

The Effectiveness of Short Card Game Method on Primary Students' Learning Outcomes

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Abstract

Mathematics education at the elementary level plays a vital role in shaping students' logical and analytical thinking. However, many students continue to face difficulties in understanding basic mathematical concepts, often due to monotonous teaching methods that fail to stimulate active learning. This study aims to assess the effectiveness of the Short Card game method in improving mathematics learning outcomes among elementary school students. Using a pre-experimental design with a one-group pretest-posttest format, the study involved 30 fifth-grade students from Madrasah Ibtidaiyah. Data were collected through observation, testing, interviews, and documentation, and analyzed using a paired sample t-test. The result of the study showed that the result of the t-test processing obtained a value of 0,000, in other words, the sig value < 0,05, which means H_0 is rejected. This means that there is a positive and significant influence on the mathematics learning outcomes of elementary school students through the application of short card-based game methods.

Keywords: Math Learning, Short Card, Learning Outcomes.

1. Introduction

Basic mathematics education in Indonesia is one of the crucial aspects in forming students' logical and critical thinking skills (Solehah et al., 2024; Widana et al., 2018; Widiyatmoko & Utaminingsih, 2021). However, despite numerous efforts that have been made, several shortcomings still hinder the effectiveness of mathematics instruction at the elementary level. (Corcoran & Silander, 2009; Janssen et al., 2021; Widana et al., 2018). One of the main weaknesses in elementary mathematics education in Indonesia is the tendency toward traditional teaching approaches, which emphasize rote memorization of formulas rather than a deep understanding of concepts. (Fakhrany et al., 2024; Hamidah et al., 2021; Pramesti et al., 2024).

Teachers often rigidly follow the curriculum, resulting in rushed lessons that leave little room for students to explore and understand the material effectively (Cuban, 2004; Mukhibin & Nafidhoh, 2023; Nurcahyono & Putra, 2022; Stronge, 2018). As a result, students may master mathematical techniques without truly grasping the logic or interrelationships between concepts (Lovianova et al., 2022). In addition, limited educational facilities, particularly in remote areas,



further hamper learning (Jahudin et al., 2025; Wika, 2025). Many schools still lack sufficient infrastructure to support students' understanding of mathematical concepts at the elementary level. (Karisma & Ahdhianto, 2023; Yangambi, 2023). This is compounded by the lack of teacher training in using effective and innovative instructional methods.

In elementary mathematics learning, teachers are expected to be more creative in designing instructional strategies that are varied and engaging. (Vale & Barbosa, 2023). Elementary students, who are still in the concrete operational stage of cognitive development, require contextual learning approaches that encourage them to be active, creative, and effective and to enjoy the learning process. This helps students construct knowledge, especially in mathematics. (Ningrum & Murti, 2023; Rani, 2023). Conceptual understanding in mathematics that is developed through meaningful learning experiences will serve as a foundation for students as they move to the next levels of education. (Harefa, 2024; Mukuka et al., 2021; Polman et al., 2021).

Mathematics is considered a universal discipline, as it forms the basis of the development of science and technology. It is a fundamental subject that must be studied by all students in school. (Abd Algani, 2022). However, mathematics is often seen as a difficult subject due to students' lack of interest, particularly when it involves memorizing formulas and dealing with differences between past and present learning systems. (Pokhrel, 2023). Mathematics learning difficulties are challenges that students face, both from internal and external factors, which hinder their brain's ability to process learning normally. (Wardhani, 2023). These challenges affect how students receive, process, and analyze information during math instruction.

This study focuses on mathematics material because of the low levels of understanding among students, particularly regarding fundamental topics such as multiplication and division. These basic skills should be easy and beneficial for elementary-aged students, as they are essential in solving more advanced mathematical problems. (Ramadhanti, 2024). MI Mukmin Wringinagung is an Islamic elementary school established in 2009. Based on classroom observations, several issues were identified, particularly the frequent use of one-way, lecture-based teaching methods in mathematics classes. This approach results in low student engagement and a passive learning environment, making it difficult for many students to grasp mathematical concepts.

