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Effectiveness of Quizizz in Enhancing Cognitive Competence in Mathematics at Islamic Elementary Schools

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Abstract

This study investigates the effectiveness of Quizizz as a gamified learning platform in enhancing students' cognitive competence in mathematics at an Islamic elementary school (Madrasah Ibtidaiyah). The study focuses on cognitive development, an area that is often underexplored in primary Islamic education. A quasi-experimental one-group pretest-posttest design was used, involving 20 fifth-grade students at MI Tarbiyatul Khoiriyah Kediri. Cognitive achievement was measured using a test aligned with Bloom's revised taxonomy. The findings revealed a significant improvement in students' cognitive competence, especially at the applying and analyzing levels. Quizizz supported active learning by engaging students in interactive, feedback-rich activities. Despite these positive outcomes, the study is limited by its small sample size, single-school setting, and short intervention period. Future research should include control groups and a larger population to validate and extend these results. Practically, the findings suggest that Quizizz can be systematically integrated into mathematics instruction at the Islamic elementary level to support structured cognitive development in an engaging and student-centered way.

INTRODUCTION

Primary education plays a crucial role in shaping students' cognitive foundations, which serve as the basis for lifelong learning. Cognitive competence refers to the ability to understand, apply, analyze, evaluate, and create knowledge, as outlined in Bloom's Taxonomy, revised by Anderson and Krathwohl (2001). This domain is not only central to national curriculum goals but also essential for cultivating higher-order thinking skills, problem-solving abilities, and readiness to face the demands of the 21st century. Strengthening cognitive competence must therefore be a central concern, particularly in Islamic elementary schools (Madrasah Ibtidaiyah, or MI), which aim to integrate both academic and religious values in the learning process.

Mathematics is one of the core subjects in elementary education that demands strong cognitive engagement. As a subject characterized by abstraction, logic, and structure, mathematics requires students to possess logical reasoning, systematic thinking, and reflective analysis (Riswadi & Adirakasiwi, 2023). However, various studies indicate that many students at the MI level struggle to develop these cognitive abilities,

particularly in understanding concepts and solving problems effectively. Preliminary observations at MI Tarbiyatul Khoiriyah Kediri revealed that the average pretest score of Grade V students in mathematics was 75.8, with most students scoring between 60 and 80, and only one student scoring above 90. While these results are slightly above the minimum passing grade (KKM), they suggest that students' conceptual understanding and critical thinking skills remain suboptimal.

One of the primary causes of low cognitive performance in mathematics is the continued reliance on conventional teaching methods, which are often teacher-centered, lecture-based, and minimally interactive. Although traditional approaches like lectures and written exercises are still commonly used, they are often insufficient to stimulate deep learning or higher-order thinking (Yuliana et al., 2024). Consequently, there is an urgent need for more innovative and interactive teaching strategies that actively engage students cognitively. In this regard, the integration of educational technology—particularly game-based learning platforms such as Quizizz—has emerged as a promising alternative.

Quizizz is an interactive quiz platform designed to provide engaging, game-like learning experiences. It enables teachers to create digital quizzes that students can access individually on their devices, featuring real-time feedback, point systems, leaderboards, and gamified elements. These elements enhance motivation, participation, and enjoyment in learning (Jong & Tacoh, 2024). Several studies have shown that Quizizz can improve student engagement, attention, and general learning outcomes (Humairoh, 2023; Suwarni et al., 2023). The platform supports active learning by involving students directly in formative assessment activities while maintaining a fun and competitive atmosphere.

However, most existing research on Quizizz focuses primarily on affective aspects, such as motivation and engagement, rather than cognitive outcomes. For instance, Hernanz et al. (2024) demonstrated that Quizizz increases students' learning motivation but did not assess cognitive achievement based on a systematic framework such as Bloom's taxonomy. Furthermore, the majority of studies have been conducted at the secondary or tertiary education levels, leaving a gap in the literature regarding the effectiveness of this approach at the primary level, particularly in Islamic elementary schools. Yet, in many MI schools, there is already sufficient technological infrastructure and growing teacher familiarity with digital platforms, indicating potential for broader and more structured integration of tools like Quizizz.

