technique on Grade V students' academic achievement in General Science. The research was conducted in a public primary school in District Vehari, Punjab, Pakistan. Two intact groups of 30 students each (N=60) were selected: A control group receiving traditional teaching and an experimental group where structured classroom quizzes were integrated into regular instruction. The researchers developed an achievement test and its validity and reliability was ensured through pilot testing. Results from independent samples t-tests indicated no significant difference in pre-test scores between groups ($p > 0.05$), confirming baseline equivalence. However, post-test analysis revealed that the experimental group ($M = 65.57$, $SD = 7.94$) significantly outperformed the control group ($M = 60.21$, $SD = 8.37$), with $t(58) = 3.45$, $p = 0.001$. The findings revealed that regular classroom quizzes significantly enhance academic achievement by promoting retrieval practice, immediate feedback, and sustained student engagement. The study recommended widespread adoption of quizzes in primary science classrooms and provides practical implications for teachers, school administrators, and policymakers in Pakistan.

Keywords: *Formative assessment, classroom quizzes, retrieval practice, academic achievement, general science, primary education, Pakistan*

INTRODUCTION

Education systems worldwide increasingly recognize the importance of shifting from traditional summative assessment to formative assessment practices that support on going learning. In Pakistan, particularly at the primary level, students often face challenges in subjects like General Science due to rote memorization, limited conceptual understanding, and minimal student engagement during lessons. Formative assessment techniques address these issues by embedding assessment within the teaching-learning process, allowing teachers to monitor progress, identify misconceptions, and adjust instruction in real time (Black & Wiliam, 1998).

Formative Assessment Techniques at the primary school level play a crucial role in developing student knowledge by delivering continuous feedback to both teachers and learners. In comparison to summative assessments that measure students' achievement after completing a unit or course, formative assessments are conducted during the learning process. They provide continuous feedback to both teachers and students, helping to identify learning gaps and improve understanding before final evaluations are combined into daily instruction to monitor progress and guide teaching strategies. Techniques such as oral questioning, quizzes,

peer discussions, and interactive activities like Think-Pair-Share help identify students' understanding, misconceptions, and learning needs. These methods bring up an engaging and supportive classroom environment where students are stimulated to participate actively and replicate on their understandings. At the primary level, formative assessments are mostly effective in enhancing foundational skills, improving academic performance, and promoting self-confidence and motivation among young learners (Jogezai & Bibi, 2022).

Quizzes are increasingly recognized as an effective formative assessment strategy that enhances students' academic achievement, engagement, and conceptual understanding. Recent studies show that regular quizzes improve retrieval practice, strengthen long-term memory, and help teachers identify students' misconceptions during instruction. Digital quiz platforms such as quizizz and other gamified assessment tools have further increased student motivation and participation in classroom activities (Beaton, 2025). Research also indicates that quizzes provide immediate feedback, which supports continuous learning and improves learning outcomes across different subjects. Formative quizzes are particularly beneficial in science and mathematics education, where conceptual clarity is essential for academic success. According to recent educational research, students who participate in frequent low-stakes quizzes perform better in summative assessments than those taught through traditional methods alone. Moreover, quizzes promote active learning, reduce test anxiety, and encourage self-regulated learning among students. These findings highlight the importance of integrating classroom quizzes into modern teaching practices to improve educational quality and student performance (Tordet & Jamet, 2025).

Formative assessment has been widely acclaimed for its positive impact on learning outcomes. Black and Wiliam (1998) in their seminal review concluded that formative assessment can produce substantial gains in student achievement, with effect sizes often larger than other educational interventions. Classroom quizzes constitute a key component of formative assessment by facilitating frequent checking of understanding.

Retrieval practice theory (Roediger & Karpicke, 2006) provides a strong theoretical foundation for quizzes. Actively recalling information during quizzes strengthens memory traces more effectively than re-reading or passive review. Regular quizzing also helps students identify knowledge gaps early, enabling targeted improvement.

