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The Effect of Baamboozle-Assisted Digital Learning Media on Students' Learning Motivation and Critical Thinking Skills in Natural and Social Sciences Learning

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Abstract. The integration of digital learning media in elementary schools requires the use of media that are not only engaging but also capable of supporting students' learning motivation and critical thinking skills. Baamboozle is a game-based learning platform that provides quiz activities, scoring, simple competition, feedback, and classroom interaction, making it relevant for use in Natural and Social Sciences learning. This study aimed to examine the effect of Baamboozle-assisted digital learning media on elementary school students' learning motivation and critical thinking skills. This research employed a quantitative approach using a quasi-experimental posttest-only nonequivalent control group design. The participants consisted of 53 third-grade elementary school students who were divided into a Baamboozle group and a conventional learning group. Data were collected using a learning motivation questionnaire and a critical thinking skills test, both of which had been tested for validity and reliability. The data were analyzed using MANOVA (Multivariate Analysis of Variance). The results showed that Baamboozle-assisted digital learning media had a significant simultaneous effect on students' learning motivation and critical thinking skills. The between-subjects test also indicated significant differences between the Baamboozle group and the conventional group in both learning motivation and critical thinking skills, with the Baamboozle group obtaining higher mean scores on both variables. These findings suggest that Baamboozle can be used as a digital learning medium that supports both the affective and cognitive aspects of students in elementary school Natural and Social Sciences learning.

Keywords: baamboozle; critical thinking; digital learning media; natural and social sciences learning; learning motivation

INTRODUCTION

Digital transformation in primary education requires teachers to design learning that is more interactive, adaptive, and aligned with the characteristics of twenty-first-century learners. The integration of digital technology in education can expand access, increase engagement, and support learning personalization when implemented through appropriate pedagogical strategies (Zou et al., 2025). Technology-based learning should also be directed toward strengthening students' motivation, interaction, learning performance, and critical thinking skills (Silva et al., 2025). In the context of Natural and Social Sciences learning, media are needed to help students understand natural and social concepts through problem-based activities and simple games that encourage learning engagement. Therefore, game-based digital learning media represent a relevant pedagogical alternative for elementary school students (Maulida & Wulandari, 2024).

Digital game-based learning has been widely examined as an approach that can enhance students' motivation and engagement in the learning process. Gamification activities using Kahoot in elementary science learning have been shown to improve students' conceptual understanding, self-efficacy, interest, and enjoyment, while studies on Kahoot and Quizizz indicate that the effectiveness of game-based learning needs to be adjusted to students' age, the characteristics of the learning material, and the subject context (Janković & Lambić, 2022; Rayan & Watted, 2024). Digital game-based learning activities have also been reported to have a more positive effect on engagement and motivation than conventional online learning activities (Nadeem et al., 2023). These findings highlight that digital game-based media should be pedagogically designed so that they are not only engaging but also relevant to the intended learning objectives.

Studies on digital game-based learning in K–12 science education show that this approach continues to develop and is widely used to support students' knowledge acquisition, affective-motivational outcomes, behavioral change, and cognitive skills (Hussein et al., 2025). The effectiveness of game-based learning is influenced by the teacher's role in providing scaffolding, as

elementary school students need guidance to connect play-based activities with the learning material (Sun et al., 2023). Gamification designed to support students' psychological needs can strengthen autonomy, competence, social relatedness, and learning motivation in elementary classrooms (Grabner-Hagen & Kingsley, 2023). This evidence indicates that game-based learning should be positioned as part of instructional design, rather than merely as a tool for entertainment or evaluation.

Previous studies have also shown a relationship between digital game-based learning and students' motivation and higher-order thinking skills. Research in STEM education indicates that digital game-based learning tends to improve students' motivation and engagement when students' gaming experiences and prior knowledge are considered in the instructional design (Ilić et al., 2024). Studies involving cooperative learning models, digital games, and augmented reality have reported improvements in critical thinking skills and learning motivation when students are engaged in collaborative technology-based learning experiences (Rizki et al., 2024). Gamified learning can support critical thinking skills by providing challenges, feedback, and problem-solving activities that encourage students to think analytically (Srinivasa et al., 2024).

