THE EFFECT OF GAMIFICATION-BASED MEDIA USE ON STUDENTS' LEARNING OUTCOMES IN THE SCIENCE SUBJECT OF GRADE IV OF STATE ELEMENTARY SCHOOL 040538 SAMPUN

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ABSTRACT

This research is motivated by the continued dominance of conventional learning in science in grade IV at SD Negeri 040538 Sampun, which leads students to be passive and results in suboptimal learning outcomes. Preliminary data show that in grade IVA, only 8 out of 20 students achieved mastery, while in grade IVB, only 7 out of 17 students completed. Therefore, this study aims to analyze the effect of gamification-based media on student learning outcomes in science. This study uses a quantitative approach with a quasi-experimental design and a Nonequivalent Control Group Design. The study population comprised all 37 grade IV students, with 20 students in the experimental class and 17 in the control class. Data were collected through tests, observations, and documentation, and then analyzed using descriptive statistics, the Shapiro-Wilk normality test, the Levene homogeneity test, and the independent-samples t-test. The results showed that the experimental class's average posttest score was 91.75, higher than the control class's 74.71. The hypothesis test showed a significance value of 0.000 < 0.05, indicating a significant effect of gamification-based media on student learning outcomes. Thus, gamification-based media is effective in improving elementary school students' science learning outcomes.

Keywords: Science, elementary school, media, gamification, students

ABSTRAK

Penelitian ini dilatarbelakangi oleh masih dominannya pembelajaran konvensional pada mata pelajaran IPAS di kelas IV SD Negeri 040538 Sampun, yang menyebabkan siswa cenderung pasif dan hasil belajar belum optimal. Data awal menunjukkan bahwa pada kelas IVA hanya 8 dari 20 siswa yang mencapai ketuntasan, sedangkan pada kelas IVB hanya 7 dari 17 siswa yang tuntas. Oleh karena itu, penelitian ini bertujuan untuk menganalisis pengaruh penggunaan media berbasis gamifikasi terhadap hasil belajar siswa pada mata pelajaran IPAS. Penelitian ini menggunakan pendekatan kuantitatif dengan jenis eksperimen semu (*quasi experimental design*) dan desain *Nonequivalent Control Group Design*. Populasi penelitian adalah seluruh siswa kelas IV yang berjumlah 37 orang, dengan 20 siswa sebagai kelas eksperimen dan 17 siswa sebagai kelas kontrol. Data dikumpulkan melalui tes, observasi, dan dokumentasi, lalu dianalisis menggunakan statistik deskriptif, uji normalitas Shapiro-Wilk, uji homogenitas Levene, dan *independent sample t-test*. Hasil penelitian menunjukkan bahwa rata-rata nilai *posttest* kelas eksperimen sebesar 91,75, lebih tinggi dibandingkan kelas

kontrol sebesar 74,71. Uji hipotesis menunjukkan nilai signifikansi 0,000 < 0,05, yang berarti terdapat pengaruh signifikan penggunaan media berbasis gamifikasi terhadap hasil belajar siswa. Dengan demikian, media berbasis gamifikasi efektif digunakan untuk meningkatkan hasil belajar IPAS siswa sekolah dasar.

Kata kunci : IPAS, sekolah dasar, media, gamifikasi, siswa

A. Introduction

Education is the primary foundation for forming the character and knowledge of students to confront future challenges. Education is the process by which human resources are cultivated to be able to adapt to the ever-changing and advanced world (F. R. Safitri et al., 2023)(Suarningsih et al., 2024). The Republic of Indonesia Law Number 20 of 2003, which pertains to the National Education System, states in Article 1 paragraph 1 that "Education is a fundamental and deliberate endeavor to establish a learning environment and learning process that enables students to actively cultivate their potential in the areas of spiritual religious strength, self-control, personality, intelligence, noble morals, and the skills required by themselves, society, nation, and state."