The state of the art from the past decade suggests that Quizizz has been widely explored for enhancing student motivation (Syawaluddin et al., 2020), improving peer interaction (Ramadhani & Rukmana, 2022), and supporting learning satisfaction (Rahmadani et al., 2022). Nonetheless, very few studies have focused on systematically measuring cognitive improvements, especially at the MI level and within the subject of mathematics. Moreover, only a limited number of studies have employed the revised Bloom's taxonomy as a framework for evaluating learning outcomes. This highlights a significant research gap, particularly in relation to how gamified learning platforms, such as Quizizz, can enhance cognitive competence among elementary students in Islamic schools.

To address this gap, the present study aims to evaluate the effectiveness of using Quizizz in enhancing cognitive competence in mathematics among Grade 5 students at MI Tarbiyatul Khoiriyah Kediri. By employing a quantitative pretest-posttest design and measuring cognitive achievement using indicators from Bloom's revised taxonomy, this research aims to provide empirical evidence on the cognitive impact of game-based learning in primary Islamic education settings. Unlike previous studies that have emphasized motivational or emotional responses, this study presents a more structured and theory-based approach to evaluating how technology integration impacts students' understanding, application, and analytical skills in mathematics.

Specifically, this research seeks to answer the following questions: (1) What is the level of students' cognitive competence in mathematics before the implementation of Quizizz-based instruction? and (2) How does the use of Quizizz affect students' cognitive competence in mathematics at MI Tarbiyatul Khoiriyah Kediri?

The novelty of this study lies in its focus on measuring cognitive learning outcomes in a primary Islamic school context, using a well-established cognitive framework (Bloom's taxonomy), and integrating gamification not merely as a motivational tool, but as a structured pedagogical instrument. By doing so, this research is expected to fill a critical gap in the literature and offer practical insights for educators seeking to implement more interactive, cognitively enriching learning environments through technology.

METHOD

This study employed a quantitative approach using a quasi-experimental method to examine the effectiveness of the Quizizz platform in enhancing students' cognitive competence in mathematics. The research utilized a One-Group Pretest–Posttest Design, in which the same group of participants was assessed before and after receiving the treatment (Fraenkel et al., 2019). Although this design lacks a control group, it was chosen due to contextual limitations within the school setting, such as uniform class structure and the absence of parallel classes suitable for comparison. Moreover, this design is still considered appropriate for providing preliminary evidence of treatment effectiveness in a real-world educational context.

Nonetheless, the researchers acknowledge several limitations inherent in this design, including potential threats to internal validity such as maturation, testing effects, and the absence of a control group to isolate treatment effects. Additionally, the relatively small sample size limits the external validity and generalizability of the findings. Therefore, this study aims to provide initial insights into the potential cognitive benefits of using gamified learning tools, such as Quizizz.

Population and Sample

The population of this study comprised all students at MI Tarbiyatul Khoiriyah Kediri during the 2024/2025 academic year, totaling 262 students. The sample was selected using purposive sampling based on the following criteria: (1) fifth-grade students who had completed mathematics content aligned with the test indicators, (2) readiness to use digital learning tools, and (3) administrative designation to receive the instructional

intervention. Based on these criteria, one fifth-grade class consisting of 20 students was selected as the study sample. Although the sample size is limited, the chosen class was considered representative in terms of average academic ability and access to technology, making it suitable for a focused pilot study.

Research Instrument

The primary research instrument was a cognitive test in the form of multiple-choice questions, consisting of 20 items developed in accordance with national curriculum standards for fifth-grade mathematics. The items were specifically designed to measure three levels of revised Bloom's Taxonomy: understanding, applying, and analyzing, in line with the cognitive focus of the study.