In the Indonesian context, Baamboozle has begun to be used as a digital learning medium in elementary schools, although related studies are still more commonly published in national journals. Research involving elementary school students shows that Baamboozle-assisted game-based learning can improve student engagement and mathematics learning outcomes, while another study indicates that Baamboozle is effective as a mathematics learning medium for enhancing fifth-grade students' problem-solving skills (Hilda & Prasetyaningtyas, 2024; Wardani & Kiptiyah, 2024). A study in elementary science learning further shows that Baamboozle-based game learning can increase students' verbal participation, discussion engagement, and collaboration in science lessons (Alfiah & Sholihah, 2025). These findings indicate that Baamboozle has practical relevance as a medium that can foster student engagement in elementary education.

The research gap lies in the limited number of studies that specifically examine Baamboozle-assisted digital learning media in elementary school Natural and Social Sciences learning by involving two dependent variables simultaneously, namely learning motivation and critical thinking skills. Studies in elementary science learning show that Baamboozle-based game learning can improve students' verbal participation, discussion engagement, and collaboration. However, these studies have not directly examined learning motivation and critical thinking skills simultaneously in Natural and Social Sciences learning (Alfiah & Sholihah, 2025). Research on gamification and serious games also indicates that game-based learning needs to be examined from both motivational and cognitive aspects, including critical thinking (Lampropoulos et al., 2023). Studies on digital game-based learning among elementary school students have reported positive effects on motivation and engagement, but they have not specifically investigated the use of Baamboozle in Natural and Social Sciences learning (Zheng et al., 2024). The novelty of this study lies in examining Baamboozle as an instructional treatment for students' learning motivation and critical thinking skills within a single analytical model. Therefore, this study aims to analyze the effect of Baamboozle-assisted digital learning media on these two variables in Natural and Social Sciences learning. The research hypotheses are formulated as follows.

H1: There is a difference in learning motivation between the Baamboozle group and the conventional group.

H2: There is a difference in critical thinking skills between the Baamboozle group and the conventional group.

H3: There is a simultaneous effect of Baamboozle-assisted digital learning media on students' learning motivation and critical thinking skills.

METHODS

This study employed a quantitative approach to examine the effect of Baamboozle-assisted digital learning media on elementary school students' learning motivation and critical thinking skills in Natural and Social Sciences learning.

Research Design

This study employed a quasi-experimental design. A quantitative approach was selected because the study examined the effect of Baamboozle-assisted digital learning media on students' learning motivation and critical thinking skills using numerical data analyzed statistically (Creswell, 2014; Creswell & Creswell, 2023). The quasi-experimental design was applied because the treatment was implemented in an authentic

classroom setting, with students grouped according to the existing class structure, so individual randomization was not conducted (Cham et al., 2024). The research model used was a posttest-only nonequivalent control group design, which compares an experimental group and a control group through measurement after the treatment without a pretest (Krishnan, 2018). The experimental group received Natural and Social Sciences learning supported by Baamboozle, while the control group received conventional learning.

Participants

The participants in this study were 53 third-grade students from two public elementary schools who were taking Natural and Social Sciences lessons. The sample consisted of 24 students from SD Negeri 2 Kober and 29 students from SD Negeri Banjarsari. The participants were selected using cluster sampling because the sample was drawn from existing student groups within the schools serving as research clusters, rather than through individual student selection. Cluster sampling is used when a population is divided into clusters, such as institutions or specific groups, and the members of the selected clusters are then included as the research sample (Ahmed, 2024). One group was assigned as the experimental group and received Baamboozle-assisted Natural and Social Sciences instruction, while the other group was assigned as the control group and received conventional instruction.

