

THE INFLUENCE OF DIGITAL GAME-BASED LEARNING ON THE LEARNING OUTCOMES OF FIFTH-GRADE ELEMENTARY SCHOOL STUDENTS IN NATURAL AND SOCIAL SCIENCES (IPAS)

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Abstract

The rapid development of digital technology has led to innovative approaches in education, one of which is Digital Game-Based Learning (DGBL). This method integrates digital games into the learning process to improve students' engagement and understanding. This study aims to determine the effect of using DGBL on elementary school students' science learning outcomes and to explore their responses toward its classroom implementation. The research employed a quantitative approach with a pre-experimental One Group Pretest-Posttest Design. The sample consisted of 25 fifth-grade students. The instruments used were a learning achievement test and a student response questionnaire. Logical and empirical validity tests confirmed that both instruments were appropriate and effective. Reliability testing using Cronbach's Alpha indicated that the instruments were reliable. The data met the assumptions of normality and homogeneity. The findings showed a significant positive effect of DGBL on students' science learning outcomes as indicated by the t-test results. The N-Gain analysis revealed a moderate improvement in learning achievement. Moreover, students' questionnaire responses demonstrated positive perceptions of DGBL, indicating that they found it enjoyable and engaging in supporting their learning. In conclusion, Digital Game-Based Learning has a significant and positive impact on students' science learning outcomes and attitudes toward learning. Its implementation in elementary education can enhance motivation, conceptual understanding, and active participation in the classroom.

Keywords:

Digital Game-Based Learning, Learning Outcomes IPAS

INTRODUCTION

Education is a strategic instrument for developing an individual's potential and achieving a prosperous life. Quality education produces human resources who are competent in spirituality, personality, intelligence, and practical skills. According to Ujud et al. (2023), education encompasses lifelong learning experiences that occur in various environments and situations, exerting positive influences on individual growth. Essentially, education is a process of human maturation through which individuals develop critical thinking abilities, moral reasoning, and self-awareness.

However, many teachers still fall short of meeting the expected competency standards. One of the main strategies to enhance the quality of education in Indonesia is by improving human resources through more effective learning processes. The learning process is a systematic series of planned activities designed to help students acquire knowledge, skills, and attitudes through interactions with teachers, peers, and their learning environment. As emphasized by Festiawan (2020), the learning process integrates the active participation of both teachers and students, where teachers act as facilitators and motivators to support learning autonomy.

This condition has led to low student participation and suboptimal learning outcomes. The subject of Natural and Social Sciences (IPAS) emphasizes conceptual understanding and the interconnection between scientific disciplines. One of the topics in Grade V, "*Indonesiaku Kaya Alamnya*" (*My Indonesia Is Rich in Natural Resources*), requires students to understand Indonesia's natural wealth and its applications in daily life. However, based on preliminary observations, many students face difficulties in grasping these concepts due to monotonous, teacher-centered approaches that rely heavily on textbooks and lectures, resulting in decreased engagement and enthusiasm.

An innovative alternative to overcome these challenges is the use of Digital Game-Based Learning (DGBL). DGBL is a learning approach that integrates digital games into educational settings to deliver instructional content through interactive play. This approach is highly suitable for elementary school students, who naturally enjoy gaming activities. By transforming abstract learning materials into engaging and interactive experiences, DGBL has the potential to enhance student motivation, attention, and conceptual understanding (Han & Ellis, 2022; Clark et al., 2016).

From a theoretical standpoint, the implementation of DGBL aligns with several major learning theories. According to Constructivism Theory, knowledge is actively constructed by learners through experiences and interactions (Piaget, 1970; Vygotsky, 1978). Games provide experiential learning contexts that encourage exploration, decision-making, and problem-solving. Additionally, Self-Determination Theory (Deci & Ryan, 2000) posits that intrinsic motivation increases when learning fulfills psychological needs for autonomy, competence, and relatedness—elements inherently embedded in DGBL environments. Furthermore, Multimedia Learning Theory (Mayer, 2009) suggests that students learn more effectively from a combination of words and visuals than from verbal information alone. Digital games present text, audio, and visual elements simultaneously, transforming abstract concepts into concrete and comprehensible representations.