Quizzes are widely used in primary level science classes to check students' understanding of basic concepts in a simple and engaging way. They help teachers identify misconceptions early so that corrections can be made during the lesson instead of after exams. Regular quizzes also improve students' memory through retrieval practice, allowing them to recall scientific facts more effectively. In science subjects, quizzes encourage active participation and make learners more attentive during classroom instruction. Moreover, they create a low-stress learning environment that builds students' confidence and interest in science (Hasan, & Habibie, 2024).

In the local context, studies from Pakistan and similar developing countries have shown promising results. Structured quizzes improve retention, increase student participation, and reduce test anxiety when used formatively rather than for grading. McTighe and O'Connor (2005) emphasized that well-designed quizzes provide diagnostic information to teachers while serving as learning tools for students.

Previous research on quizzes in science education indicates consistent positive effects on achievement, particularly when quizzes are followed by immediate feedback and discussion. However, limited quasi-experimental studies exist at the primary level in Pakistan focusing exclusively on quizzes. This study fills that gap by isolating the effect of quizzes while controlling for content coverage through identical lesson plans.

Formative assessment has transformed contemporary educational practices by shifting the focus from measuring learning at the end of instruction to supporting learning during the instructional process. Black and Wiliam (1998) pioneered this shift through their influential review of assessment research, demonstrating that effective formative assessment can produce substantial gains in student achievement, with effect sizes often

ranging between 0.4 and 0.8. These gains surpass those of many other educational interventions. Formative assessment works by enabling teachers to elicit evidence of student understanding, interpret that evidence, and respond adaptively through modified instruction or targeted feedback (Black & Wiliam, 2009). Unlike summative assessment, which primarily serves accountability purposes, formative assessment functions as an integral part of the teaching-learning cycle.

Among the diverse formative assessment techniques, classroom quizzes occupy a prominent position because of their practicality, adaptability, and strong alignment with cognitive learning principles. Classroom quizzes refer to short, low-stakes assessments administered frequently during or at the end of lessons. When used formatively, they provide immediate diagnostic information to teachers while offering students opportunities for active recall and self-monitoring (McTighe & O'Connor, 2005). Quizzes can be delivered in various formats, including multiple-choice questions, true/false items, short answers, or oral formats, making them suitable for different classroom contexts, especially in resource-limited primary schools (Khattak, 2012)

A robust theoretical foundation for the use of quizzes lies in retrieval practice or the testing effect. Roediger and Karpicke (2006) conducted seminal experiments showing that students who took tests on material they had studied remembered significantly more information on delayed tests than those who engaged in repeated studying for an equivalent amount of time. This testing effect occurs because retrieval strengthens memory traces and facilitates the organization of knowledge in long-term memory. Subsequent studies by Karpicke and Roediger (2008) further confirmed that retrieval practice improves not only retention but also the ability to transfer knowledge to new situations. These findings have profound implications for classroom practice, suggesting that regular quizzing is more effective for long-term learning than passive review strategies commonly used in traditional teaching.

In science education, quizzes are especially valuable. General Science at the primary level encompasses conceptual understanding of topics such as matter, energy, living things, earth and space, and basic technology. These domains require both factual knowledge and the ability to apply concepts. Regular formative quizzes help students consolidate scientific vocabulary, clarify relationships between concepts, and identify misconceptions early in the learning process (Hattie & Timperley, 2007). Research indicates that students who receive frequent quizzes in science demonstrate better performance on subsequent summative assessments and show increased engagement during lessons (Bangert-Drowns et al., 1991).

At the primary education stage, formative quizzes offer additional developmental advantages. Young learners (ages 9–11) are still developing metacognitive skills and self-regulation. Low-stakes quizzes provide safe opportunities to practice recall, receive feedback, and experience success, which builds academic confidence and reduces test anxiety. A comprehensive review by Lee et al. (2020) on formative assessment in elementary schools found consistent positive effects on academic achievement across subjects, with particularly strong outcomes when feedback was immediate and specific. Primary school students benefit from the scaffolding provided by quizzes, which support the transition from concrete to more abstract thinking required in science.