Rapid global developments, particularly in technology, information, and communication, require the world of Education to adapt continually. Education systems can no longer rely on traditional, one-way approaches, as 21st-century students have distinct characteristics from previous generations.(Daga, 2025)(Zaleha, 2025). The current generation is the digital generation, namely the generation that grew up with exposure to technology from childhood, such as smartphones, the internet, digital applications, interactive games, and various other forms of visual media.(Purba et al., 2024)(Anton et al., 2024) Therefore, a modern educational approach must meet the needs and characteristics of students who are more visual, interactive, and quick to absorb information.(Anton et al., 2024)(Trikesumawati et al., 2025) (Ghani, 2025).

Nevertheless, the practical reality is that lecture-based methods and conventional media, such as textbooks and whiteboards, continue to dominate the learning process. This model makes students passive, less engaged, and quickly bored, which affects their conceptual understanding. This is evident in the

fourth-grade science subject at SD Negeri 040538 Sampun, which includes the topic "Forces Around Us," where the concepts are abstract and require concrete and interactive learning experiences.

In today's digital era, learning emphasizes not only the theoretical delivery of material but also how teachers can create an engaging, interactive, and enjoyable learning environment.(Shabrina et al., 2025)(Azmi et al., 2024) state that learning media play a crucial role in creating engaging, interactive learning experiences tailored to students' characteristics in the digital age. Therefore, teachers are required to use various innovative media, including gamification.(Tisna et al., 2024)(D. Safitri et al., 2025).

Natural and Social Sciences (IPAS) is an important subject in elementary school that aims to develop students' knowledge and skills about nature and social life.(Andreani & Gunansyah, 2023)(Zakarina et al., 2024)(Sari et al., 2021). Students often struggle to understand abstract concepts. Conventional, teacher-centered learning can lead to low student interest and learning outcomes.(Antoh, 2025)(Hendranti et al., 2025). Based on the researcher's observations of the science learning process for Class IV at SD Negeri 040538 Sampun, it is still dominated by conventional methods, such as caramah. This school has a total of 37 students, and to date, it has not implemented.

Gamification media in learning activities as an alternative to improve student learning outcomes. As a result, some students appear passive and lack enthusiasm and engagement because the classroom learning process remains monotonous, which affects low science learning outcomes. Currently, several elementary schools and grade levels have implemented the Independent Curriculum. Based on interviews with fourth-grade teachers at SD Negeri 040538 Sampun, our fourth-grade students have implemented the Independent Curriculum; the assessment criteria are now called KKTP (Criteria for Achievement of Learning Objectives), rather than KKM (Minimum Completion Criteria).

Consequently, it is imperative to have a diverse array of learning media that actively involve students in the learning process, including

gamification-based learning media. By using gamification media, teachers can create a more interactive, competitive, and enjoyable learning environment.(Azrani et al., 2025)(Fauziyah et al., 2025) stated that the application of gamification in elementary Education has been shown to improve learning outcomes while fostering a healthy competitive spirit among students. Through this approach, it is hoped that students will be more active, enthusiastic, and achieve better learning outcomes.

Based on the description above, the author proposes a study titled "The Influence of Gamification-Based Media on the Learning Outcomes of Students in the Science Subject of Grade IV SDN 040538 Sampun".

B. Research methods

Research design

A quantitative, quasi-experimental design is employed in this investigation. The quantitative approach was selected for this study due to its objective to evaluate the impact of gamification-based learning media on student learning outcomes through the use of structured, objective measurements that can be statistically analyzed. In quasi-experimental research, researchers administer treatments to specific groups in order to establish cause-and-effect relationships. However, not all external variables can be completely controlled, as is the case in pure experiments. According to the research document, the design employed is a Nonequivalent Control Group Design, which entails the selection of two groups based on pre-existing classes rather than arbitrary selection.

In this design, the pretest was administered to both groups to evaluate the students' initial capabilities. Subsequently, the experimental group was instructed through gamification-based media, while the control group was instructed through conventional methods. A final test (posttest) was administered to both groups following the treatment to evaluate the changes in student learning outcomes. This design enabled researchers to evaluate the efficacy of gamification media in science learning on the subject of "Forces Around Us" and to compare the learning outcomes of the experimental and control groups. In order to ensure the comparison results were more objective, the learning

process in both groups was conducted with the same material and duration, and the same teacher. Consequently, the primary distinction is solely in the treatment.

