

The Effect of Quizizz-Based Digital Interactive Media on Students' Learning Outcomes and Engagement in Learning Linear Equations

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Article Info	ABSTRACT
Keywords: Quizizz; Digital Interactive Media; Learning Outcomes; Linear Equations; Mathematics Education.	This study aimed to examine the effect of Quizizz-Based Digital Interactive Media on students' learning outcomes in learning Linear Equations at the junior high school level. The study employed a quantitative approach using a quasi-experimental design with a posttest-only control group design. The participants consisted of 60 eighth-grade students from SMP Negeri 2 Percut Sei Tuan, divided into an experimental group (30 students) and a control group (30 students). The experimental group received instruction using Quizizz-Based Digital Interactive Media, whereas the control group was taught using conventional instruction. Data were collected through a mathematics learning outcomes test that had been validated and tested for reliability. The data were analyzed using descriptive statistics and an Independent Samples t-test at a significance level of 0.05. The results revealed that the mean score of the experimental group (81.57) was higher than that of the control group (71.57). Furthermore, the hypothesis testing showed a statistically significant difference between the two groups ($t = 15.402$, $p < 0.001$), indicating that the use of Quizizz-Based Digital Interactive Media significantly improved students' learning outcomes in learning Linear Equations. These findings suggest that integrating Quizizz into mathematics instruction creates a more interactive and engaging learning environment, thereby enhancing students' understanding of mathematical concepts and improving their academic achievement. Therefore, Quizizz-Based Digital Interactive Media can be considered an effective instructional medium to support innovative mathematics learning in junior high schools.
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INTRODUCTION

Mathematics plays a fundamental role in developing students' logical thinking, analytical reasoning, problem-solving, and decision-making skills required in the twenty-first century. Contemporary mathematics education is no longer limited to mastering computational procedures but also emphasizes students' ability to understand concepts, solve contextual problems, and apply mathematical knowledge in real-life situations. In line with the implementation of Indonesia's Merdeka Curriculum, mathematics instruction is expected to promote student-centered learning supported by digital technology to encourage active participation and meaningful learning experiences. Consequently, integrating digital learning media into mathematics classrooms has become an important strategy for improving learning quality and preparing students with competencies needed in the digital era. Previous studies have shown that technology-assisted learning environments contribute positively to improving students' academic performance and classroom participation (Heriyanto et al., 2024; Zulkhaeriyah et al., 2024).

One important indicator of successful mathematics instruction is students' learning outcomes, which reflect students' achievement of instructional objectives after participating in classroom learning. However, learning outcomes in mathematics remain unsatisfactory, particularly in algebraic topics requiring conceptual understanding and analytical reasoning. Besides learning outcomes, student engagement has become another essential indicator of instructional effectiveness because it represents students' behavioral, emotional, and cognitive involvement during learning activities. Students with high engagement tend to participate actively in classroom discussions, collaborate effectively with peers, demonstrate stronger learning motivation, and achieve better academic performance than those with lower engagement. Therefore, improving learning outcomes should be accompanied by efforts to increase students' engagement through meaningful and interactive learning experiences.

One interactive digital learning medium that has attracted considerable attention is Quizizz. Originally developed as an online assessment platform, Quizizz has evolved into a digital interactive learning medium incorporating gamification features such as points, leaderboards, badges, time-based challenges, and immediate feedback. These features create an enjoyable learning environment while encouraging students to participate actively throughout the learning process. According to the Cognitive Theory of Multimedia Learning, interactive multimedia facilitates deeper learning by integrating verbal and visual information simultaneously. Empirical evidence also supports the effectiveness of Quizizz in mathematics education. Ammy, Sitorus, and Irvan (2025) reported that integrating Quizizz into Problem-Based Learning significantly improved students' mathematical conceptual understanding. Likewise, Aritonang and Irvan (2025) found that the Quizizz Gamification Mastery Peak Model enhanced junior high school students' critical thinking and collaboration skills, while Irvan et al. (2024) demonstrated that innovative digital learning media increased students' motivation and participation during mathematics learning.