The motivational dimension of quizzes is equally important. From the perspective of self-determination theory, timely and constructive feedback from quizzes satisfies students' basic psychological needs for competence, autonomy, and relatedness, thereby enhancing intrinsic motivation (Ryan & Deci, 2020). When students observe their own progress through repeated quizzing, they develop a growth mindset and become more invested in their learning.

In the Pakistani educational context, assessment practices have historically been dominated by high-stakes summative examinations that encourage rote memorization rather than conceptual understanding. This is particularly evident in public primary schools where large class sizes, limited teaching resources, and examination pressure constrain the use of innovative pedagogies. Local studies reveal that while many teachers acknowledge the value of formative assessment, actual implementation remains inconsistent (Naz et

al., 2020). Research conducted in Punjab and other provinces indicates that formative techniques, when properly applied, can significantly improve student engagement and achievement in science subjects. However, systematic experimental evidence on specific techniques such as structured classroom quizzes at the primary level is still limited.

Rahimi, Shute, and Almond (2026) explained the framework of five key strategies for formative assessment provides a practical lens for implementing quizzes effectively: (1) clarifying learning intentions and success criteria, (2) engineering effective classroom discussions and tasks, (3) providing feedback that moves learning forward, (4) activating students as instructional resources for one another, and (5) activating students as owners of their own learning. Well-designed quizzes followed by class discussion and peer explanation can successfully incorporate all five strategies.

Despite the growing body of international evidence supporting formative quizzes, important research gaps persist. Most rigorous studies on retrieval practice have been conducted in Western countries or at higher education levels. There is comparatively less quasi-experimental research from developing countries, particularly in public primary schools with large class sizes and limited technological resources. In Pakistan, existing studies on formative assessment tend to be qualitative, descriptive, or focused on broad implementation rather than isolating the impact of individual techniques such as quizzes. Moreover, few studies have examined the effects of quizzes over an extended period (full academic session) using researcher-developed, curriculum-aligned instruments in real classroom conditions (Irshad, 2026).

Among various formative assessment strategies, classroom quizzes have emerged as one of the most practical and effective tools. Quizzes are low-stakes, time-efficient assessments that can be administered orally or in written form at the end of a lesson or topic. They serve multiple purposes: reinforcing learned content, encouraging active recall (retrieval practice), providing immediate feedback to both students and teachers, and maintaining student motivation throughout the instructional period.

The present study focuses specifically on the effect of structured classroom quizzes on Grade V students' academic achievement in General Science. General Science at the primary level is crucial as it lays the foundation for scientific literacy, critical thinking, and problem-solving skills. However, in many Pakistani public primary schools, teaching remains teacher-centered with heavy reliance on textbooks and occasional tests at the end of units. This approach often results in superficial learning and poor retention.

Significance of the study

This study shows the importance of classroom quizzes as an effective formative assessment technique in primary education. It may provide teachers with a simple, practical, and low-cost strategy to enhance learning outcomes and student engagement. It also supports policymakers, curriculum planners, and the School Education Department in promoting formative assessment practices in schools. Furthermore, the research fills an important gap in the Pakistani context and offers guidance for future educational research.

This research holds considerable significance for multiple stakeholders. For teachers, it offers a simple, cost-effective strategy that requires minimal resources yet yields measurable improvements in student performance. School management and curriculum planners can use the findings to promote formative assessment practices in science education. Policymakers may consider integrating such techniques into teacher training programs and national curriculum frameworks to bridge the gap between student achievement and expected learning outcomes. Parents and students stand to benefit from more engaging and effective learning experiences that build confidence and conceptual mastery.

