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The Effectiveness of Quizizz Digital Learning Media in Improving Elementary Students' Science Learning Outcomes

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Abstract

The integration of digital learning media is increasingly essential in elementary education to enhance students' engagement and learning outcomes. However, empirical evidence on the effectiveness of gamified digital platforms such as Quizizz in improving elementary students' science learning outcomes particularly on abstract topics such as changes in the states of matter—remains limited. Therefore, this study aims to examine the effectiveness of Quizizz as a digital learning medium in improving students' understanding of science concepts, particularly changes in the states of matter. This research employed a quantitative approach using a quasi-experimental design with a nonequivalent control group. The subjects were Grade V students of SDS Ulul Albab, consisting of class VA as the experimental group and class VB as the control group. Data were collected through pretest and posttest instruments and analyzed using paired sample t-tests. The results revealed a significant improvement in the experimental group's learning outcomes after the implementation of Quizizz, with mean scores increasing from 56.43 to 77.86. Meanwhile, the control group taught through conventional methods showed a lower increase from 57.14 to 74.28. Statistical analysis indicated a significant difference ($p < 0.05$). The intervention also produced a large effect size (paired-samples $t(13) = -11.16$, $p < .001$, Cohen's $dz \approx 2.98$). The findings suggest that Quizizz enhances students' motivation, engagement, and conceptual understanding through interactive and gamified learning experiences. Quizizz is effective as a digital learning medium for improving elementary students' science learning outcomes.

Keywords: Digital Learning Media; Quizizz; Learning Outcomes; Elementary School; Science Education.

INTRODUCTION

The rapid advancement of digital technology has significantly transformed the landscape of education, including science education at the primary school level (Ningtyas et al., 2024). In the era of digital learning, students are increasingly exposed to various forms of digital media such as videos, interactive applications, animations, and online platforms that shape their learning habits, attention span, and cognitive engagement (Chukwuere, 2020). However, this

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transformation also presents challenges, particularly in science education, which traditionally relies on verbal instruction, memorization, and teacher-centered approaches. When these conventional methods are not adapted to contemporary digital contexts, students often experience reduced motivation, superficial understanding of scientific concepts, and difficulties in connecting abstract science topics with real-life phenomena. This phenomenon raises concerns about the effectiveness of current instructional practices in fostering deep conceptual understanding and meaningful science learning among students.

Empirical observations at SDS Ulul Albab Jember indicate similar challenges in the implementation of science education. Preliminary observations and informal interviews with the science teacher revealed that although the school supports the use of instructional media, the science learning process still tends to rely heavily on textbook-based instruction and verbal explanation. As a result, students often demonstrate limited engagement during lessons, passive participation, and difficulty connecting scientific concepts with real-life situations. Classroom observation data showed that a significant number of students struggled to explain core concepts related to changes in the states of matter such as melting, freezing, evaporation, and condensation beyond rote memorization. These findings suggest that while cognitive exposure to these concepts exists, meaningful conceptual understanding remains limited..

Further empirical data from SDS Ulul Albab Jember reveal that students' learning motivation during conventional science lessons is relatively lower compared to sessions that utilize multimedia or interactive digital tools. Teachers reported that students showed higher enthusiasm and active participation when digital media were occasionally used, such as short science animation videos or interactive quizzes. However, the use of digital learning media has not yet been systematically integrated into science instructional design. This inconsistency results in uneven learning experiences and limits the potential of digital media to support students' conceptual understanding of science (Sofia et al., 2020). These conditions indicate a gap between students' digital learning preferences and the instructional strategies employed in science classrooms.

The observable symptoms of the problem include students' passive learning behavior, limited critical reasoning about scientific phenomena, and persistent misconceptions regarding changes in the states of matter. For example, teachers noted that students frequently confused the concepts of melting and dissolving, or evaporation and boiling, despite repeated

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verbal explanation. Without engaging instructional strategies, scientific concepts risk being memorized superficially rather than understood meaningfully (Iqbal Mustakim et al., 2024).

One potential solution to address these challenges is the systematic integration of digital learning media into science instruction. Digital learning media offer multimodal learning experiences that combine visual, auditory, and interactive elements, enabling students to construct meaning more effectively (Aliyyah et al., 2024). Research has shown that digital media can enhance students' motivation, engagement, and conceptual understanding by providing contextualized and experiential learning (Dahliani, 2023). In the context of science education, gamified digital platforms such as Quizizz which combine instructional content with interactive quizzes, instant feedback, and competitive elements can support students in understanding and retaining abstract scientific concepts in a meaningful way (Dahliani, 2023).