A growing body of research supports the effectiveness of DGBL in improving students' motivation and academic achievement. Wiseza and Andini (2023) highlight that education shapes the cognitive, affective, and psychomotor domains through diverse learning approaches. Similarly, Putra et al. (2024) demonstrated that game-based platforms such as *Wordwall* enhance student engagement and performance in digital learning environments. Sari et al. (2022) also reported that digital media provide enjoyable and meaningful learning experiences for elementary students. Lubis (2022) further noted that digital learning innovations encourage active participation and self-directed learning.

In the global context, several studies also reinforce the role of DGBL in education. Annetta et al. (2009) and Qian and Clark (2016) found that game-based learning increases retention and critical thinking skills by embedding content within problem-solving contexts. Han and Ellis (2022) revealed that gamified learning systems foster engagement and self-efficacy, especially in younger learners. These findings align with the view that digital learning tools are central to the *Education 4.0* and *5.0* paradigms, which emphasize personalization, interactivity, and technology integration (Wang & Tahir, 2020).

Based on these considerations, this study aims to analyze the impact of using Digital Game-Based Learning on the learning outcomes of fifth-grade students in the IPAS subject and to explore students' perceptions of its implementation. The study is expected to provide theoretical contributions by strengthening the discussion on digital-based learning effectiveness and practical implications for teachers as an innovative and engaging instructional strategy. Moreover, it encourages schools to

integrate technology into classroom practices to enhance the quality and relevance of elementary education in the era of Industry 5.0.

METHODOLOGY

This study employed a quantitative research approach using a pre-experimental design, specifically the One-Group Pretest–Posttest Design. This design was selected to determine the effect of the treatment—Digital Game-Based Learning (DGBL)—on students’ learning outcomes without using a control group. The research was conducted at SDN 2 Narimbang Mulya, involving 25 fifth-grade students selected through purposive sampling, based on their accessibility and relevance to the study objectives.

The data collection instruments consisted of a learning achievement test and a student response questionnaire. The learning test comprised 15 multiple-choice and essay questions, each designed to assess students’ understanding of IPAS (Integrated Science and Social Studies) concepts. Both instruments underwent logical and empirical validity testing to ensure content accuracy and construct relevance. The reliability of the instruments was determined using the Cronbach’s Alpha formula, while item difficulty level and discrimination index analyses were conducted to evaluate the quality of the test items.

Data collection was carried out in two stages—before and after the implementation of DGBL. The pretest was administered to measure students’ initial understanding, followed by the treatment using digital game-based media, and then the posttest to assess improvement.

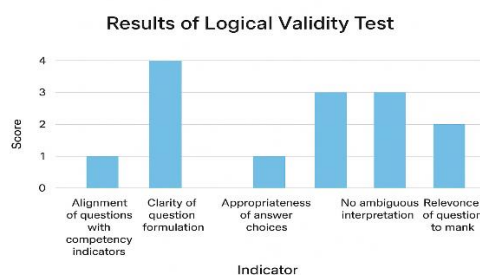
Data analysis was performed using SPSS version 26.0. The analysis began with the normality test (Shapiro–Wilk) to ensure that the data were normally distributed, followed by the homogeneity test (Levene’s test) to verify data consistency. The N-Gain test was used to measure the level of improvement in students’ learning outcomes after the intervention. Finally, the paired sample t-test was conducted to determine the significance of the effect of Digital Game-Based Learning (variable X) on students’ IPAS learning outcomes (variable Y).

RESULTS

Pre-Analysis Test Results

This research began with logical and empirical validity tests for both the test and the questionnaire to evaluate the appropriateness of the instruments with the measured indicators. The logical validity test was carried out through expert judgment, while the empirical validity test assessed the validity of the instruments based on field trials and statistical analysis using real data. These steps ensured that the instruments were both conceptually and practically suitable for measuring students’ abilities and responses.