Instruments

The learning motivation instrument was developed in the form of a questionnaire by adapting the measurement principles of the Reduced Instructional Materials Motivation Survey (RIMMS), which is based on the ARCS model. This instrument was used to measure students' learning motivation across four aspects: Attention, Relevance, Confidence, and Satisfaction (Loorbach et al., 2015; Wang et al., 2020). The learning motivation questionnaire was adjusted to the context of Baamboozle-assisted Natural and Social Sciences learning and consisted of 16 statements. Each aspect contained four statements measured using a four-point Likert scale, namely strongly disagree (1), disagree (2), agree (3), and strongly agree (4). The distribution of the aspects and statements in the learning motivation questionnaire is presented in Table 1.

Table 1. Learning Motivation Questionnaire

Aspect	Statements
Attention	I am interested in learning science and social studies.
	I listen to the teacher during science and social studies lessons.
	Baamboozle makes science and social studies lessons more interesting.
	I want to join the science and social studies activities actively.
Relevance	I think science and social studies are useful in daily life.
	I can connect science and social studies lessons with things around me.
	Learning science and social studies with Baamboozle helps me learn better.
	I know why learning science and social studies is important for my life.
Confidence	I feel confident when answering science and social studies questions.
	I am brave enough to share my opinion in science and social studies lessons.
	I believe I can understand science and social studies lessons well.
	I can finish the science and social studies tasks given by the teacher.
Satisfaction	I feel satisfied after learning science and social studies.
	I feel happy when I answer science and social studies questions correctly.
	I want to finish my science and social studies tasks well.
	Science and social studies lessons are fun for me.

The critical thinking skills test was developed in the form of essay questions based on Natural and Social Sciences material. The critical thinking aspects used in this study were interpretation, analysis, inference, and explanation, as these aspects are relevant for assessing critical thinking skills in science learning and are appropriate for the context of elementary school students (Sarwanto et al., 2021; Sujatmika et al., 2025). The test consisted of 10 essay questions. Students' answers were assessed using a scoring rubric ranging from 1 to 5, with a score of 5 assigned to answers that were correct, complete, systematic, and supported by reasoning consistent with Natural and Social

Sciences concepts. The distribution of aspects, indicators, and the number of items in the critical thinking skills test is presented in Table 2. The learning materials for the experimental group were designed as Baamboozle-assisted Natural and Social Sciences activities, while the control group used conventional learning.

Table 2. Critical Thinking Skills Test Blueprint

Aspect	Question Indicator	Total
Interpretation	Students identify important information from texts, pictures, or situations in Natural and Social Sciences questions.	2
Analysis	Students explain relationships between information, causes and effects, or events in Natural and Social Sciences problems.	3
Inference	Students draw logical conclusions based on the information provided in the questions.	2
Explanation	Students provide reasons or explanations based on relevant Natural and Social Sciences concepts.	3
Total		10

Data Collection Procedures

The data collection procedure was conducted in several stages. The first stage involved preparing the learning materials, Baamboozle media, learning motivation questionnaire, and critical thinking skills test. The second stage involved determining the research groups, consisting of one experimental group and one control group. The experimental group received Natural and Social Sciences learning supported by Baamboozle, while the control group received conventional learning in accordance with the learning activities commonly used in the classroom.

Learning in the experimental group was implemented by using Baamboozle as an educational game medium in Natural and Social Sciences activities. The teacher delivered the material, guided students to participate in question-and-answer or quiz activities through Baamboozle, provided feedback, and connected students' answers to the Natural and Social Sciences concepts being studied. Learning in the control group was carried out through teacher explanations, question-and-answer activities, and practice exercises without the use of Baamboozle. After all treatments had been completed, both groups were given a posttest consisting of a learning motivation questionnaire and a critical thinking skills test. The questionnaire and test data were then coded without including students' names and prepared for data analysis.