Several relevant studies have demonstrated the positive impact of digital learning media on religious and character education. For instance, a study by (Fahmi Romisa, 2023) found that the use of multimedia-based Islamic learning materials significantly improved students' understanding of moral values and increased learning motivation in primary schools. Similarly, research by (Khasanah & Rusman, 2021) indicated that digital storytelling and interactive media effectively supported character education by fostering empathy, moral reasoning, and reflective thinking among students. Moreover, a study conducted by (Surya, 2023) highlighted that technology-enhanced learning environments contribute to deeper conceptual understanding and active student engagement, particularly when instructional design aligns with pedagogical objectives. These findings suggest that digital learning media have strong potential to enhance Islamic values education when implemented thoughtfully.

Despite the growing body of research on digital learning media, a research gap remains, particularly regarding the specific use of Quizizz as a gamified digital learning medium in elementary science education in Indonesia. Most existing studies focus on general digital learning media, technology acceptance, or student motivation, while limited attention is given to the effectiveness of Quizizz specifically on abstract and often misunderstood science topics such as changes in the states of matter (Khasanah & Rusman, 2021). Additionally, few studies provide empirical, quasi-experimental evidence comparing Quizizz-based instruction with conventional teaching in improving elementary students' science learning outcomes. Furthermore, research focusing on private elementary schools, such as SDS Ulul Albab Jember, remains underrepresented in the literature. Moreover,

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although international studies report that gamified quiz platforms can enhance engagement and achievement, most were conducted at the secondary or tertiary level and on non-science subjects, so their effectiveness for abstract primary-school science concepts remains largely untested. Building on this gap, the novelty of this study lies in its focus on applying Quizizz to a specific, frequently misunderstood science topic among elementary learners, supported by a quasi-experimental comparison between an experimental and a control group. Therefore, this study aims to examine the effectiveness of Quizizz-based digital learning media in improving Grade V students' science learning outcomes, particularly on the topic of changes in the states of matter, at SDS Ulul Albab Jember.

RESEARCH METHOD

Research Design

This study employed a quantitative research approach using a quasi-experimental design, specifically the non-equivalent control group pretest–posttest design. This design was chosen because the researcher did not randomly assign students to groups; instead, intact classes were used as research subjects in accordance with the existing classroom structure at the school. The quasi-experimental design allows researchers to examine the effectiveness of an instructional intervention by comparing learning outcomes between an experimental group and a control group before and after treatment (Cresswell, 2016). In this study, Quizizz-based digital learning media were implemented as the independent variable, while students' science learning outcomes served as the dependent variable.

Research Setting and Participants

The participants of this study were Grade V students from Class VA and Class VB, with a total sample of 28 students (14 in the experimental group, Class VA, and 14 in the control group, Class VB). Class VA (n = 14) was designated as the experimental group, which received instruction using Quizizz-based digital learning media, while Class VB (n = 14) served as the control group, receiving conventional instruction using PowerPoint presentations and textbooks. Sampling was conducted using a total sampling technique, as both intact classes were included in the study.

Research Variables

This study involved two main variables. The independent variable was the use of Quizizz-based digital learning media in science instruction, including interactive slides, embedded quizzes, images, and short videos. The dependent variable was students' science

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learning outcomes, which encompassed cognitive understanding of the concept of changes in the states of matter, as measured through pretest and posttest scores.

Research Instruments

Data were collected using a test instrument designed to measure students' science learning outcomes on the topic of changes in the states of matter. The initial instrument consisted of 30 multiple-choice items aligned with the Grade V science curriculum. The instrument was validated through expert judgment (content validity) and a pilot test administered to Grade V students at SD Baiturahaman. Item analysis using the KR-20 formula indicated that 21 of the 30 items were valid, with the instrument showing a high level of reliability (KR-20 = 0.84). Based on item difficulty and discrimination index analysis, 20 best-performing items were selected as the final pretest and posttest instrument.

Research Procedure

The research procedure was carried out in three main stages. First, a pretest was administered to both Class VA and Class VB to measure students' initial understanding of Islamic values and character education. Second, the treatment stage was implemented over several instructional sessions. During this stage, Class VA received learning activities supported by digital learning media, while Class VB continued learning through conventional teaching methods such as lectures and textbook-based instruction. Third, a posttest was administered to both groups to measure changes in students' understanding after the intervention.