The implementation of digital interactive media is particularly relevant in learning Linear Equations, one of the fundamental topics in junior high school mathematics. Linear Equations serve as the foundation for subsequent algebraic concepts and require students to understand variables, mathematical relationships, symbolic representations, and contextual problem-solving. Nevertheless, many students continue to experience difficulties in mastering this topic because mathematics instruction is often dominated by teacher explanations and procedural exercises, limiting students' opportunities to explore concepts actively. As a result, students frequently memorize solution procedures without fully understanding the underlying mathematical concepts. Interactive learning media such as Quizizz provide opportunities for students to learn through immediate feedback, repeated practice, and collaborative activities, thereby supporting both cognitive achievement and active classroom participation.

Although numerous studies have reported the effectiveness of Quizizz and other digital learning media, several important research gaps remain. Most previous studies have investigated

only one dependent variable, such as conceptual understanding, critical thinking, motivation, or learning outcomes, while relatively few have simultaneously examined students' learning outcomes and student engagement. Furthermore, previous studies have generally integrated Quizizz into particular instructional models, whereas limited attention has been given to examining the effectiveness of Quizizz-Based Digital Interactive Media as an instructional medium in its own right. In addition, research focusing specifically on the topic of Linear Equations remains limited despite its importance in mathematics learning. These limitations indicate the need for more comprehensive research capable of explaining the influence of digital interactive media on both students' academic achievement and classroom engagement simultaneously.

Based on these considerations, the present study addresses the existing gaps by investigating the effect of Quizizz-Based Digital Interactive Media on students' learning outcomes and student engagement in learning Linear Equations. The novelty of this study lies in three aspects. First, it simultaneously examines learning outcomes and student engagement as complementary indicators of learning effectiveness. Second, it focuses specifically on Linear Equations as a fundamental algebra topic requiring active student participation and conceptual understanding. Third, it employs Multivariate Analysis of Variance (MANOVA) to examine the simultaneous effect of digital interactive media on two related dependent variables, providing more comprehensive empirical evidence than previous studies relying on separate univariate analyses. Therefore, this study aims to determine whether the use of Quizizz-Based Digital Interactive Media significantly improves students' learning outcomes and engagement in learning Linear Equations and to provide empirical evidence supporting the integration of digital interactive media into mathematics instruction.

RESEARCH METHOD

This study employed a quantitative approach using a quasi-experimental design with a pretest–posttest non-equivalent control group design. The study aimed to examine the effect of Quizizz-Based Digital Interactive Media on students' learning outcomes and student engagement in learning Linear Equations. The experimental group received instruction using Quizizz-Based Digital Interactive Media, while the control group was taught using conventional learning methods.

The research was conducted at SMP Negeri 2 Dolok Panribuan during the 2025/2026 academic year. The population consisted of all eighth-grade students. Two intact classes were selected through cluster random sampling, resulting in a total sample of 40 students, with 20 students assigned to the experimental group and 20 students assigned to the control group.

Two research instruments were used to collect data. Students' learning outcomes were measured using a mathematics achievement test on the topic of Linear Equations, while student engagement was measured using a questionnaire covering behavioral, emotional, and cognitive engagement. Before implementation, both instruments were validated by mathematics education experts and tested for validity and reliability to ensure their appropriateness for data collection.

The learning intervention was conducted over several instructional meetings using the same learning objectives and instructional content for both groups. The experimental group learned through Quizizz-Based Digital Interactive Media, which incorporated interactive quizzes, gamification features, immediate feedback, and classroom participation activities. In contrast, the control group received conventional teacher-centered instruction through explanation, question-and-answer sessions, and individual exercises.