Data Analysis

Data were analyzed in two stages. The first stage involved empirically examining the quality of the instruments using SmartPLS 4 through measurement model evaluation. The instrument evaluation was conducted by examining outer loading, Average Variance Extracted (AVE), Composite Reliability (CR), Cronbach's Alpha, and the Heterotrait-Monotrait Ratio (HTMT). Indicators were considered to meet convergent validity when the outer loading value was ≥ 0.70 and the AVE value was ≥ 0.50. The instruments were considered reliable when the CR and Cronbach's Alpha values were ≥ 0.70 (Hair, et al., 2019). Discriminant validity was assessed using HTMT, with a criterion value of < 0.85 (Henseler et al., 2015).

The second stage involved the main data analysis using descriptive statistics and Multivariate Analysis of Variance (MANOVA). Descriptive statistics were used to obtain the mean, standard deviation, minimum value, and maximum value. MANOVA was used because this study involved one categorical independent variable, namely the type of learning, and two metric dependent variables, namely learning motivation and critical thinking skills. Therefore, MANOVA was appropriate for examining group differences across several dependent variables simultaneously (Hair et al., 2019). Assumption testing was conducted through normality testing, homogeneity of variance testing, and homogeneity of covariance matrix testing. Hypothesis testing was performed at a significance level of 0.05. The MANOVA results were followed by between-subjects tests to examine the effect of the treatment on each dependent variable.

RESULTS AND DISCUSSION

Instrument Validity and Reliability

Instrument quality testing was conducted

through measurement model evaluation using SmartPLS 4. The first stage involved assessing the outer loading value of each indicator. An indicator was considered valid when its outer loading value was ≥ 0.70, whereas indicators with outer loading values < 0.70 were considered invalid and were eliminated from the measurement model. The outer loading results are presented in Table 3.

Table 3. Outer Loading Results

Construct	Aspect	Indicator	Loading
Learning Motivation	Attention	M1	0.842
		M2	0.683
		M3	0.534
		M4	0.841
	Relevance	M5	0.849
		M6	0.858
		M7	0.529
		M8	0.887
	Confidence	M9	0.855
		M10	0.323
		M11	0.826
		M12	0.828
	Satisfaction	M13	0.789
		M14	0.862
		M15	0.793
		M16	0.881
Critical Thinking Skills	Interpretation	CT1	0.899
		CT2	0.889
	Analysis	CT3	0.858
		CT4	0.881
		CT5	0.857
	Inference	CT6	0.822
		CT7	0.931
	Explanation	CT8	0.892
		CT9	0.871
		CT10	0.863

Table 3 shows that most indicators had outer loading values of ≥ 0.70. In the learning motivation instrument, indicators M2, M3, M7, and M10 had outer loading values below 0.70; therefore, they were considered invalid and eliminated from the measurement model. All indicators of critical thinking skills had outer loading values of ≥ 0.70, indicating that all of them were valid. After the invalid indicators were eliminated, the analysis proceeded to internal reliability and convergent validity testing. The results of the testing are presented in Table 4.

Table 4. Reliability and Convergent Validity Results

Construct	Aspect	α	CR	AVE
Learning Motivation	Attention	0.783	0.900	0.818
	Relevance	0.851	0.910	0.771
	Confidence	0.800	0.882	0.714
	Satisfaction	0.852	0.900	0.693
Critical Thinking Skills	Interpretation	0.749	0.888	0.799
	Analysis	0.834	0.900	0.749
	Inference	0.716	0.871	0.771
	Explanation	0.849	0.908	0.766

Table 4 shows that all aspects had Cronbach's Alpha values of ≥ 0.70, Composite Reliability values of ≥ 0.70, and AVE values of ≥ 0.50. These results indicate that the learning motivation and critical thinking skills instruments met the criteria for internal reliability and convergent validity. The AVE values for all aspects were above 0.50, indicating that each aspect was able to explain more than 50% of the variance in its indicators. The remaining indicators after the elimination process were therefore considered appropriate for use in the main data analysis.