The content validity of the instrument was assessed through expert judgment, involving two certified mathematics teachers and one university lecturer in mathematics education. Experts reviewed each item for its relevance to the learning objectives, cognitive alignment, clarity, and appropriateness of language. Revisions were made accordingly, and all items were deemed valid for implementation.

To ensure instrument reliability, a pilot test was conducted on 25 students outside the main study sample. The internal consistency of the test was analyzed using the Kuder-Richardson Formula 20 (KR-20), resulting in a reliability coefficient of 0.76, which falls within the high reliability category. The same instrument was used for both the pretest and posttest to ensure measurement consistency and enable valid score comparisons.

Data Collection Procedure

Data collection was carried out in three main stages: Pretest: Administered to assess students' baseline cognitive competence in mathematics. Treatment implementation: Conducted over three consecutive sessions, in which mathematics instruction was delivered using the Quizizz platform. The platform served as the primary tool for quizzes, interactive exercises, and feedback activities. Posttest: Administered using the same instrument to evaluate changes in cognitive competence following the intervention. All assessments were conducted online using the Quizizz platform, which allowed for automated data recording and export in numerical format. The researcher ensured that all students had sufficient digital access and understanding of the procedures before implementation.

Data Analysis Techniques

Pretest and posttest scores were analyzed using inferential statistics, specifically the paired sample t-test, to determine whether there was a statistically significant difference in students' cognitive competence before and after the treatment. Before this, data were tested for normality using the Shapiro–Wilk test, as the sample size was fewer than 50 participants. If the data met the normality assumption, the t-test was applied. If not, a non-parametric alternative, the Wilcoxon signed-rank test, was used. All analyses were conducted at a 5% significance level ($\alpha = 0.05$) using SPSS version 26. In addition to statistical significance (p-value), the study also considered effect size (Cohen's d) to evaluate the practical impact of the intervention on students' cognitive development

RESULTS

This study aimed to evaluate the effectiveness of using the Quizizz platform to improve the cognitive competence of fifth-grade students in mathematics at MI Tarbiyatul Khoiriyah Kediri. Data were collected through pretest and posttest assessments administered to 20 students and analyzed using both descriptive and inferential statistics to determine score differences and learning effectiveness.

The pretest results showed that the average student score was 75.80, with a standard deviation of 9.20. Most students fell within the "adequate" category, with only one student scoring above 90. This indicates that students' conceptual understanding of mathematics was generally limited, especially in application-based questions that required higher-order thinking skills. Following the intervention using Quizizz-based learning, the posttest average increased to 82.35, with a standard deviation of 11.06. The mean score increase of 6.55 points reflects a quantifiable improvement in students' cognitive abilities (Table 1).

Table 1. Mean and Standard Deviation of Pretest and Posttest Scores

Statistik	Pretest	Posttest
Mean ($\bar{x}$)	75,80	82,35
Standard Deviation (s)	9,20	11,06
Mean Difference	-	6,55

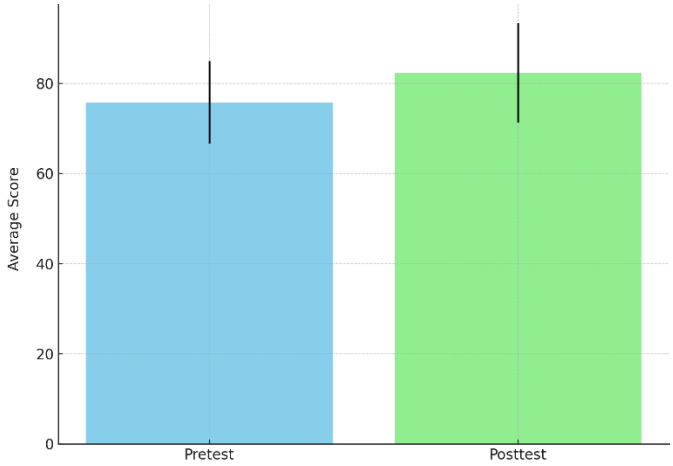

Figure 1. Comparison of Pretest and Posttest Average Scores

To validate the use of parametric tests, a normality test was conducted on the pretest and posttest data using the Lilliefors test**.** The results indicated that both data sets were normally distributed ($L_o < Lt$), allowing the use of a t-test for further analysis (Table 2).

