AXIOM : Jurnal Pendidikan dan Matematika
(2024) Volume 13, No. 1, Page 30-40
https://doi.org/10.30821/axiom.v13i1.17158

The effectiveness of smart card media on mathematics learning interest and achievement in third-grade elementary school students

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Received: 19 August 2023 / Accepted: 22 June 2024 / Published Online: 30 June 2024

Abstract
This research aims to determine the effectiveness of using smart card media in influencing the interest and learning achievement of third-grade students at Muhammadiyah Ambarbinangun Elementary School in the mathematics division. The research method employed is quasi-experimental. The study found that the use of smart card learning media effectively influenced both learning interest and achievement. Hypothesis testing revealed that the mean rank value for the experimental class (33,69) was higher than the control class (19.31), indicating differences in learning interest between the two groups. Similarly, in terms of learning achievement, the t-count value (4.578) exceeded the t-table (2,009), demonstrating a significant difference in learning achievement between the experimental and control classes. Post-test scores further supported this, with the experimental class achieving a higher score (81,15) compared to the control class (65,38). Based on statistical analysis, the significance value for interest in learning was less than 0,05 (0,01 < 0,05), indicating that smart cards were more effective than division table media. Similarly, for learning achievement, the significance value was also less than 0.05 (0.00 < 0.05), reinforcing the superiority of smart card media over division table media.

Keywords: Smart cards, Interests, Achievements, Mathematics

How to Cite: Sari, O.P.D & Budiharti. (2024). The effectiveness of smart card media on mathematics learning interest and achievement in third-grade elementary school students. AXIOM : Jurnal Pendidikan dan Matematika, *13*(1), 1-11. https://doi.org/10.30821/axiom.v13i1.17158

Introduction

Quality education significantly influences both individual intelligence and national progress. The comprehensive development of education across various scientific fields enables students to gain broader insight and diverse abilities. This preparation not only equips them for academic challenges but also empowers them to contribute positively to society. The learning process, particularly in mathematics, plays a central role within the education system. Mathematics is taught at all levels of education, from kindergarten to elementary school and college (Pasaribu, 2019). Mathematics learning plays a crucial role in honing students' thinking abilities to solve various types of problems, both related to mathematical concepts and challenges encountered in everyday life. However, many students lack interest in studying mathematics because they perceive it as an abstract subject. Additionally, some students

mistakenly believe that only highly intelligent individuals can master mathematics. Unfortunately, this lack of interest often leads to difficulties in learning the subject. (Permatasari, 2021)

Teachers can train students' mindsets by stimulating students' interest in learning mathematics (Putri et al., 2019). At elementary school age 7-12 years, students are in the concrete operational stage, and they possess the ability to think systematically about real-world objects and events. To enhance students' thinking abilities, educators can create an engaging and enjoyable learning environment. Such an environment captures students' attention, ensuring their active participation in the learning process. When students have a genuine interest in learning, they can effectively learn and practice mathematics. Interest often begins with a sense of joy and a positive attitude (Putri et al., 2019). Interest refers to students liking and being engaged in an activity, even if they don't explicitly state it (Muhria, 2020). When students lack motivation during lessons, fail to take notes, and do not pay attention to their learning, it often indicates low interest (Muhria, 2020). This phenomenon becomes evident when students actively participate, demonstrate a strong desire to learn, and thoughtfully engage with the content. The impact of interest on learning activities is significant. Students who genuinely find a topic interesting can easily retain the information presented by the teacher because it captures their attention (Sutisna et al., 2022). In conclusion, student interest in learning manifests when students experience happiness, demonstrate focused attention, express genuine interest, and actively participate in the learning process.

Beyond interest, another critical factor influencing achievement is the ability to comprehend mathematics learning. Therefore, it is essential to cultivate students' interest in learning mathematics. When students are genuinely interested in mathematics, they naturally pay more attention and actively seek to deepen their understanding of the subject. Consequently, their mathematics achievement scores tend to be significantly better than those of students who lack interest and strong learning abilities in mathematics. A keen interest in learning correlates with higher achievement, while a lack of interest often leads to lower learning outcomes, according to Djamara (Sutisna et al., 2022). Meanwhile, Pratiwi (Sutisna et al., 2022) mentioned that providing attention and motivation to students is very important to foster interest in learning and improve student learning achievement. Learning achievement in mathematics can be a benchmark for knowledge or achievement that reflects student learning development (Febriyanti & Murdiono, 2016). Evaluation of learning achievement is often carried out through exams or achievement tests, which function as a means of revealing the actual abilities that have been obtained as a result of learning (Lomu & Widodo, 2018). Grades assigned to students during the learning process serve as a measure of their learning achievement. Student success is gauged by their overall learning achievement, which reflects the knowledge acquired through exams and assessments. After completing the learning stage, assessment results provide insights into students' achievements across various learning activities, including assignments, exams, and tests. Teachers assign grades or scores to evaluate this achievement.