Descriptive Statistics of Learning Motivation and Critical Thinking Skills

The analysis was continued with descriptive statistics to provide a general overview of the learning motivation and critical thinking skills scores in the experimental and control groups. The descriptive statistics included the minimum value, maximum value, mean, and standard deviation. The results of the descriptive statistical analysis are presented in Table 5.

Table 5. Descriptive Statistics of Learning Motivation and Critical Thinking Skills

Variable	Group	N	Mean	StD
Learning Motivation	Experimental	24	47.04	6.643
	Control	29	37.97	8.508
Critical Thinking Skills	Experimental	24	36.83	5.814
	Control	29	28.69	5.714

Table 5 shows a tendency for score differences between the experimental and control groups on both research variables. The experimental group obtained a higher mean score in learning motivation than the control group. A similar pattern was observed in critical thinking skills, where the experimental group also achieved a higher mean score than the control group. These descriptive results provide an initial indication that Baamboozle-assisted Natural and Social Sciences learning tends to produce better outcomes than conventional learning. However, descriptive results alone cannot confirm a statistically significant effect; therefore, assumption testing and MANOVA were conducted.

Assumption Testing for MANOVA

Assumption testing was conducted to ensure that the data met the requirements for multivariate analysis. The assumption tests included normality testing, homogeneity of variance testing, and homogeneity of covariance matrix testing. Data normality was tested using the Shapiro-Wilk test because the sample size in each group was fewer than 50. Homogeneity of variance was examined using Levene's Test, while homogeneity of the covariance matrix was assessed using Box's M Test. The data were considered to meet the assumptions when the significance value was greater than 0.05.

Table 6. Normality Test Results

Variable	Group	Shapiro-Wilk	df	Sig.
Learning Motivation	Control	0.932	29	0.064
	Experimental	0.971	24	0.691
Critical Thinking Skills	Control	0.980	29	0.847
	Experimental	0.922	24	0.066

Table 6 shows that all Shapiro-Wilk significance values for the learning motivation and critical thinking skills variables were above 0.05. These values indicate that the data in both the experimental and control groups were normally distributed. The normality assumption is an important requirement because MANOVA compares groups based on a combination of multiple dependent variables. Therefore, the normality assumption in this study was considered to be met.

Table 7. Levene's Test of Homogeneity of Variance

Variable	Levene Statistic	df1	df2	Sig.
Learning Motivation	1.188	1	51	0.281

Critical Thinking Skills	0.271	1	51	0.605

Table 7 shows that the significance values of Levene's Test for learning motivation and critical thinking skills were above 0.05. The significance value for learning motivation was 0.281, while that for critical thinking skills was 0.605, indicating that the variances of both variables were homogeneous. Homogeneity of variance indicates that the differences in scores between groups were not caused by extreme imbalance in data distribution. Therefore, the assumption of homogeneity of variance in this study was considered to be met.

Table 8. Box's M Test of Equality of Covariance Matrices

Box's M	F	df1	df2	Sig.
1.544	0.492	3	2087983.531	0.688

Table 8 shows that the significance value of Box's M Test was 0.688, which is greater than 0.05. This result indicates that the covariance matrices of the learning motivation and critical thinking skills variables in the experimental and control groups were homogeneous. Homogeneity of the covariance matrix is important because MANOVA examines group differences through the simultaneous combination of two dependent variables. The results of the normality test, homogeneity of variance test, and homogeneity of covariance matrix test indicate that the data met the assumptions required for analysis using MANOVA.

Multivariate Effect of Baamboozle-Assisted Digital Learning

MANOVA was conducted to examine the simultaneous effect of Baamboozle-assisted digital learning media on students' learning motivation and critical thinking skills. This analysis was specifically used to test H3, which states that Baamboozle-assisted digital learning media has a simultaneous effect on students' learning motivation and critical thinking skills. Four multivariate statistics were used to ensure the consistency of the test results, namely Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root. The results of the multivariate test are presented in Table 9.