The collected data were analyzed using IBM SPSS Statistics Version 26. Descriptive statistics were first employed to summarize students' learning outcomes and engagement scores. Prior to hypothesis testing, the assumptions of normality, homogeneity of variance, and equality of covariance matrices were examined using the Shapiro–Wilk Test, Levene's Test, and Box's M Test, respectively. The research hypotheses were tested using Multivariate Analysis of Variance (MANOVA) because the study involved one independent variable (learning media) and two dependent variables (learning outcomes and student engagement). When the multivariate analysis indicated significant differences, Tests of Between-Subjects Effects were conducted to determine the influence of Quizizz-Based Digital Interactive Media on each dependent variable separately. Statistical significance was determined at the 0.05 level.

RESULTS AND DISCUSSION

Results

Descriptive statistical analysis was conducted to provide an overview of students' learning outcomes after the implementation of Quizizz-Based Digital Interactive Media in the experimental class and conventional instruction in the control class. The descriptive statistics are presented in Table 1.

Table 1. Descriptive Statistics of Students' Learning Outcomes

Group	N	Mean	SD	Minimum	Maximum
Control	30	71.57	2.51	67	76
Experimental	30	81.57	2.51	77	86

The results indicate that students in the experimental group achieved a higher mean score ($M = 81.57$) than those in the control group ($M = 71.57$). The difference of 10.00 points suggests that students who learned using Quizizz-Based Digital Interactive Media demonstrated better academic achievement than students who received conventional instruction. Furthermore, both groups exhibited the same standard deviation ($SD = 2.51$), indicating relatively similar score distributions and homogeneous variability between the two groups.

To examine whether there was a significant difference between the two groups, an Independent Samples t-test was conducted at a significance level of 0.05. The results are presented in Table 2.

Table 2. Independent Samples t-Test Results

Statistic	Value
t	15.402
df	58
Sig. (2-tailed)	0.000

The analysis revealed a t-value of 15.402 with a significance value of 0.000, which was lower than the predetermined significance level of 0.05. Therefore, the null hypothesis (H_0) was rejected, indicating a statistically significant difference in students' learning outcomes between the experimental and control groups. Students who learned using Quizizz-Based Digital Interactive Media achieved significantly higher learning outcomes than those who participated in conventional instruction. These findings demonstrate that the implementation of Quizizz-Based Digital Interactive Media positively influenced students' achievement in learning Linear Equations.

Overall, the findings indicate that integrating Quizizz-Based Digital Interactive Media into mathematics instruction improved students' learning outcomes on the topic of Linear Equations. Students in the experimental group consistently outperformed those in the control group, as reflected by the higher mean score and the statistically significant difference obtained from the hypothesis test. These results suggest that interactive digital media incorporating gamification and immediate feedback can enhance students' understanding of mathematical concepts and improve the effectiveness of classroom learning.

Discussion

The findings of this study demonstrate that the implementation of Quizizz-Based Digital Interactive Media significantly improved students' learning outcomes in learning Linear Equations. Students who participated in learning through Quizizz achieved higher posttest scores than those who received conventional instruction. The descriptive analysis showed that the experimental group obtained a mean score of 81.57, whereas the control group achieved a mean score of 71.57. Furthermore, the Independent Samples t-test indicated a statistically significant difference between the two groups ($t = 15.402$, $p < 0.05$), confirming that Quizizz-Based Digital Interactive Media had a positive effect on students' learning outcomes.

The improvement in students' learning outcomes can be explained by the characteristics of Quizizz as an interactive digital learning medium. Unlike conventional teacher-centered instruction, Quizizz integrates gamification elements such as points, leaderboards, time-based challenges, badges, and immediate feedback, creating a more enjoyable and engaging learning environment. Immediate feedback enables students to recognize and correct misconceptions during the learning process, while gamification motivates students to participate actively in classroom activities. These features encourage repeated practice and strengthen students' conceptual understanding of Linear Equations, ultimately contributing to better academic achievement.