To enhance interest in learning and positively impact student achievement, incentives play a crucial role. When students possess a strong desire to learn, they can better comprehend mathematics at their proficiency level. Moreover, such motivated learners acquire essential skills, becoming critical thinkers, creative problem solvers, and logical analysts (Sirait, 2016).

The use of media in the classroom learning process can be a factor in making a significant contribution. However, not all media are suitable for conveying learning material or making it easy for students to understand it. Then, to make students feel motivated to learn, teachers can choose effective media. Smart cards can be used to present learning, especially division material in mathematics. With this smart card media, students can stay active and avoid boredom. Using smart cards as a learning tool can increase students' knowledge (Yuliana, 2021). The smart cards used have practice questions and a list of questions related to the lesson material.

In the initial phase of this research, the researchers conducted interviews with two class teachers: Mrs. Ambar Wahyu Ningsih, who taught 26 students in class 3A, and Mr. Puji Hariyanto, who taught 26 students in class 3B. Additionally, the researcher interviewed two students: Aqila Azarah Shalsabila from class 3A and Nadira Najla Maylania Rahayu from class 3B. The findings from these teacher and student interviews revealed that teachers were not fully optimizing specific learning media for teaching. Instead, they primarily relied on books and worksheets, rarely incorporating other learning materials. Consequently, this situation may lead to decreased interest and achievement in mathematics lessons. It highlights that teachers still tend to provide material or information to students in a traditional manner, particularly when it comes to division material in mathematics.

The results of interviews with students indicate that some students still hold opinions about learning mathematics, which they consider quite difficult to understand, especially in certain materials. Additionally, they believe that there are mathematical topics that can be described as simple and quickly comprehensible. On the other hand, some students express less interest in mathematics and find it challenging, often due to its association with formulas and numbers. For instance, division material continues to confuse students. According to (Raharjo et al., 2021) Teachers must have the ability to think creatively during the learning process to address students' challenges. However, many students remain passive and inattentive. Consequently, some students ignore or fail to listen to the teacher's instructions. Only a few actively participate by asking questions or sharing their opinions during lessons. Additionally, students often become preoccupied with other activities, such as playing and chatting, which leads to a lack of engagement with the material they receive.

The issue mentioned above shares similarities with other research related to smart card learning media, particularly concerning learning interest and achievement. Previous studies have found that the use of smart cards effectively enhances students' interest in the classroom (Ningtyas & Sembiring, 2020). Furthermore, other research also states that smart card media can increase student interest in learning, motivation, and learning outcomes (Yuliana, 2021), This is also confirmed by the results that there is an influence of smart card media on learning achievement (Hidanurhayati et al., 2018). Meanwhile, in this research, the smart cards used include concrete learning media for mathematics subjects. Specifically, the focus is on division material for third-grade students, aiming to measure both students' interests and learning achievement. The applied learning model is Problem-Based Learning (PBL) using experimental research.

The use of card media in education today is very important to develop effective, innovative, and creative learning programs so that students can study subjects according to the prescribed reading (Frasandy et al., 2022). Then smart card media can influence students'

interest and learning achievement, especially in learning mathematics, and division material. Smart cards provide space for students to be creative during the teaching and learning process so that students can increase their potential. This has an impact on increasing learning concentration (Khoirullah et al., 2023). Then, smart card media can be an alternative that students need in solving problems for students who have difficulty or have problems understanding the material (Putra, 2023).