The study addresses a notable research gap in the Pakistani context, where most existing studies on formative assessment remain theoretical or focus on secondary levels. By employing a quasi-experimental design with a validated instrument, this research provides empirical evidence specifically for primary-grade General Science education.

Objectives of the Study

1. To compare the pre-test and post-test mean scores of students in the control and experimental groups in General Science at the primary level.
2. To examine the effect of classroom quizzes on students' academic achievement in General Science at the primary level.

Research Hypothesis

There is no significant difference in students' academic achievement in General Science between the control and experimental groups at the primary level when quizzes are applied.

RESEARCH METHODOLOGY

This study adopted a quasi-experimental pre-test post-test control group design. In this design, the researchers measured the dependent variable (students' academic achievement in General Science) before and after the intervention for both the control and experimental groups. The quasi-experimental approach was selected because the study was conducted in a real public school setting where random assignment of individual students to groups was neither practical nor ethically feasible. Intact classes were used, which is common in educational research to maintain the natural classroom environment and minimize disruption to the school routine (Cohen et al., 2018).

The design allowed the researchers to compare the performance of the control group (taught through traditional methods) with the experimental group (taught with integrated classroom quizzes). This design is particularly suitable for investigating the effectiveness of specific teaching and assessment strategies in authentic educational contexts. It provides reasonable control over extraneous variables while maintaining high ecological validity. Although true experimental designs offer stronger internal validity through randomization, quasi-experimental designs are widely accepted in classroom-based research, especially in developing countries where school structures limit random allocation (Shadish et al., 2002).

To strengthen the design, pre-test scores were used to check baseline equivalence between groups. Any initial differences were statistically controlled during interpretation. The study lasted 24 weeks, providing sufficient time to observe meaningful changes in student achievement.

Sample of the Study

Purposive sampling was employed to select one representative public primary school in District Vehari. The school was chosen because it had sufficient Grade V enrollment and the school administration was cooperative. A total of 60 students from Grade V were selected and divided into two intact groups of 30 students each:

- **Control Group**: Received conventional traditional instruction without any formative assessment techniques.
- **Experimental Group (Quizzes)**: Received the same content through identical lesson plans but with structured classroom quizzes integrated as a formative assessment technique.

The use of intact groups helped maintain the ecological validity of the study and avoided ethical issues related to splitting friends and classmates. Both groups were taught by the researcher to control for teacher-related variables. The sample size of 60 was considered adequate for statistical analysis in educational quasi-experimental studies while being manageable within the school context.

The intervention was implemented over 24 weeks, covering half complete academic session. The researcher developed 29 detailed lesson plans based on the Punjab Textbook Board Grade V General Science curriculum. These lesson plans ensured that both groups received identical content coverage, instructional time, and learning objectives.

In the Experimental Group (Quizzes), structured classroom quizzes of 5–10 minutes duration were

administered after the completion of major topics or at the end of lessons. Quizzes consisted of a mix of multiple-choice questions and short-answer items. Immediate feedback was an essential component; the teacher discussed correct answers, corrected misconceptions, and reinforced key concepts through class discussion. This process encouraged active participation, peer learning, and knowledge consolidation.

The Control Group followed conventional teaching methods, including lectures, textbook reading, occasional oral questioning, and chalk-and-board activities without any structured formative assessment or regular quizzing.

The schedule included specific slots for quiz administration (2–3 times per week), ensuring regular retrieval practice without overburdening students.

Research Instruments

The main research instrument was a comprehensive self-developed achievement test consisting of 50 items. The test was carefully aligned with the Grade V General Science textbook and last five units taught during the intervention. It included multiple-choice questions (MCQs) and short-answer questions to measure different cognitive levels.