Table 9. Multivariate Test Results

Test	Value	F	Hyp. df	Error df	p	ηp²
Pillai's Trace	0.405	17.036	2	50	<0.001	0.405
Wilks' Lambda	0.595	17.036	2	50	<0.001	0.405
Hotelling's Trace	0.681	17.036	2	50	<0.001	0.405
Roy's Largest Root	0.681	17.036	2	50	<0.001	0.405

Table 9 shows that all multivariate statistics for the Class effect had significance values of < 0.001. Pillai's Trace showed a value of 0.405 with $F(2, 50) = 17.036$, $p < .001$, and a partial eta squared of 0.405. Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root also showed the same pattern of significance. These results indicate a significant simultaneous difference between the Baamboozle group and the conventional group in learning motivation and critical thinking skills. Therefore, H3 was accepted, confirming that Baamboozle-assisted digital learning media had a simultaneous effect on students' learning motivation and critical thinking skills.

This simultaneous finding can be understood because Baamboozle does not merely present game-based activities but also changes the way students interact with the learning material. Students engage with questions, answer choices, game rules, scores, feedback, and group interaction. This condition provides opportunities for affective and cognitive aspects to develop at the same time. Studies on digital game-based learning show that digital game media can influence academic, cognitive, motivational-affective, and social outcomes, although their effectiveness still depends on the design and implementation in the classroom (Slattery et al., 2025). Research on gamification in education also shows that game elements can enhance engagement, motivation, active participation, focus, curiosity, and cognitive-social development when applied in a student-centered manner (Lampropoulos et al., 2022).

The findings of this study are consistent with gamification research that positions motivation and

learning performance as two interrelated aspects. Gamification can strengthen motivation by providing learning experiences that are more active, challenging, and enjoyable. Such experiences help students assimilate knowledge and develop academic competence through activities that are not entirely passive. Adaptive gamification environments in science learning have also been reported to increase students' motivation because game elements provide learning experiences that are more engaging and aligned with students' needs (Jaramillo-Mediavilla et al., 2024; Zourmpakis et al., 2023). The MANOVA findings in this study strengthen the position of Baamboozle as a learning strategy that integrates engagement, challenge, and conceptual processing.

Effects on Each Dependent Variable

The Tests of Between-Subjects Effects analysis was conducted to examine the effect of the treatment on each dependent variable. This test was used to address H1 and H2 separately after the MANOVA results indicated a significant simultaneous effect. H1 states that there is a difference in learning motivation between the Baamboozle group and the conventional group. H2 states that there is a difference in critical thinking skills between the Baamboozle group and the conventional group. The results of the analysis are presented in Table 10.

Table 10. Tests of Between-Subjects Effects

Variable	SS	df	MS	F	p	ηp^2
Learning Motivation	1081.774	1	1081.774	18.137	< .001	0.262
Critical Thinking Skills	870.913	1	870.913	26.258	< .001	0.340

Table 10 shows that the Class effect on learning motivation had a value of $F(1, 51) = 18.137$, with $p < .001$ and a partial eta squared of 0.262. This result indicates a significant difference in learning motivation between the Baamboozle group and the conventional group. The mean learning motivation score of the Baamboozle group was higher than that of the conventional group. Therefore, H1 was accepted, indicating that there was a difference in learning motivation between the Baamboozle group and the conventional group.

The increase in learning motivation in the Baamboozle group can be explained by the characteristics of the media, which provide a more active learning experience than conventional learning. Students did not merely receive explanations from the teacher, but also participated in selecting questions, answering them, earning scores, waiting for their turn, and responding to feedback. These activities made the learning process more dynamic, competitive, and enjoyable. Studies on Baamboozle have shown that the platform can increase students' enthusiasm for learning because it makes learning more enjoyable, less monotonous, and provides opportunities for students to reflect on the material (Winaningsih et al., 2022; Winaningsih & Syarif, 2023).