Data Analysis Techniques

The collected data were analyzed using inferential statistical techniques. Descriptive statistics were used to determine the mean, standard deviation, and score distribution of pretest and posttest results. Prior to hypothesis testing, normality and homogeneity tests were conducted to ensure that the data met statistical assumptions. The effectiveness of digital learning media was examined using an independent samples t-test to compare posttest scores between the experimental and control groups, as well as a paired samples t-test to analyze improvements within each group. All statistical analyses were conducted at a significance level of 0.05.

Ethical Considerations

Ethical considerations were taken into account throughout the research process. Formal permission to conduct the study was obtained from the principal and the science

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teacher of SDS Ulul Albab Jember. Prior to data collection, informed consent was obtained from parents/guardians, and verbal assent was obtained from student participants. Students' participation was voluntary, and no student was disadvantaged academically for declining to participate. All data were used solely for research purposes, and participants' identities were anonymized and kept strictly confidential throughout data analysis and reporting.

RESULT AND DISCUSSION

Result

Implementation of Learning Activities

Learning Implementation in Grade V Students at SDS Ulul Albab Jember (Experimental Group) Using Quizizz

This study was conducted at SDS Ulul Albab Jember. Prior to the implementation, preliminary observations were carried out to understand the school environment, learning facilities, and students' characteristics. Based on these observations, Grade V students (n = 28) were selected as research participants, as they were considered cognitively capable of engaging in technology-assisted learning. The class teacher and science teacher, Hasiana, S.Pd., supported the implementation of the study.

Before applying Quizizz as a digital learning medium, a pretest and posttest instrument consisting of 30 multiple-choice items was developed to measure students' initial and final understanding of science concepts. Instrument validation included content validity, reliability testing (KR-20), item difficulty, and discrimination index analysis. The validation process involved expert judgment and pilot testing with Grade V students from SD Baiturahaman. Of the 30 items, 21 items were valid, and the reliability test indicated a high reliability level, allowing the instrument to be used in the study. Based on item analysis, 20 best-performing items were selected for the final test.

The instructional material focused on changes in the states of matter, aligned with the Grade V science curriculum. Quizizz-based learning media were designed using interactive slides combining text, images, short videos, and embedded quizzes. The learning process began with students joining a digital classroom via a Quizizz access code. When individual devices were unavailable, learning activities were facilitated through a projector to ensure equal participation.

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Research Findings

Learning Outcomes of the Experimental Group

Before treatment, students in the experimental group completed a pretest consisting of 20 multiple-choice items. Each correct response was scored 1, while incorrect responses received 0. The pretest results are summarized in Table 1.

Table 1. Pretest Score Distribution of the Experimental Group

Interval	Frequency	Percentage (%)
20–32	2	14.28
33–45	3	21.42
46–58	2	14.28
59–71	3	21.42
72–84	4	28.57
Mean		56.43
Max–Min		80–20

The pretest mean score of **56.43** indicates a moderate initial understanding with considerable variability among students. After the Quizizz-based instruction, a posttest was administered using the same instrument. The results are presented in Table 2.

Table 2. Posttest Score Distribution of the Experimental Group

Interval	Frequency	Percentage (%)
45–55	3	21.42
67–77	4	28.57
78–88	2	14.28
89–99	5	35.71
Mean		77.86
Max–Min		95–45

The posttest mean increased to 77.86, representing a gain of 21.43 points. The majority of students (35.71%) achieved scores above 89, indicating a substantial improvement in conceptual mastery after the use of Quizizz.

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Learning Outcomes of the Control Group

Students in the control group followed conventional instruction using PowerPoint presentations and textbooks. Pretest results (Table 3) show a similar baseline performance to the experimental group.

Table 3. Pretest Score Distribution of the Control Group

Interval	Frequency	Percentage (%)
15–30	2	14.28
47–62	6	42.85
63–78	4	28.57
79–94	2	14.28
Mean		57.14

After instruction, posttest results are shown in Table 4.

Table 4. Posttest Score Distribution of the Control Group

Interval	Frequency	Percentage (%)
45–54	2	14.28
55–64	1	7.14
65–74	2	14.28
75–84	4	28.57
85–94	5	35.71
Mean		74.28

Although the control group demonstrated improvement, the mean gain (17.14 points) was lower than that of the experimental group.