Some of the research mentioned earlier indicates a positive influence of using learning media, such as smart cards. These media have significant implications for planning and implementing learning across various fields, including mathematics and other subject areas. In the specific context of this research, smart card media were employed in mathematics learning, specifically focusing on division material. The study measured students' interest and learning achievement during classroom sessions. Smart cards serve as a medium to facilitate students' understanding and communication in mathematics. By incorporating playful learning, students engage with new concepts, fostering interest and enjoyment. Importantly, this approach allows students to learn without feeling pressured or compelled by external factors. As a result, the title of this research is: "The Effectiveness of Smart Card Media on Mathematics Learning Interest and Achievement in Third-Grade Elementary School Students”

Methods

This research was conducted at SD Muhammadiyah Ambarbinangun Kalipakis (Elementary School), Tirtonirmolo, Kasihan District, Bantul Regency, Yogyakarta. The study employed a quasi-experimental design method. Specifically, a nonequivalent control group design was applied, involving both an experimental group and a control group that was not randomly selected. The research procedure included several steps: preparing the desired learning media, selecting the treatment group, administering a pre-test and questionnaire at the beginning of the lesson, conducting the teaching and learning process in both experimental and control classes, and finally, administering a post-test and questionnaire at the end of the lesson.

This research spanned one week, comprising three meetings for each class. The study employed a quasi-experimental design method, specifically a nonequivalent control group design. This design involved both an experimental group and a control group, which were not randomly selected. The research procedure included several steps: preparing the desired learning media, selecting the treatment group, administering a pre-test and questionnaire at the beginning of the lesson, conducting the teaching and learning process in both experimental and control classes, and finally, administering a post-test and questionnaire at the end of the lesson. The sample population consisted of all 3rd-grade classes, with 26 students in each class, totaling 52 students.

The instruments used in this research included a closed questionnaire with 20 questions to collect data related to students’ learning interests. Additionally, pre-tests and post-tests were administered to measure student learning achievement. To assess the implementation of learning, researchers utilized a learning implementation observation sheet. For validity testing, the Pearson product-moment correlation technique was employed, along with reliability analysis using Cronbach’s Alpha. A normality test was conducted to determine whether the sample data followed a normal distribution; the Kolmogorov-Smirnov test was chosen due to

the sample size exceeding 50. Furthermore, a homogeneity test ensured that the population from both sample groups had similar variances. Regarding hypotheses, the Mann-Whitney test, a non-parametric method, was used to measure interest in learning based on the final questionnaire. Meanwhile, the Independent Samples t-test, a parametric approach, required normally distributed and homogeneous data to assess student learning achievement.

Result

This research involved two different classes. Class 3A implemented learning using smart card media, while the control class (Class 3B) employed a learning method based on division tables. The learning sessions took place over three meetings. Subsequently, the final questionnaire and post-test were administered. Student pre-test and post-test data were collected through questions comprising ten items, with a duration of 45 minutes, and focusing on division material. Table 1 displays the students' pre-test scores.

Table 1. The Pre-test and Post-test Scores of Experimental and Control Class

	Experimental Class		Control Class	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
Mean	53,46	83,07	44,61	66,53
Highest Score	70	100	70	90
Lowest Score	10	60	20	30

There is a significant difference in scores from the two classes as evidenced by the respective average pre-test and post-test scores. Thus, smart card media can prove its effectiveness through the grades students get during learning.

Questionnaire Results

The aim of the questionnaire with 20 questions given to students is to calculate the percentage of the number answered by respondents. This determines how many questions the respondents answered in the questionnaire. Table 2 shows a description of the questionnaire.

Table 2. The Results of the First and the Final Questionnaire

	Experimental Class		Control Class	
	First Questionnaire	**Final Questionnaire**	**First Questionnaire**	**Final Questionnaire**
SL	102	159	46	73
SR	109	87	93	116
KD	108	114	170	115
J	82	85	90	71
TP	117	79	121	81

The results of the questionnaire scores prove the differences in the learning interest of each student before and after using different media in mathematics learning.

Desolation of Illegality

The implementation of the learning process used by both classes is the result of research into the implementation of the learning process according to the Lesson Plans in Table 3 below.

Table 3. The Percentage of Learning Process in Experimental Class

Meetings	Total Score		Total Score	Score		Category
	Teacher	Students		Teacher	Students	
1	40	40	41	97,56%	97,56%	Very Good
2	41	41	41	100%	100%	Very Good
3	41	41	41	100%	100%	Very Good

The implementation of experimental class learning proves to be very good when the learning process is carried out according to the planned procedures with the help of smart card media. Then, to determine the comparison between the two classes, it can be seen in the achievement of the implementation of learning in the control class in Table 4 below.