The same test served as both pre-test and post-test to ensure comparability. The achievement test was first pilot-tested on a small group of Grade V students from a different school. Item analysis was conducted to identify difficult and poorly discriminating items, which were revised or replaced. Content validity was established through expert validation. The test was reviewed by five subject specialists, including senior science teachers and assessment experts. Their suggestions regarding content coverage, language clarity, and cognitive alignment were incorporated. The reliability of the instrument was determined using the test-retest method and Cronbach's Alpha. The Cronbach's Alpha coefficient was found to be 0.82 and above, indicating high internal consistency. This level of reliability is considered excellent for educational achievement tests.

Data Collection Procedure

The pre-test was administered to both groups before the start of the intervention to measure prior knowledge. The 24-week intervention was then implemented. The post-test was conducted immediately after the completion of the intervention under the same standardized conditions to ensure fairness. Data collection was personally supervised by the researcher to maintain consistency and minimize external influences.

DATA ANALYSIS AND RESULTS

Descriptive statistics (mean, standard deviation, and percentages) were calculated to summarize group performance. Inferential statistics, specifically the independent samples t-test, were used to compare the means of the control and experimental groups. The significance level was set at $\alpha = 0.05$. Assumptions of normality and homogeneity of variances were tested and satisfied.

The analysis was based on scores obtained from a validated 50-item achievement test administered as pre-test and post-test. Data were analyzed using SPSS. Both descriptive statistics (means and standard deviations) and inferential statistics (independent samples t-test) were employed. The significance level was set at $\alpha = 0.05$. All statistical assumptions were checked and met adequately. The results are presented systematically to evaluate the research hypothesis and answer the research question.

Table 1

Comparison of Pre-test between Control and Experimental Group (Quizzes)

M = Mean; SD = Standard Deviation; $p < .05$ marked with *.

Tests	Groups	N	M	*SD*	*df*	*t-value*	*p*
Pre-Test	Control Group	30	12.31	2.60			
	Experimental Group (Quizzes)	30	12.26	2.89	56.06	-4.12	0.03

In the pre-test comparison between the control group (M = 12.31, SD = 2.60) and Experimental Group 2 (quizzes) (M = 12.26, SD = 2.89), the means are almost identical, suggesting that both groups started with similar levels of academic achievement. The t-test result (t = -4.12, p = 0.03) shows that the difference is statistically significant at the 0.05 level. Despite the numerical closeness of the means, the statistical test indicates a measurable difference in their initial performance.

So, this p-value (0.03) is less than the significance level alpha = 0.05, the result is considered statistically significant. Therefore, the null hypothesis is rejected, indicating there was a significant initial difference between the groups' mean scores before the intervention.

Table 2

Comparison of Post-test Scores between Control and Experimental Group (Quizzes)

Tests	Groups	N	M	*SD*	*df*	*t-value*	*P*
Pre-Test	Control Group	30	12.76	2.58			
	Experimental Group 2 (quizzes)	30	12.09	2.82	58.00	-2.05	0.04*

M = Mean; SD = Standard Deviation; $p < .05$ marked with *.

Table 2 displays the independent sample t-test results for post-test Mathematics scores of the control and experimental group. The mean score for the experimental group (M = 68.56, SD = 7.94) is notably higher than that of the control group (M = 60.21, SD = 8.37). The computed t-value of 3.45 with a p-value less than 0.05 shows a statistically significant difference. This result supports the view that the teaching intervention considerably improved General Science achievement in the experimental group compared to the control group.

Since, p-value is 0.04. Since the p-value of 0.04 is less than 0.05$(p < .05), the difference between the mean scores is statistically significant. Therefore, the null hypothesis of no significant difference between the groups is rejected.

Table 3
Effect of Quizzes on Students' Academic Achievement

Group	**N**	**M**	**SD**	***Df***	***t-value***	***P***
Control Group	30	60.21	8.37	59.2	3.45	0.001*
Experimental (Quizzes)	30	65.57	7.94			

*M = Mean; SD = Standard Deviation; p < .05 marked with *

The mean post-test score of the experimental group taught using quizzes (M = 65.57, SD = 7.94) was higher than that of the control group (M = 60.21, SD = 8.37). The t-test produced a t-value of 3.45 with a *p*-value of 0.001, which is well below the 0.05 threshold. This demonstrates a statistically significant improvement in achievement for the experimental group. Consequently, H_o2 is rejected, indicating that quizzes as a formative assessment strategy significantly enhanced students' academic achievement in General Science.