Statistical Analysis

Normality and Homogeneity Tests

Normality was tested using the Shapiro–Wilk test ($\alpha = 0.05$). As shown in Table 5, all significance values exceeded 0.05, indicating normal data distribution.

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Table 5. Shapiro–Wilk Normality Test Results (Summary)

Group	Pretest Sig.	Posttest Sig.
Experimental	> 0.05	> 0.05
Control	> 0.05	> 0.05

Homogeneity of variance was tested using Levene's test. The posttest significance value was 0.875 > 0.05, confirming homogeneous variance between groups (Table 6).

Hypothesis Testing

A Paired Sample t-test was conducted to examine differences between pretest and posttest scores in the experimental group.

Table 6. Paired Sample t-Test Results

Mean Difference	t	df	Sig. (2-tailed)
-21.43	-11.157	13	0.000

To complement the significance test, the effect size of the intervention was calculated using Cohen's dz for paired samples, derived from the t-value and sample size ($dz = t / \sqrt{n}$). Based on the paired sample t-test results ($t = -11.157$, $n = 14$), the effect size was $dz \approx 2.98$, which exceeds Cohen's (1988) threshold of 0.8 for a large effect. This indicates that the improvement in students' science learning outcomes following the implementation of Quizizz was not only statistically significant but also practically substantial.

Discussion

The findings of this quasi-experimental study demonstrate that the use of Quizizz as a digital learning medium has a significant positive effect on Grade V students' learning outcomes in science, particularly in the topic of changes in the states of matter. Based on the quantitative results, students in the experimental group showed a higher increase in posttest scores compared to those in the control group who received conventional instruction. The experimental group's mean score increased from 56.43 to 77.86, while the control group improved from 57.14 to 74.28. This difference indicates that digital learning media incorporating interactive and gamified elements are more effective in facilitating students' conceptual understanding than traditional PowerPoint-based instruction.

The substantial improvement observed in the experimental group supports the view that technology-enhanced learning environments promote active engagement and meaningful learning. Quizizz enables students to interact directly with learning content through real-time

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quizzes, instant feedback, and competitive scoring features. According to Schindler et al. (2017), interactive digital tools increase students' attention and participation by transforming passive learning into active knowledge construction. The results of this study align with this argument, as students in the experimental class were more engaged during lessons and demonstrated better retention of scientific concepts.

The higher posttest performance of the experimental group can also be explained through cognitive engagement theory, which emphasizes that students learn more effectively when they are mentally and emotionally involved in the learning process (Jayanti et al., 2021). Digital quizzes embedded within instructional activities encourage students to think critically, make decisions quickly, and reflect on their answers (Anshar & Arsal, 2023). The real-time feedback provided by Quizizz allowed students to immediately recognize misconceptions and correct their understanding, which is a key factor in improving learning outcomes. This mechanism was absent in the control group, where feedback was delayed and limited to verbal explanations (Sahusilawane et al., 2024).

Moreover, the gamification features of Quizizz, such as points, rankings, and countdown timers, played a crucial role in enhancing students' motivation. Previous studies have consistently shown that gamified learning environments positively influence students' motivation and academic achievement (Aini et al., 2024). In the present study, students in the experimental group displayed higher enthusiasm and competitiveness, which encouraged them to focus more on lesson content and strive for better performance. This finding corroborates research by (Oktaviani & Isdaryanti, 2024), who reported that digital quiz platforms significantly improve students' engagement and learning achievement in classroom settings.

Although the control group also showed an increase in learning outcomes, the improvement was relatively lower than that of the experimental group. This indicates that conventional instruction remains effective to some extent, particularly in delivering structured explanations and reinforcing basic concepts. However, conventional methods are less capable of sustaining students' attention and encouraging active participation, especially among learners who are accustomed to digital environments. As argued by OECD (2020), traditional teacher-centered approaches often fail to meet the learning preferences of digital-native students, resulting in suboptimal learning gains.

The statistical analysis further strengthens the validity of the findings. The Shapiro–Wilk normality test and Levene's homogeneity test confirmed that the data met the

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assumptions for parametric testing. The paired sample t-test revealed a significant difference between pretest and posttest scores in the experimental group ($p = 0.000$), indicating that the observed improvement was not due to chance. This result reinforces the effectiveness of Quizizz as an instructional intervention. Similar findings were reported by Rahman et al. (2020), who found that digital quiz-based learning significantly improved elementary students' science achievement compared to traditional teaching methods.