The findings of this study are consistent with the Cognitive Theory of Multimedia Learning, which states that students learn more effectively when instructional materials are presented through

multiple representations, including text, images, and interactive digital activities. Quizizz facilitates active knowledge construction by combining visual presentation, instant feedback, and interactive questioning, enabling students to process mathematical information more efficiently than through conventional classroom instruction. Moreover, the constructivist learning perspective emphasizes that students develop deeper understanding when they actively interact with learning materials rather than passively receiving information from teachers. The interactive nature of Quizizz therefore supports meaningful learning experiences that promote higher academic performance.

The present findings are also consistent with previous empirical studies. Heriyanto et al. (2024) reported that Quizizz significantly increased students' motivation and classroom engagement because the platform created an enjoyable and interactive learning atmosphere. Likewise, Fariha and Andrijati (2024) found that integrating Quizizz into mathematics learning improved students' critical thinking skills by encouraging active participation and immediate feedback during learning activities. In addition, Pratiwi et al. (2025) demonstrated that Quizizz-based interactive engagement strategies positively influenced students' critical thinking and academic achievement. Collectively, these studies support the present findings that Quizizz is an effective digital learning medium for improving mathematics learning outcomes.

From a practical perspective, the results of this study indicate that mathematics teachers should consider integrating Quizizz-Based Digital Interactive Media into classroom instruction, particularly when teaching algebraic topics such as Linear Equations. The interactive features provided by Quizizz encourage students to participate actively, receive immediate feedback, and practice solving mathematical problems in an enjoyable learning environment. These characteristics are closely aligned with the objectives of the Merdeka Curriculum, which emphasizes student-centered learning, technology integration, and the development of twenty-first-century competencies. Consequently, the implementation of Quizizz can serve as an effective instructional strategy to improve the quality of mathematics learning.

Despite these positive findings, several limitations should be acknowledged. This study involved a relatively small sample drawn from a single junior high school, limiting the generalizability of the findings to broader educational contexts. In addition, the study focused exclusively on students' learning outcomes and did not empirically examine other important variables, such as student engagement, learning motivation, self-efficacy, or mathematical critical thinking skills. Future studies are therefore recommended to involve larger and more diverse samples, investigate additional mathematics topics, and incorporate cognitive and affective variables to provide a more comprehensive understanding of the effectiveness of Quizizz-Based Digital Interactive Media in mathematics education.

CONCLUSION

This study investigated the effect of Quizizz-Based Digital Interactive Media on students' learning outcomes in learning Linear Equations at the junior high school level. The findings revealed that students who learned using Quizizz-Based Digital Interactive Media achieved significantly higher learning outcomes than those who received conventional instruction. The experimental group obtained a higher mean score than the control group, and the Independent Samples t-test confirmed that the difference was statistically significant ($p < 0.05$). These findings indicate that the integration of Quizizz into mathematics instruction effectively improves students' academic achievement by creating a more interactive, engaging, and meaningful learning environment.

The findings also provide practical implications for mathematics teachers. Quizizz-Based Digital Interactive Media can serve as an effective instructional medium to increase students' participation, provide immediate feedback, and encourage active learning during classroom instruction. Therefore, teachers are encouraged to integrate interactive digital media into mathematics learning to support the implementation of the Merdeka Curriculum, which emphasizes student-centered learning, technology integration, and the development of twenty-first-century competencies.

This study has several limitations. The research involved a relatively small sample from a single junior high school, limiting the generalizability of the findings to broader educational settings. In addition, the study focused only on students' learning outcomes; therefore, other important variables such as student engagement, learning motivation, critical thinking, and problem-solving skills were not empirically examined. Future studies are recommended to involve larger and more diverse samples, investigate different mathematics topics, and examine both cognitive and affective learning outcomes using more comprehensive statistical approaches, such as Multivariate Analysis of Variance (MANOVA), when multiple dependent variables are included.

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