This finding on learning motivation is further supported by other studies on gamification and game-based learning. Gamification using Baamboozle and Quizizz has been reported to improve students' engagement, motivation, and learning ability in online classrooms (Saud et al., 2022). Wordwall-based digital game media in elementary science learning have also been found to have a positive effect on students' learning motivation, as game-based activities make students more interested in following the material and understanding the learning content (Safitri et al., 2022). Multimedia edu-games in elementary science learning have been shown to improve both learning motivation and learning outcomes, indicating that digital game media can serve as a relevant alternative for strengthening student engagement in elementary education (Oktania et al., 2025).

Table 10 also shows that the Class effect on critical thinking skills had a value of $F(1, 51) = 26.258$, with $p < .001$ and a partial eta squared of 0.340. This result indicates a significant difference in critical thinking skills between the Baamboozle group and the conventional group. The mean critical thinking skills score of the Baamboozle group was higher than that of the conventional group. Therefore, H2 was accepted, indicating that there was a difference in critical thinking skills between the Baamboozle group and the conventional group.

The difference in critical thinking skills indicates that Baamboozle does not only influence

the learning atmosphere but also provides opportunities for students to process information actively. Students need to understand information, select answers, consider reasons, and connect their responses to the Natural and Social Sciences concepts being studied. This process is relevant to the skills of interpretation, analysis, inference, and explanation. Research on the use of Gimkit in elementary science learning shows that game-based learning platforms can improve critical thinking skills because students are engaged in activities such as analyzing information, formulating problems, drawing conclusions, and evaluating data (Putri & Sari, 2025). Kahoot-based gamification integrated with problem-based learning has also been reported to be effective in improving elementary school students' critical thinking skills and learning motivation (Nopianti et al., 2026).

The findings of this study are consistent with research in Natural and Social Sciences learning showing that game-based learning can significantly improve elementary school students' learning motivation and critical thinking skills (Supiyah et al., 2026). Digital game-based learning in biology education has also been reported to support constructivist, problem-based, and inquiry-based approaches, as well as the development of twenty-first-century skills through simulated and interactive learning experiences (Situmorang et al., 2024). Studies on digital game-based learning in elementary mathematics further indicate that digital games have the potential to support cognitive skills such as reasoning and problem-solving. The characteristics of elementary school students, who are still closely connected to play-based activities, make game-based digital media relevant for linking learning activities with conceptual processing (Dan et al., 2024).

Teacher support remains an important factor in the use of Baamboozle. A meta-analysis on scaffolding in digital game-based learning shows that assistance, guidance, and feedback designed according to students' needs can improve learning achievement (Cai et al., 2022). The effects of gamification may also vary depending on students' characteristics and preferences, meaning that digital game media do not automatically increase motivation or learning outcomes when they are not properly designed (Oliveira et al., 2022). The academic contribution of this study lies in examining Baamboozle in elementary school Natural and Social Sciences learning by involving two dependent variables simultaneously, namely learning motivation and critical thinking skills. These results expand the empirical evidence that Baamboozle can be used as a digital learning medium that supports affective and cognitive dimensions at the same time, provided that game-based activities are connected to learning objectives, conceptual questions, feedback, and conceptual reinforcement by the teacher.

CONCLUSION

Baamboozle-assisted digital learning media was found to have a significant effect on elementary school students' learning motivation and critical thinking skills in Natural and Social Sciences learning, both simultaneously and separately. The test results showed that H1, H2, and H3 were accepted, with the Baamboozle group obtaining higher scores than the conventional group on both variables. These findings confirm that Baamboozle can serve as a learning medium that supports learning engagement while also encouraging students' thinking processes through quiz activities, interaction, feedback, and conceptual reinforcement. The main contribution of this study lies in examining Baamboozle within a single analytical model that integrates affective and cognitive aspects in elementary school Natural and Social Sciences learning. Future studies may expand the context of Baamboozle use by examining different materials, grade levels, or treatment durations.

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