Population and sample

The population in this study comprised all fourth-grade students at SD Negeri 040538 Sampun in the 2025/2026 academic year, totaling 37 students. The population is understood as all subjects who have certain characteristics and are the target of research generalization. Because the number of research subjects was fewer than 100, all members of the population were included. Thus, this study is a population-based study because all fourth-grade students were included.

The research sample was divided into two groups based on the school's existing classes. Class IVA was designated as the experimental group, with 20 students, while Class IVB was designated as the control group, with 17 students. This sample determination is consistent with the characteristics of a quasi-experimental design, namely the use of pre-formed groups without full individual randomization. The

experimental group received treatment through gamified learning media, while the control group followed conventional learning. This division was intended to allow researchers to compare student learning outcomes in both groups after the treatment was administered, so they could determine whether gamification media affected student learning outcomes.

Research instruments

Research instruments are tools used to collect data during the research process. According to the research documents, the instruments used include observation, testing, and documentation. Observation is used to monitor the learning process in the classroom, both in the experimental and control groups. Through observation, researchers gather information on the learning situation, student engagement, student responses to the learning media, and the implementation of the learning process as per the predetermined design. Thus, observation serves as a supporting tool to provide a realistic picture of the treatment's implementation in the field.

The main instrument in this study was a learning outcome test. The Test was used to measure students' abilities before and after treatment, namely through a pretest and posttest. The Test was structured as a multiple-choice test with four answer options: a, b, c, and d. The test questions were designed using a grid aligned with basic competencies, learning indicators, and cognitive levels, covering knowledge, understanding, and application of the science material on the topic "Forces Around Us". This Test aims to obtain quantitative data on student learning outcomes, enabling the treatment effect to be measured objectively. In addition, this study used documentation as a complementary instrument, including a list of student names, initial scores, pretest and posttest results, photos of learning activities, learning videos, and other documents related to the study's implementation. Documentation strengthens data from observations and tests, making the research data more complete.

Before being used in research, the test instrument is first tested for validity and reliability. Validity testing is conducted to determine the extent to which test items measure what they are intended to measure. The research document states that validity testing can be conducted using Product-Moment correlation or Pearson correlation. Meanwhile, reliability testing is conducted to assess the instrument's consistency and ensure its suitability as a data collection tool. The instrument's reliability in the document will be assessed using Cronbach's alpha. Through validity and reliability testing, the research instrument is expected to demonstrate adequate accuracy and consistency, enabling the research results to be scientifically accounted for.

Data analysis

Data analysis in this study was conducted in stages, starting with descriptive analysis and continuing through inferential analysis. Descriptive analysis was used to describe student learning outcomes obtained from pretests and posttests in the experimental and control groups. Through this analysis, researchers obtained an overview of the minimum, maximum, average, and trends in student learning outcomes after participating in the learning

process. Descriptive analysis is essential as a preliminary step to understanding data distribution before conducting hypothesis testing.

Descriptive analysis was followed by prerequisite analysis tests, which included homogeneity and normality tests. The objective of the normality test is to ascertain whether the student learning outcome data are normally distributed. The Shapiro-Wilk test was employed to conduct the normality test, as the number of subjects in each group was less than 50, as indicated by the research document. The significance level was set at 0.05. The program was IBM SPSS Statistics version 22. The data are deemed to be normally distributed if the p-value is greater than 0.05. The following step was to conduct a homogeneity test to ascertain whether the variances of the two groups were comparable. If the significance value exceeds 0.05, the data is considered homogeneous. In order for the parametric t-test to be conducted accurately, these two prerequisite tests must be satisfied. Independent sample t-tests and paired sample t-tests were implemented in this investigation to evaluate hypotheses. In order to ascertain whether there were disparities in learning outcomes between the experimental and control groups, the independent sample t-test was implemented. In the interim, a paired-samples t-test was implemented to evaluate variations in learning outcomes between the experimental group and the control group prior to and following treatment. The significance level of 0.05 was used to inform the decision-making process. The null hypothesis is rejected and the alternative hypothesis is accepted if the p-value is less than 0.05, which suggests a substantial effect or difference. In contrast, the null hypothesis is accepted and the alternative hypothesis is refuted when the p-value exceeds 0.05. This study can offer objective conclusions regarding the impact of gamification media on student learning outcomes by examining these phases.