Table 2. Normality Test Results for Pretest and Posttest

Test Type	L_o	Lt ($\alpha = 0.20$)	Distribution
Pretest	0.84754	0.12267	Normal
Posttest	0.94981	0.12267	Normal

Inferential analysis using a paired sample t-test revealed that the computed t-value was -8.290, which far exceeded the critical t-value of 2.030 at a 5% significance level. The p-value (2-tailed) was extremely small at 4.20×10^{-16}, indicating a statistically significant difference between pretest and posttest scores (Table 3).

Table 3. Paired Sample t-Test Results

Statistic	Value
t-value (t Stat)	-8.290
t-table ($\alpha = 0.05$, df = 19)	2.030
p-value (2-tailed)	4.20×10^{-16}
Decision	t Stat > t table
Conclusion	Significant

These findings confirm that the use of Quizizz had a positive and statistically significant effect on improving students' cognitive competence. To evaluate the pedagogical effectiveness of this improvement, an N-Gain analysis was conducted. The results showed an average N-Gain score of 0.46647, which falls into the moderate category. A total of 40% of students showed high improvement, another 40% moderate, and 20% low improvement (Table 4).

Table 4. N-Gain Results of Students

Statistic	Value
Average N-Gain	0.46647
Effectiveness Category	Moderate
Students with High Gain	8 students (40%)
Students with Moderate Gain	8 students (40%)
Students with Low Gain	4 students (20%)

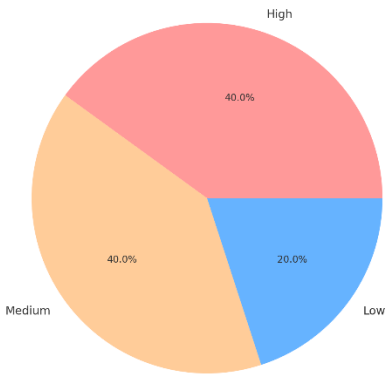

Figure 2. Distribution of Students by N-Gain Category

Table 5. Examples of individual N-Gain data

No	Student	Pretest	Posttest	N-Gain	Category
1	A1	74	89	0.576	Moderate
2	A3	71	90	0.655	Low
3	A7	65	89	0.685	Moderate
4	A11	71	91	0.689	High
5	A16	75	82	0.280	High

According to Figure 2, overall, 80% of students demonstrated meaningful cognitive improvement after engaging with Quizizz-based learning. This analysis highlights the strong pedagogical potential of gamified learning tools to enhance academic performance, particularly in mathematics

DISCUSSION

The significant improvement in students' cognitive scores following the implementation of Quizizz-based learning media demonstrates the effectiveness of this platform in enhancing cognitive competence, particularly in mathematics at the Islamic elementary school (Madrasah Ibtidaiyah/MI) level. This was evidenced not only by the increase in mean pretest and posttest scores but also through the N-Gain analysis, which showed that the majority of students experienced moderate to high learning gains. These findings support the notion that gamified learning can activate students' thinking processes more holistically and meaningfully.

Analyzed through the lens of Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001)Students' cognitive abilities before the intervention were mostly limited to the remembering and understanding levels, as indicated by their ability to answer basic definition or direct calculation questions. However, after the Quizizz intervention, there was a notable shift toward higher-order levels such as applying and analyzing, which was reflected in improved performance on word problems, contextual questions, and concept application tasks. This suggests that Quizizz not only assists in knowledge retention but also encourages students to think more reflectively and apply their understanding in new situations.