Another important aspect of this study is the role of formative assessment embedded in digital learning media. Quizizz allows teachers to monitor students' understanding in real time and adjust instruction accordingly (Mudeing et al., 2023). Formative assessment is widely recognized as a powerful tool for improving learning outcomes, as it provides continuous feedback and supports adaptive teaching strategies (Ramadhan & Usriyah, 2021). In this study, the teacher was able to identify students' difficulties during the lesson and provide immediate clarification, which contributed to improved conceptual understanding.

From a pedagogical perspective the findings suggest that digital learning media are particularly effective when combined with hands-on activities and real-life examples (Pribadi et al., 2021), as implemented in the experimental group. The integration of simple experiments alongside digital quizzes helped students connect abstract scientific concepts with observable phenomena. This approach aligns with constructivist learning theory, which emphasizes learning through experience and reflection (Anam & Septiliana, 2023). The combination of digital media and experiential learning created a more holistic learning environment that supported deeper understanding.

Despite its positive findings, this study has several limitations that should be acknowledged. First, the sample size was relatively small and limited to a single school, which may affect the generalizability of the results. Second, the study focused on short-term learning outcomes measured through posttests, without examining long-term retention or transfer of knowledge (Mella et al., 2022). Future research could address these limitations by involving larger samples, multiple schools, and longitudinal designs. Additionally, future studies could explore the impact of digital learning media on other learning variables, such as critical thinking skills, creativity, or collaborative learning (Alief Fathul Habibie et al., 2023).

The results of this study confirm that Quizizz-based digital learning media are more effective than conventional instruction in improving elementary students' science learning outcomes. These findings contribute to the growing body of evidence supporting the

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integration of digital tools in primary education. As highlighted by (İbrahim Bozan, 2024), effective digital learning is not merely about technology use but about aligning digital tools with sound pedagogical principles. Therefore, teachers should be encouraged and trained to integrate digital media thoughtfully to enhance instructional quality and student learning.

When compared with previous studies, the magnitude of improvement found in this study is broadly consistent with, and in some respects exceeds, findings reported in comparable research. For example, Oktaviani & Isdaryanti (2024) reported that E-flashcard Quizlet-based media improved elementary students' IPAS learning outcomes, although the reported gain was more modest than the 21.43-point increase observed in the present study. Similarly, Surya, (2023) found that visual and interactive media improved students' understanding of the water cycle, supporting the broader pattern that interactive digital media are particularly effective for abstract, process-based science topics such as changes in the states of matter. These comparisons suggest that the gamification and instant-feedback features unique to Quizizz beyond general interactivity alone may help explain the relatively large effect observed in this study(Ghufron et al., 2023). Theoretically, these findings extend the cognitive theory of multimedia learning, which posits that well-designed multimedia reduces extraneous cognitive load and supports active knowledge construction (Nursakinah et al., 2023); the present findings suggest that gamified elements (points, rankings, timers) may further amplify this effect by increasing learners' motivational engagement alongside cognitive processing

CONCLUSION

This study concludes that Quizizz-based digital learning media are effective for improving Grade V students' science learning outcomes on the topic of changes in the states of matter at SDS Ulul Albab Jember. Posttest scores in the experimental group increased significantly and exceeded those of the conventionally taught control group, as confirmed by the paired-sample t-test ($p < 0.05$) with a large effect size. The main contribution of this study is empirical, quasi-experimental evidence that gamified quiz platforms through interactive quizzes, real-time feedback, and game elements strengthen students' engagement, motivation, and conceptual understanding of abstract science topics at the elementary level, where conventional methods produced comparatively smaller gains. Practically, the findings suggest three implications. Elementary science teachers are encouraged to integrate platforms such as Quizizz for topics students find abstract or difficult to visualize; schools

should provide adequate infrastructure (e.g., shared projectors) to ensure equitable access for students without individual devices; and teacher-training programs should guide teachers in designing pedagogically sound gamified materials rather than using digital tools merely as a novelty. As a single-school quasi-experiment, these findings are context-bound. Future research is therefore recommended to involve larger, multi-school samples and longitudinal designs to examine long-term concept retention, and to extend the inquiry to outcomes such as critical thinking, collaborative learning, and science process skills, as well as to compare Quizizz with other gamified platforms

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