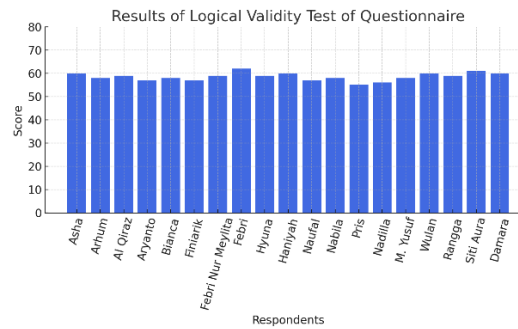
Figure 1. Logical Validity Test Results (Test)



Based on the figure above, the average logical validity score was 3.37, which falls into the “feasible with revision” category. This result indicates that the test items were generally appropriate for use in learning activities, although minor revisions were suggested to enhance clarity. Therefore, the logical

validity evaluation confirmed that the instruments were usable with slight modifications.

Figure 2. Logical Validity Test Results (Questionnaire)



According to the figure, student responses from 25 participants in the Digital Game-Based Learning (DGBL) trial obtained an average percentage of 62.36%, categorized as “Good.” This shows that students generally responded positively to the questionnaire, indicating acceptance and engagement. Consequently, the DGBL method was considered effective for use in the learning process.

Table 1. Empirical Validity Results (Test)

No	Item	r-count	Sig. (2-tailed)	r-table	Description
1	Multiple Choice	0.647	0.000	0.396	Valid
2	Multiple Choice	0.487	0.014	0.396	Valid
3	Multiple Choice	0.487	0.014	0.396	Valid
4	Multiple Choice	0.680	0.000	0.396	Valid
5	Multiple Choice	0.416	0.039	0.396	Valid
6	Multiple Choice	0.452	0.023	0.396	Valid
7	Multiple Choice	0.423	0.035	0.396	Valid
8	Multiple Choice	0.517	0.008	0.396	Valid
9	Multiple Choice	0.541	0.005	0.396	Valid
10	Multiple Choice	0.663	0.000	0.396	Valid
11	Essay	0.440	0.028	0.396	Valid
12	Essay	0.610	0.001	0.396	Valid
13	Essay	0.629	0.001	0.396	Valid
14	Essay	0.579	0.002	0.396	Valid
15	Essay	0.439	0.028	0.396	Valid

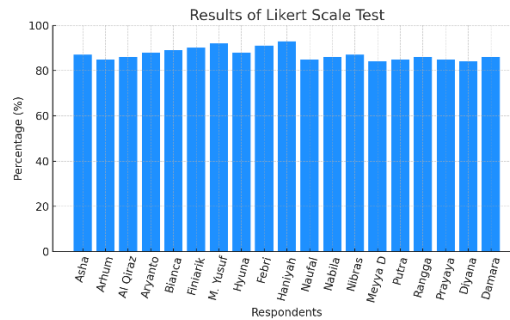
Based on the empirical validity results, 12 out of 15 items had r-count values greater than r-table and were declared valid. The remaining 3 items were excluded from the final instrument. These results indicate that most test items had good empirical validity and were suitable for assessing students' abilities.

Table 2. Empirical Validity Results (Questionnaire)

No	Statement Item	r-count	Sig. (2-tailed)	r-table	Description
1–20	P1–P20	0.397–0.608	≤ 0.05	0.396	Valid

All 20 questionnaire items had r-count values greater than 0.396, confirming that the items were valid. The results show that the questionnaire effectively represented the constructs being measured. This validation ensures that the data collected from students reliably reflect their perceptions and experiences.

Figure 3. Likert Scale Results



Based on responses from 25 students across 20 statements, the total score was 1,092 out of a maximum of 1,250. This falls into a positive response category, indicating favorable student perception. These results support the suitability of DGBL as an engaging learning medium.