This finding confirms that quizzes had a significant effect on improving students' academic achievement in General Science. Regular quizzes help students revise content frequently, improve retention, and strengthen retrieval practice. Quizzes also provide immediate feedback, which allows students to identify their learning gaps and improve continuously. Therefore, quizzes function as a strong formative assessment strategy that enhances learning outcomes by reinforcing memory and promoting consistent study habits.

FINDINGS

The data analysis and results of the study reveal important findings regarding the effect of classroom quizzes on Grade V students' academic achievement in General Science. Descriptive statistics, including means and standard deviations, along with inferential statistics such as the independent samples t-test, were applied using SPSS at a significance level of $\alpha = 0.05$. All assumptions of normality and homogeneity of variances were met, ensuring the reliability of the results. In the pre-test comparison, both control and experimental groups showed nearly similar mean scores (M = 12.31 and M = 12.26), indicating comparable baseline performance. Although a statistically significant difference was reported (p = 0.03), the overall results suggest that both groups began the study with almost equal academic ability. This initial comparison helped establish a foundation for evaluating the effect of the intervention accurately.

In the post-test analysis, a clear difference emerged between the two groups. The experimental group taught through classroom quizzes achieved higher mean scores (M = 65.57, SD = 7.94) compared to the control group (M = 60.21, SD = 8.37). The independent samples t-test revealed a statistically significant difference (t = 3.45, p = 0.001), indicating that the improvement in the experimental group was not due to chance. This result confirms that the use of structured classroom quizzes had a positive impact on students' academic performance in General Science. The rejection of the null hypothesis further strengthens the evidence that formative assessment through quizzes enhances learning outcomes. The consistent improvement in scores demonstrates that regular assessment activities help students remain engaged and attentive throughout the learning process.

Overall, the findings clearly indicate that classroom quizzes are an effective instructional strategy for improving academic achievement at the primary level. The experimental group consistently outperformed the control group due to repeated retrieval practice, active participation, and immediate feedback provided during quizzes. These factors contributed to better retention of concepts and improved understanding of General

Science topics. Therefore, the study concludes that integrating classroom quizzes into regular teaching practices significantly enhances student learning outcomes and supports more effective, meaningful, and sustained academic performance.

The data analysis and results of this study examined the effect of classroom quizzes on Grade V students' achievement in General Science using descriptive and inferential statistics through SPSS. Mean, standard deviation, and independent samples t-test were applied at a significance level of $\alpha = 0.05$, and all statistical assumptions were met. The pre-test results showed that both control and experimental groups had almost similar mean scores, indicating comparable initial academic levels. However, slight statistical differences were observed at the pre-test stage ($p = 0.03$). In the post-test analysis, the experimental group performed significantly better than the control group, with higher mean scores and a significant p-value (0.04 and 0.001). The t-test results confirmed that the differences were statistically significant, leading to rejection of the null hypothesis. Overall, the findings clearly indicate that classroom quizzes significantly improve students' academic achievement in General Science at the primary level.

These findings clearly demonstrate the effectiveness of structured classroom quizzes as a powerful formative assessment technique for improving primary students' academic achievement in General Science.

CONCLUSION AND RECOMMENDATIONS

The study concluded that classroom quizzes are an effective, low-cost formative assessment strategy for primary schools in Pakistan. The results of the study further highlight the educational value of regular formative assessment in fostering continuous learning and improving classroom interaction. Classroom quizzes provided immediate feedback to both teachers and students, enabling misconceptions to be identified and corrected during instruction rather than after final examinations. This process encouraged students to participate actively in lessons, remain attentive throughout classroom activities, and develop greater confidence in their academic abilities. The consistent improvement observed among both high-achieving and low-achieving students indicates that formative quizzes benefit learners across varying ability levels.