C. Results and Discussion

Research result

This research was conducted on fourth-grade students at SD Negeri 040538 Sampun in the 2025/2026 academic year, with a total of 37 subjects: 20 in the experimental class

and 17 in the control class. The experimental class received treatment through gamification-based media, while the control class followed learning videos and lecture methods. The research data analyzed included pretest and posttest scores, which were used to describe changes in learning outcomes and to test the effect of gamification media on students' science learning outcomes.

Instrument eligibility

The validity test results showed that of the 25 pretest questions, 20 were declared valid and 5 were declared invalid based on the comparison of the Corrected Item-Total Correlation value with the table of 0.444. In the posttest instrument, of the 25 questions, 20 were declared valid, and 5 were declared invalid, so 20 valid questions were used in the research data collection.r

Table 1. Summary of instrument validity test results

Instrument	Number of items tested	Valid items	Invalid item	Criteria
Pretest	25	20	5	Used 20 valid items
Posttest	25	20	5	Used 20 valid items

The reliability test results showed that the pretest instrument had a Cronbach's Alpha value of 0.740, while the posttest instrument had a Cronbach's Alpha value of 0.745. Both values are greater than 0.60; thus, the research instrument is considered reliable and suitable for measuring student learning outcomes.

Table 2. Results of instrument reliability testing

Instrument	Cronbach's Alpha	Number of items	Information
Pretest	0.740	20	Reliable
Posttest	0.745	20	Reliable

Description of learning outcomes

The frequency distribution of pretest scores in the experimental class shows that 6 students (30%) are in the 45–54 interval, 11 students (55%) are in the 55–64 interval, and 3 students (15%) are in the 65–74 interval. After the treatment was given, the distribution of posttest scores in the experimental class changed

significantly, namely 1 student or 5% was in the 80–84 interval, 4 students or 20% in the 85–89 interval, 9 students or 45% in the 90–94 interval, and 6 students or 30% in the 95–100 interval. These findings indicate that

student learning outcomes in the experimental class increased significantly after learning with gamification media.

Table 3. Frequency distribution of experimental class scores

Types of tests	Value interval	Frequency	Percentage
Pretest	45–54	6	30%
	55–64	11	55%
	65–74	3	15%
Posttest	80–84	1	5%
	85–89	4	20%
	90–94	9	45%
	95–100	6	30%

In the control class, the frequency distribution of pretest scores showed that 7 students (41.2%) were in the 45–54 interval and 10 students (58.8%) were in the 55–64 interval. After learning using video media and lecture methods, the distribution of posttest scores in the control class showed that 3 students or 17.6% were in the 65–69 interval, 6 students or 29.4% were in the 70–74 interval, 5 students were in the 75–79 interval, and 3 students were in the 80–85 interval. Although learning outcomes increased in the control class, the increase was lower than in the experimental class.

Table 4. Frequency distribution of control class values

Types of tests	Value interval	Frequency	Percentage
Pretest	45–54	7	41.2%
	55–64	10	58.8%
Posttest	65–69	3	17.6%
	70–74	6	29.4%
	75–79	5	17.6%
	80–85	3	17.6%

Descriptively, the posttest score for the experimental class averaged 91.75 with a standard deviation of 5.447, while the posttest score for the control class averaged 74.71 with a standard deviation of 5.720. This difference in mean values indicates that students' learning outcomes in gamification-based learning were higher than those in conventional learning.

Table 5. Posttest group statistics

Group	N	Mean	Standard Deviation	Std. Error Mean
Experiment	20	91.75	5,447	1,218
Control	17	74.71	5,720	1,387

Prerequisite test

The results of the Shapiro-Wilk normality test showed that the p-values were: 0.05 (namely, the experimental c(s pre)test of 0.065), 0.108 (the experimental cl(post)test of 0.108), 0.056 (the control c(s pre)test of 0.056), and 0.180 (the control cl(post)test of 0.180). Thus, the data in both groups were normally distributed and met the requirements for parametric statistical tests.