The current instructional approaches observed do not provide sufficient room for more participatory methods, such as problem-based learning or educational games, which could potentially increase student interest in learning mathematics. One such strategy, the card sort learning model, can help teachers manage classrooms more effectively, increase student enthusiasm, and foster social interaction. (Sexcio & Dafit, 2022).

Based on the description above, improving mathematics learning outcomes can be done through the short-card method. Therefore, this study aims to test whether the short card method can significantly improve elementary school students' mathematics learning outcomes. The hypothesis is that if the sig value > 0.05 then H_0 is rejected, which means that there is no effect of the short card method on improving elementary school students' mathematics learning outcomes, and if the sig value < 0.05 then H_a is accepted, which means that there is an effect of the short card method on improving elementary school students' mathematics learning outcomes.

2. Methods

This study employs a quantitative research method. Quantitative research is based on the positivist paradigm, which was developed by Auguste Comte (1798–1857). The positivist paradigm is also referred to as the traditional, experimental, and empirical paradigm. According to this paradigm, science is considered a valid form of knowledge because it is derived from human experience that can be perceived through the five senses and processed through reasoning or logic. The subjects in this study were students of class V MI Baitul Mukminin Jombang, with a total of 30 students. Data collection techniques in this study were observation,

tests, interviews, and documentation. The validity and reliability of the instruments were tested using Cronbach's alpha. The data analysis technique used a paired t-test, because the test was conducted in the same class. Before data analysis, a normality test and a homogeneity test were carried out as prerequisite tests. The normality test used the Kolmogorov-Smirnov test, while the homogeneity test used the Levene Test.

3. Results and Discussion

3.1. Validity Test

Validity is a measure that indicates the degree to which an instrument is valid or accurate. An instrument is considered valid when it demonstrates a high level of validity. Conversely, an instrument with low validity is considered less accurate or unreliable. A validity test is conducted to determine the extent to which each item in the research instrument is appropriate for measuring the intended construct. The validity of the instrument was tested to assess how well the items reflect the content and characteristics being measured.

The validity test in this study employed a product-moment correlation technique, which calculates the correlation coefficient between the score of each item and the total score of the instrument. The analysis was carried out using SPSS version 20.0, with the following criteria: if the calculated correlation coefficient (*r count*) is greater than the critical value (*r table*), the item is considered valid. Otherwise, if *r count* is less than *r table*, the item is deemed invalid. A total of 20 items were tested for validity, and the detailed results are presented as follows.

Table 3.1 Results of the Validity Test of Research Instruments

Item Number	Pearson's R (R_{xy})	Comparison	Critical Value (R-Table)	Validity Status
1	0.005	<	0.361	Not Valid
2	0.891	>	0.361	Valid
3	0.400	>	0.361	Valid
4	0.577	>	0.361	Valid
5	0.006	<	0.361	Not Valid
6	0.477	>	0.361	Valid
7	0.616	>	0.361	Valid
8	0.084	<	0.361	Not Valid
9	0.268	<	0.361	Not Valid
10	0.044	<	0.361	Not Valid
11	0.059	<	0.361	Not Valid
12	0.044	<	0.361	Not Valid
13	0.000	<	0.361	Not Valid
14	0.741	>	0.361	Valid
15	0.310	<	0.361	Not Valid
16	0.616	>	0.361	Valid
17	0.961	>	0.361	Valid
18	0.746	>	0.361	Valid
19	0.148	<	0.361	Not Valid
20	0.107	<	0.361	Not Valid

From the validity test conducted, there were 9 valid and 11 invalid. This is by the criteria, namely if the calculated R value is greater than the R table value, the question is considered valid, and if the calculated R value obtained is lower than the R table value, the question is considered invalid and cannot be used. So in this case, the researcher made improvements to the instrument to conduct a validity test again with 30 different respondents with 20 question items. The results of the validity test obtained 19 valid items and 1 invalid item because the correlation value was less than 0.361, so it had to be dropped out on 1 invalid item.