Table 3. Test Reliability Results

Cronbach's Alpha	N of Items
0.770	15

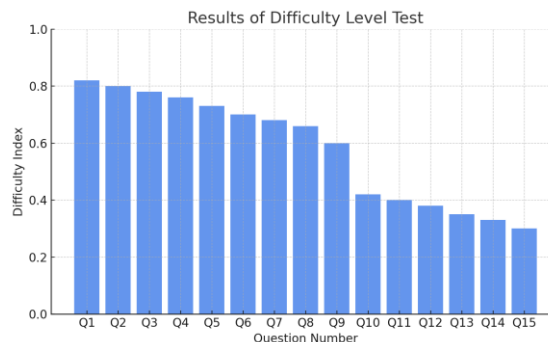
The reliability coefficient of 0.770 indicates that the test instrument is sufficiently reliable for research purposes. High reliability ensures that the instrument consistently measures students' knowledge across the items. Therefore, the test results can be considered stable and dependable.

Table 4. Questionnaire Reliability Results

Cronbach's Alpha	N of Items
0.800	20

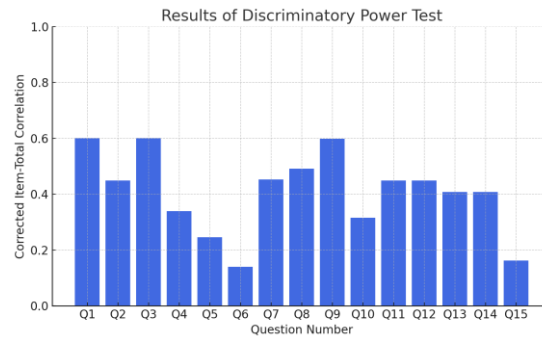
The reliability coefficient of 0.800 demonstrates high reliability of the questionnaire. This indicates that it can consistently capture students' perceptions and responses. Consequently, the data derived from this questionnaire are dependable for analyzing students' motivation and attitudes.

Figure 4. Difficulty Level Test Results



The analysis of test difficulty indicates that most items were within an ideal range, categorized as moderate. This suggests that the questions were neither too easy nor too difficult for fifth-grade students. A balanced difficulty level contributes to accurate assessment of learning outcomes.

Figure 5. Discrimination Index Test Results



The discrimination index analysis shows that most items were effective in differentiating students' performance levels. High discrimination ensures that the test can distinguish between high-achieving and low-achieving students. This further confirms the quality of the test instrument.

Data Analysis

Further analysis included normality, homogeneity, N-Gain, and paired t-tests to ensure the accuracy and reliability of the data collected. These statistical tests were conducted to determine whether the data met the assumptions required for parametric analysis and to evaluate the effectiveness of Digital Game-Based Learning on students' IPAS learning outcomes. By performing these analyses, the study aimed to provide a comprehensive understanding of both the distribution and improvement of student scores, as well as to identify significant differences between pretest and posttest results.

Table 5. Normality Test Results (Shapiro–Wilk)

Variable	Statistic	df	Sig.
Pretest	0.950	25	0.251
Posttest	0.851	25	0.092

Both pretest and posttest data had significance values greater than 0.05, indicating that the data were normally distributed. This normality allows for the application of parametric tests for further analysis. Therefore, the statistical assumptions for subsequent testing were met.

Table 6. Homogeneity Test Results (Levene's Test)

Type of Test	Sig.	Conclusion
Posttest	0.784	Homogeneous

The significance value of 0.784 (> 0.05) confirms homogeneity of the data. Homogeneity indicates that the variability in student scores is consistent across groups. This ensures that comparisons between pretest and posttest scores are valid.