Table 6. Results of the Shapiro-Wilk normality test

Data	N	Sig.	Information
Experimental pretest	20	0.065	Normal
	20	0.108	Normal
Pretest control	17	0.056	Normal
	17	0.180	Normal

Additionally, the homogeneity test, which was conducted using Levene's Test, yielded a p-value of 0.445 for the mean. The data satisfy the criteria for additional hypothesis testing via the independent-samples t-test due to the fact that the variances of both groups are determined to be homogeneous by the significance value of greater than 0.05.

Table 7. Results of the homogeneity test

Variables	Levene Statistics	df1	df2	Sig.	Information
Science learning outcomes	0.525	1	35	0.445	Homogeneous

Hypothesis testing

A value of 9.270 was obtained with 35 degrees of freedom and a 2-tailed significance value of 0.000, as indicated by the independent-samples t-test results, under the assumption of equal variances. Additionally, a mean difference of 17.044 was determined, with a 95% confidence interval spanning from 13.311 to 20.777. The null hypothesis is rejected, and the alternative hypothesis is accepted, as the p-value is less than 0.05. This suggests a substantial disparity in the learning outcomes of students between the experimental and control classes.

Table 8. Results of the independent sample t-test

Assumptions	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Standard Error Difference	95% CI Lower	95% CI Upper
Equal variances assumed	0.374	0.545	9,270	35	0,000	17,044	1,839	13,311	20,777
Equal variances not assumed.	—	—	9,232	33,440	0,000	17,044	1,846	13,290	20,798

Based on these results, gamification-based learning media have been shown to have a positive, significant impact on the science learning outcomes of fourth-grade students at SD Negeri 040538 Sampun. Empirically, students who learn using gamification media achieve higher learning outcomes than students who follow conventional learning. Thus, gamification media can be seen as an effective learning alternative to improve learning outcomes in the topic "Forces Around Us".

D. Discussion

The average posttest score in the experimental class was higher than that in the control class, as indicated by the research results. The experimental class was subjected to gamification-based learning media in the Natural and Social Sciences (IPAS) subject, with an emphasis on the forces that surround us. The

posttest results indicated that the experimental class's students obtained superior learning outcomes in comparison to the control class, which was instructed using conventional learning methods.

In the control class, learning was conducted without the use of gamification-based media. Despite an increase in learning outcomes, it was not as substantial as that observed in the experimental class. This suggests that media that is founded on gamification has a more significant impact on the learning outcomes of students. Additionally, statistical tests were implemented to analyze the research data. The data were not normally distributed, as indicated by the normality test; consequently, the normality assumption was disregarded. The significance value of 0.204 was greater than 0.05, as indicated by Levene's Test. This

suggests that the variance of the research data is homogeneous.

Due to the non-normal distribution of the data, a t-test for independent samples was carried out. Ho was rejected, and Ha was accepted, as the test results indicated a significance value of 0.01, 2-tailed. Consequently, the experimental and control sections exhibited a substantial disparity in their learning outcomes. The results of this study suggest that the learning outcomes of fourth-grade pupils at SD Negeri 040538 Sampun in the 2025/2026 academic year are positively impacted by the use of gamification-based media. This medium has the potential to enhance students' interest in learning, facilitate a more concrete comprehension of the material, and enhance the overall learning experience.

This research is supported by several research results such as research by Lutviana, Amrulloh, & Laili (2025) which showed that the application of gamification-based learning media in the fifth grade science subject of MI NU Metro succeeded in significantly increasing student learning motivation, with an average motivation score before the intervention of 65.2 increasing to 88.7 after (an increase of 36.2%). This approach involves game elements such as points, levels, and competitive challenges, delivered through a simple digital platform, which was proven effective by a statistical t-test (p<0.05) and positive student engagement observations. These results confirm that gamification is an innovative solution to address low learning motivation in the digital era, especially in integrative subjects such as science in Islamic elementary schools.(Lutviana et al., 2025). Research (Khoiriyatin et al., 2025) found that Wordwall-based gamification learning media significantly improved the learning outcomes of third-grade students in Pancasila Education subjects in Islamic elementary schools, with an average pretest score of 68.5 increasing to 89.2 in the posttest (a 30% increase), using a one-group pretest-posttest pre-experimental design. This approach utilizes gamification elements such as interactive quizzes, leaderboards, and visual rewards on the Wordwall platform, which were proven effective based on t-tests (Sig. 0.000 < 0.05) as well as observations of increased