3.2. Reliability Test

The reliability of the instrument in this study was assessed using the Cronbach's Alpha formula. This formula is commonly used to determine the internal consistency of instruments that yield scores beyond binary values, such as questionnaires or open-ended test items. The following is the interpretation of the Cronbach's Alpha table:

Table 3.3. The Instrument in the Cronbach's Alpha formula

Nilai Cronbach's Alpha	Tingkat Reliabilitas	Interpretasi
>0,90	Sangat Tinggi	Reliabilitas sangat tinggi
0,80 – 0,90	Tinggi	Reliabilitas Baik
0,70 – 0,79	Cukup	Dapat diterima
0,60 – 0,69	Rendah	Perlu diperiksa kembali
0,50 – 0,59	Buruk	Reliabilitas Rendah
<0,50	Tidak dapat diterima	Tidak reliabel

The reliability test in this study was conducted with the aid of SPSS version 20.0, and the results were obtained as follows:

Table 3.4. Instrument Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	N of Items
,646	20

Based on the general interpretation of George & Mallery (2003), it shows a sufficient level of reliability, meaning that the reliability of this instrument is acceptable (George & Mallery, 2024).

3.3. Paired Sample t-Test

Before conducting hypothesis testing, the data must first meet several prerequisite conditions. Parametric statistical analysis requires the fulfillment of key assumptions, the most important being that the data must be normally distributed. If the data distribution meets the criteria of normality, the researcher is permitted to use parametric statistical techniques. However, if the data do not follow a normal distribution, non-parametric statistical methods must be employed.

Accordingly, a normality test was conducted before hypothesis testing to ensure that the data fulfilled the assumptions necessary for parametric analysis.

Table 3.5. Mayor One-Sample Kolmogorov-Smirnov Test

Mayor One-Sample Kolmogorov-Smirnov Test			
			Unstandardized Residual
N			30
Normal Parameters ^{a,b}		Mean	,0000000
		Std. Deviation	5,78238661
Most Extreme Differences	Extreme	Absolute	,130
		Positive	,084
		Negative	-,130
Test Statistic			,130
Asymp. Sig. (2-tailed)			,200 ^{c,d}
a. Test distribution is Normal.			
b. Calculated from data.			
c. Lilliefors Significance Correction.			
d. This is a lower bound of the true significance.			

Based on the table above, the results of the Shapiro-Wilk test indicate that the data are normally distributed. This is evidenced by the obtained significance value, which is greater than 0.05, namely Sig. = 0.200 > 0.05. Therefore, the data meet the prerequisite for conducting a parametric statistical analysis, and hypothesis testing can proceed using the Paired Sample t-Test.

The purpose of hypothesis testing is to determine whether the alternative hypothesis (Ha) or the null hypothesis (H₀) should be accepted or rejected, based on the following decision rules:

1. Based on the comparison between the calculated t-value and the critical t-value from the table:
 - a. If the calculated t-statistic (t-output) is greater than the critical t-value (t-table), then H₀ is accepted.
 - b. If the calculated t-statistic (t-output) is less than the critical t-value (t-table), then H₀ is rejected.

To determine the critical t-value, it must be obtained from the t-distribution table by first calculating the degrees of freedom (df), which is derived using the formula N – 1. In this study, the number of respondents (N) is 15, so the degrees of freedom (df) is 15 – 1 = 14. With df = 14 and a significance level of α = 0.05, the critical t-value is 2.145.

2. Based on the probability value (p-value):
 - a. If the probability value is greater than 0.05, then H₀ is accepted.
 - b. If the probability value is less than 0.05, then H₀ is rejected.

The results of the Paired Sample t-test using SPSS version 20.0 are as follows:

Table 3.6. Sample t-test in Paired Samples Test

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pret - post	-25,300	6,577	1,201	-27,756	-22,844	-21,071	29	,000

Based on the data analysis, this study indicates that the implementation of the Short Card game-based method has a positive and significant impact on improving elementary students' mathematics learning outcomes. This is evidenced by the significant difference between pre-test and post-test scores, supported by hypothesis testing results showing a significance level of 0.000 ($p < 0.05$).

This improvement demonstrates that the use of card-based educational games can provide more effective stimulation in mathematics learning, especially in the context of Madrasah Ibtidaiyah. The Card Sort learning model facilitates conceptual understanding through engaging classification and discussion activities (Anggraini et al., 2025; Falaria & Basri, 2024). The Short Card method also helps to break students' boredom and negative perceptions of mathematics, which is often labeled as "difficult" or "intimidating." This is further supported by interview results with the sixth-grade homeroom teacher, who observed a significant improvement in student scores following the implementation of this method. Additionally, students admitted that they found the material easier to understand due to the visualization and direct interaction with the learning content (Austin, 1972; Himmele & Himmele, 2017).