Table 7. N-Gain Score Results

Minimum	Maximum	Mean	Std. Deviation
0.17	1.00	0.6101	0.26172

The average N-Gain score of 0.61, categorized as moderate, indicates that students' learning outcomes improved significantly after using DGBL with Quizizz. This demonstrates that digital game-based methods can enhance students' comprehension and engagement. The moderate gain also highlights the potential for further improvement with continued application.

Table 8. Paired Sample t-Test Results

Pair	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pretest–Posttest	30.800	9.755	15.786	24	0.000

The paired sample t-test results showed a mean difference of 30.800 and a significance value of 0.000 < 0.05. Since $t\text{-count} (15.786) > t\text{-table} (1.711)$, it can be concluded that there was a significant difference between pretest and posttest results.

The findings demonstrate that Digital Game-Based Learning significantly improved students' IPAS learning outcomes. The increase in average scores from pretest to posttest indicates that students found it easier to understand the topic "*Indonesiaku Kaya Alamnya*" when presented through digital games compared to traditional methods.

According to Lubis (2022), digital-based learning enhances student motivation and engagement by creating a more interactive environment. Similarly, Wardani et al. (2024) confirmed that DGBL effectively improves conceptual understanding and learning outcomes among elementary students. Furthermore, Putra et al. (2024) emphasized that game-based learning promotes active student participation, as students perceive the learning process as play while simultaneously acquiring new knowledge.

Positive student responses in this study indicate that digital game media influence not only the cognitive domain but also the affective domain, fostering greater motivation, enthusiasm, and meaningful learning experiences. Therefore, it can be concluded that DGBL not only significantly affects learning outcomes but also contributes to creating a more engaging and interactive classroom atmosphere.

DISCUSSION

The results of this study align with previous research emphasizing the benefits of Digital Game-Based Learning (DGBL) in fostering engagement and improving learning outcomes (Clark et al., 2016; Annetta et al., 2009). The use of digital games provides an interactive medium that supports experiential learning, as students can explore real-world situations in a simulated digital environment (Prensky, 2001; Gee, 2007).

The findings also reinforce Piaget's (1970) and Vygotsky's (1978) theoretical frameworks, where learning is an active process of constructing meaning through experience and social interaction. DGBL encourages students to participate collaboratively, reflect on feedback, and solve problems together—key principles of constructivist learning environments (Jonassen, 1999).

Moreover, from the motivational perspective, Deci and Ryan's (1985) Self-Determination Theory supports the idea that games can enhance intrinsic motivation by fulfilling psychological needs for competence, autonomy, and relatedness. Students who participated in DGBL activities showed increased interest, persistence, and satisfaction in the learning process (Qian & Clark, 2016; Han & Ellis, 2022).

Empirical evidence from Indonesian studies supports these theoretical insights. Putra et al. (2024) and Wardani et al. (2024) both concluded that the integration of game-based models improved students' performance and engagement. Lubis (2022) added that digital innovation in learning environments contributes to better student outcomes through active participation and creative interaction.

In summary, Digital Game-Based Learning has proven to be a highly effective approach in promoting motivation, engagement, and achievement in elementary education. The combination of theoretical foundations and empirical findings indicates that DGBL not only modernizes instructional practices but also enhances the quality and enjoyment of learning.

CONCLUSION

Based on the research findings and discussion, it can be concluded that the use of Digital Game-Based Learning (DGBL) had a significant impact on the learning outcomes of fifth-grade students at SDN 2 Narimbang Mulya. The average student score increased from 60.4 (pretest) to 80.2 (posttest), with an N-Gain score of 0.53, categorized as *moderate*. The t-test results showed a significant difference ($p < 0.05$) between pretest and posttest scores, confirming that DGBL improved students' understanding of the topic "*Indonesiaku Kaya Alamnya*.". In addition, student responses toward DGBL were generally positive — most students reported feeling more motivated, enthusiastic, and helped in understanding the material through digital game-based learning. Therefore, it can be concluded that DGBL is not only effective in improving learning outcomes but also capable of creating a fun, engaging, and student-centered learning environment, aligned with the characteristics of elementary learners.

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