student interest and participation. These results confirm Wordwall as an innovative tool for optimizing the learning of Pancasila values at the elementary level, in line with the needs of character education in the digital era. Research(Cahyani et al., 2024)shows that the use of reality-based gamification media (such as augmented reality with interactive game elements) in science learning for grade VI of SDN Gempolsongo has succeeded in significantly improving student learning outcomes, with an average initial score of 62.4 increasing to 85.6 after intervention (a 37.2% increase) through a two-cycle CAR approach. This media uses 3D visualization, point-based challenges, and reality simulations for science materials such as the water cycle and food chain, which have proven effective in normality tests and in increasing student activity from 55% to 92%. These results confirm reality-based gamification as an innovative strategy to overcome boredom in learning science in elementary schools, in line with the need for technological adaptation in the digital era. The results of this study(Rahmawati et al., 2025)that the implementation of an AI gamification-based assessment platform in elementary school science learning has succeeded in significantly improving student learning outcomes, with an average pretest score of 64.8 jumping to 87.3 on the posttest (a 34.6% increase) through a quasi-experimental design in grades IV and V. This platform integrates artificial intelligence for personalized adaptive challenges, reward points, badges, and algorithm-based instant feedback, which is proven effective through paired t-test analysis (Sig. <0.05) as well as observations of increased motivation and retention of science concepts such as ecosystems and energy from 60% to 91%. These findings confirm the potential of AI gamification as an adaptive formative assessment innovation to optimize science learning in the digital era, especially at the elementary level.

This study has several limitations that need to be considered. First, the study was conducted with only fourth-grade students at one elementary school, resulting in a limited sample size, so the results cannot be generalized to other schools or educational levels. Second, this study used a quasi-experimental design, so the researcher could not fully control

external variables that could affect student learning outcomes, such as learning motivation, differences in students' initial abilities, learning environment conditions, and parental support at home. Third, the use of gamification-based learning media through the Wordwall application in the experimental class was implemented in a relatively short time, so the long-term effect of Wordwall media on student learning outcomes cannot be fully assessed.

Furthermore, the test instrument used in this study measured only students' cognitive abilities, thereby failing to assess their affective and psychomotor abilities comprehensively. Therefore, future research is expected to involve a larger sample, employ a more robust experimental design, extend the duration of learning media implementation, and develop assessment instruments that comprehensively cover cognitive, affective, and psychomotor domains.

Consequently, it is possible to infer that gamification-based media is both feasible and advantageous for the acquisition of scientific knowledge, particularly in the context of the forces that surround us. This is corroborated

by the results of the independent t-test, which demonstrate a p-value of less than 0.05, suggesting that the use of gamification-based media has an impact on the learning outcomes of grade IV students at SD Negeri 040538 Sampun.

E. Conclusion

The learning outcomes of fourth-grade pupils at SD Negeri 040538 Sampun who did not utilize gamification-based media were inferior. This is due to the fact that learning is still conducted in a traditional manner, which leads to a suboptimal comprehension of the forces that surround us in the field of science. The learning outcomes of fourth-grade students at SD Negeri 040538 Sampun who utilized gamification-based media exhibited considerable improvement. This is apparent in the fact that the posttest scores were higher than those of the pretest. Hypothesis tests and normality and homogeneity tests were implemented to analyze the research data. The data were found to be normally distributed by the normality test. A p-value of indicated that the data variances between groups are homogeneous, as demonstrated by

the homogeneity test conducted using Levene's Test. Moreover, the hypothesis was tested using an independent t-test, and the results indicated a significance value (2-tailed) of, resulting in the rejection of Ho and the acceptance of Ha.

The learning outcomes of fourth-grade pupils at SD Negeri 040538 Sampun are positively impacted by the use of gamification-based media, as indicated by the research results and hypothesis testing. The learning outcomes of the experimental and control classes demonstrate that students who make use of gamification-based media attain superior academic performance. Therefore, gamification-based learning media have been discovered to be an effective alternative learning medium for enhancing the science learning outcomes of elementary school students.

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