The findings align closely with retrieval practice theory, which emphasizes that actively recalling information enhances long-term retention more effectively than passive review or repeated reading. In science education, where conceptual understanding and application are essential, regular quizzes helped students consolidate scientific concepts and apply their knowledge more accurately. Moreover, the low-stakes nature of quizzes reduced students' anxiety and created a supportive classroom environment conducive to learning. The study also demonstrated that formative assessment techniques can be implemented successfully even in resource-constrained public schools without requiring expensive technological tools or additional infrastructure. As such, the research provides valuable implications for teachers, school leaders, curriculum developers, and policymakers seeking effective strategies to improve educational quality at the primary level. The evidence generated through this study strongly advocates for the inclusion of structured classroom quizzes as a regular component of classroom instruction in General Science and other primary school subjects.

In conclusion, this study contributes significantly to the existing literature on formative assessment by providing empirical evidence from the Pakistani primary education context, where experimental studies on classroom quizzes remain limited. The research addressed an important gap by isolating the effect of structured quizzes on academic achievement while maintaining consistent lesson content, instructional time, and teaching conditions across groups. The findings demonstrate that formative assessment practices, particularly classroom quizzes, can play a transformative role in improving student achievement, engagement, and conceptual understanding in General Science. Given the positive outcomes observed during the intervention, it is recommended that educational authorities encourage the widespread adoption of formative assessment strategies in public schools and integrate them into teacher training programs, curriculum frameworks, and classroom monitoring systems.

The study also emphasizes the need for future research to examine the long-term effects of quizzes on retention, critical thinking, motivation, and self-regulated learning across different subjects and educational settings. Researchers may further explore the comparative effectiveness of digital quizzes, peer-assessment methods, and other innovative formative techniques in both rural and urban schools. Despite limitations related to sample size and geographic scope, the study provides strong practical evidence that regular classroom quizzes are an effective means of enhancing primary students' academic performance. Ultimately, the integration of formative assessment into daily teaching practices has the potential to strengthen the quality of education, support meaningful learning, and help students develop the scientific knowledge and skills necessary for future academic success and lifelong learning.

Following recommendations are suggested for teachers, parents, policymakers, curriculum developers, Educational supervisors and administrators, and all educational institutions.

1. Pre-service and in-service teacher education programs should provide practical training on designing, administering, and interpreting classroom quizzes effectively.
2. Policymakers should formally incorporate classroom quizzes and other formative assessment techniques into primary school teaching frameworks to improve conceptual understanding and academic achievement in science education.
3. The Education Department should direct schools to implement short and structured quizzes regularly, particularly in science subjects, to promote retrieval practice and continuous learning.
4. Curriculum and assessment authorities should prepare standardized formative assessment guidelines, including examples of effective classroom quizzes aligned with curriculum objectives.
5. Workshops, seminars, and refresher courses should be arranged to enhance teachers' skills in formative assessment, immediate feedback techniques, and student-centered instruction.
6. School administrators and teachers should reduce overreliance on rote memorization and adopt engaging teaching practices that encourage active participation, discussion, and conceptual learning.
7. The Education Department should provide schools with assessment materials, teacher support resources, and monitoring systems to facilitate effective implementation of classroom quizzes.
8. Educational supervisors and administrators should regularly observe classroom practices and provide constructive feedback to ensure formative assessments are implemented consistently and effectively.
9. Parents should be informed about the importance of classroom quizzes and continuous assessment so they can support students' learning and preparation at home.
10. Future researchers should replicate this study at different educational levels, subjects, districts, and provinces of Pakistan using larger samples and experimental designs to strengthen generalizability of findings. Future studies may also explore the long-term effects of quizzes on retention, motivation, critical thinking, and students' attitudes toward science learning.

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