According to constructivist theory, students will find it easier to understand concepts if they actively build their knowledge through fun and meaningful learning experiences (Bruner, 1964). Short cards provide an active learning experience, where students can associate mathematical concepts directly through images, symbols, and interactive activities. Previous research by Utami (2020) also showed that the use of card-based media can improve understanding of basic mathematical concepts, especially in number operations and recognition of geometric shapes (Utami, 2020). In addition, learning with visual aids has been shown to improve students' long-term memory (Arsyad, 2013; Khairuddin et al., 2023). Thus, short card media not only enrich classroom learning methods but also improve student learning outcomes in both cognitive and affective aspects.

From a pedagogical perspective, these findings also underscore the importance of diversifying teaching methods, especially in elementary education (Erfan Karyadiputra, 2023; Villegas & Irvine, 2010). Teachers are encouraged to continuously innovate in the learning process, whether through the development of instructional media or strategies that actively engage students in learning. (Kwangmuang et al., 2021). Thus, the Short Card method functions not only as a teaching aid but also as a constructivist learning approach, enabling students to build understanding independently through exploration.

Recent research by Frasandy et al. shows that the use of smart card media in mathematics learning, especially in division material, significantly increases the interest and learning achievement of grade III students at SD Muhammadiyah Ambarbinangun. (Sari & Budiharti, 2024). This media allows students to learn creatively and interactively, thereby increasing concentration and understanding of mathematical concepts. Furthermore, Januar et al., in their research, revealed that card-based learning methods, such as short cards, have a positive impact on mathematics learning. This media encourages student activity and can be applied to various activities (Solehah et al., 2024) Mathematics materials, including geometry and spatial figures.

According to the results of the existing research, the short-card method can affect children's mathematics learning outcomes. It can be seen from the results of the pretest and posttest difference tests that show a significant value of $0.00 < 0.05$. According to the hypothesis proposed, H_0 is rejected and H_a is accepted, which means there is an effect of the short card method on improving elementary school students' mathematics learning outcomes. Theoretically, the findings of this study reinforce active learning theory and game-based learning theory, both of which assert that students' active participation in the learning process enhances information retention, conceptual understanding, and learning motivation (Adipat et al., 2021; Khozaei et al., 2022).

Moreover, this study supports the constructivist approach, where students actively construct knowledge through direct experience.

4. Conclusions

The most important finding of this research is the significant positive effect of the Short Card game-based method on the mathematics learning outcomes of elementary students. This strategy not only improved students' academic performance, as shown by the pre-test and post-test comparison, but also reshaped their perception of mathematics from being a difficult and uninteresting subject to one that is interactive and enjoyable. The study highlights the pedagogical wisdom that incorporating engaging and visual learning tools, such as card games, into mathematics instruction can help overcome learning difficulties, foster deeper conceptual understanding, and support the development of essential problem-solving skills among students.

This research contributes meaningfully to the academic discourse on innovative teaching practices in mathematics education. It introduces a constructivist-aligned game-based method that enhances active participation and knowledge construction in early learners. The study not only supports existing theories in active and game-based learning but also presents empirical evidence from a local context, thereby enriching the educational literature with culturally relevant insights. However, the study is limited by its scope, focused on a single grade level, location, and small sample size. Future research should explore broader demographic variables such as age, gender, and regional differences, and consider the use of larger-scale survey methodologies. Such expansion would offer a more comprehensive understanding and strengthen the policy implications of adopting game-based learning strategies in elementary education.

5. CRediT Authorship Contribution Statement

Khurin In Ratnasari, Vannisa and Aviana Melinda: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Project administration, Resources, **Amak Fadholi:** Software, Validation, Visualization, Writing – original draft, and Writing – review & editing. **Mowafg Abraham Masuwd:** Conceptualization, Supervision, Validation, and Writing – review & editing.

6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

7. Data Availability

Data will be made available on request.

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