From the perspective of Piaget's cognitive development theory (2015)Students at the concrete operational stage are typically at the MI level, where they learn best through hands-on, visual, and interactive experiences. Quizizz, with its engaging interface and instant feedback, offers a learning environment that aligns well with this developmental stage. Through elements such as live rankings, reward points, and time challenges, the platform creates a meaningful and enjoyable learning experience that fosters active student participation.

These findings are also in line with several previous studies. Silvia et al. (2024) Emphasized that Quizizz effectively enhances cognitive learning outcomes due to its competitive and interactive nature. Pratama and Sari (2023) Reported that integrating Quizizz into mathematics instruction improved students' conceptual application skills. Similarly, Monika et al., (2024) found that students engaged in gamified learning environments achieved higher cognitive outcomes than those taught through conventional methods. Furthermore, Khasanah and Lestari (2021) noted that Quizizz facilitates quicker conceptual understanding and helps students independently correct misconceptions through real-time, metacognitive feedback features.

In the context of Islamic elementary education, the results of this study hold additional significance. MI institutions often implement curricula that integrate academic content with religious values, requiring adaptive and contextualized teaching approaches.

Quizizz can be modified to incorporate Islamic content—such as examples involving zakat, prayer times, or ethical considerations in mathematical problems—thus supporting both cognitive development and value-based learning. In this way, the platform becomes not only a cognitive support tool but also a medium for reinforcing cultural and religious relevance in the classroom.

The novelty of this study lies in its explicit focus on measuring cognitive competence using Bloom's taxonomy within the MI context—a focus that remains underexplored in current literature. Most prior research on Quizizz emphasizes motivational or affective outcomes, rarely investigating its impact on the development of higher-order thinking skills in Islamic elementary school students. This study fills that gap by systematically analyzing cognitive gains in a religious primary school setting.

Nonetheless, several limitations of the study should be acknowledged. The use of a one-group pretest-posttest design without a control group raises potential threats to internal validity, such as history and maturation effects. The small sample size (20 students) from a single class also limits the generalizability of the findings. Additionally, the short intervention period (three sessions) may not capture long-term effects, and the study did not incorporate qualitative insights, which could have provided a richer understanding of students' learning experiences and engagement with the platform.

Despite these limitations, the study offers meaningful practical implications. Teachers in MI settings can integrate Quizizz not only as an assessment tool but also as part of systematic instructional planning, including warm-up activities, concept reinforcement, and reflective closure tasks. Furthermore, by designing Quizizz questions based on Bloom's taxonomy, teachers can ensure that learning activities target a balanced range of cognitive levels. The platform's flexibility also allows for differentiated instruction, where question sets can be adapted to accommodate individual students' abilities.

In conclusion, Quizizz-based learning has proven effective in improving students' cognitive competence at the MI level, particularly in understanding, applying, and analyzing mathematical concepts. Beyond its quantitative impact, the platform enriches the learning experience by promoting engagement, reflection, and cognitive activation. This study contributes to the development of interactive learning strategies tailored to Islamic elementary education and serves as a foundation for broader and more in-depth future research

CONCLUSION

This study demonstrates that the use of Quizizz is significantly effective in enhancing the cognitive competence of fifth-grade students at MI Tarbiyatul Khoiriyah Kediri in mathematics. The average score increased from 75.80 to 82.35, with an N-Gain score of 0.466 (moderate category). The *t*-test results showed a statistically significant difference ($p < 0.05$). Most students showed improvement, particularly at the applying and analyzing levels of Bloom's Taxonomy, whereas their initial abilities were primarily concentrated at the remembering and understanding levels. The second research question

was thus confirmed: Quizizz effectively promotes cognitive improvement, including higher-order thinking skills. Practically, Quizizz can be systematically integrated into mathematics instruction at Islamic elementary schools as an interactive tool that supports active learning and cognitive-oriented outcomes. However, this study has several limitations, including the use of a single-group design, a small sample size, and a short intervention period. For future research, it is recommended to involve a larger sample, include control groups, and explore the integration of Quizizz into blended learning models or the development of gamified digital worksheets to strengthen the instructional impact further.

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