Table 4. The Percentage of Learning Process in the Control Class

Meeting	Total Score		Total Score	Score		Category
	Teacher	Student		Teacher	Students	
1	38	38	41	92,68%	92,68%	Very Good
2	40	40	41	97,56%	97,56%	Very Good
3	41	41	41	100%	100%	Very Good

The implementation of controlled classroom learning has been proven to be very good with progress in each meeting according to the planned procedures, assisted by the use of a division table media.

Normality Test

In the Shapiro-Wilk test, H_o indicates that data has a normal distribution, while Hα 1 indicates that data does not have a normal distribution. The sig value is then balanced with the significance level, which is 0.05. A sig value greater than 0.05 indicates that there is not enough evidence to reject H_0, which means that the data considered has a normal distribution. On the other hand, a sig value lower than 0.05 indicates the rejection of H_0, which means that the data does not have a normal distribution. The results of the normality test are shown in Table 5.

Table 5. The Results of Normality Tests

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
EPre-test	.157	26	.100	.930	26	.078
EPost-test	.169	26	.054	.931	26	.081
KPre-test	.184	26	.024	.925	26	.059
KPost-test	.234	26	.001	.927	26	.066

The results of the Kolmogorov-Smirnov test showed that the pre-test and post-test data from the control class in the experiment had a normal distribution (with a sig value greater than 0.05).

Homogeneity Test

Homogeneity test to ensure that the populations of two groups of sample data have the same level of variance. Using SPSS 23 Software, the Bartlett method was applied. In the homogeneity test, H_0 indicates that the variance between data groups was the same

(homogeneous), while H_α indicates that the variance between data groups was different (not homogeneous). The data results can be seen in Table 6.

Table 6. The Results of the Homogeneity Test of Variants

Levene Statistics	df1	df2	Sig.
.479	1	1	.492

The significant value of the homogeneity test is 0.492 > 0.05, which means there is not enough evidence to reject H_0. This shows that the two groups, namely the experimental group and the control group, have very homogeneous values.

Hypothesis Test

To test the hypothesis on students' learning interest, the Mann Whitney test is used because it is non-parametric data, while for learning achievement the Independent Sample t-test is used because it is parametric. As for the significance level of 5% (0.05) and if the sig value is less than 0.05, then H_0 is rejected and H_0 is accepted, and the hypothesis is accepted. On the other hand, if the sig value is more than 0.05, the H_0 value is rejected and the hypothesis is rejected. Mann Whitney test results using SPSS 23 software can be seen in Table 7.

Table 7. Malnn Whitney Data about Learning Interest

	Class	N	Mean	Total
Learning Interest	Class Experiment	26	33.69	876.00
	Control Class	26	19.31	502.00
	Total	52		

The results of the Mann Whitney test showed that the experimental class value was 33.69, which was greater than the control class value of 19.31, with a significant value of 0.01 < 0.05, so that H_0 was rejected or there was a significant difference between the experimental class and the control class. Thus, it can be concluded that smart card media is effective in students' interest in learning.

To see the results of student learning achievement, an Independent Sample t-test was carried out using SPSS 23 software in Table 8 below.

Table 8. Independent Sample T-Test about Learning Achievement

	t	Sig. (2-tailed)
Learning Achievement	4,578	0,000

The total t-count is 4.578 according to the results of the t-test, by comparing the t-table 2.009 with db 49, it can be concluded that the t-count>t-table in the tally is significantly 0.0 < l0.05. The results show that the learning achievements of individuals who use smart card learning media and those who use divider table media are different. Furthermore, based on the post-test scores, the mean learning achievement scores are obtained in Table 9.

Based on Table 8, there is a significant difference between the post-test scores of the experimental class and the control class. Furthermore, based on Table 9, the experimental class meal score of 81.15 is better than the control class meal score of 65.38. This shows that smart card media is effective in student learning achievement.

Table 9. Group Staltistic Independent Salmple T-Test about Learning Achievement

	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Learning Achievement	Post-Experimental Class	26	81.15	13.365	2.621
	Post-Control Class	26	65.38	11.395	2.235

Discussion

According to the results of research and hypothesis testing, the use of smart cards in mathematics learning in class 3 of SD Muhammadiyah Ambarbinangun influences students' interest and learning achievement. The use of learning media such as smart cards can help create a comfortable, interesting, and effective learning environment. This research can influence the learning process in schools and may even provide new insights into the use of learning methods that focus on students' interests and learning achievements.

Effectiveness of Smart Card Learning Media on Students' Interest in Learning

The score of students' learning interest in the experimental class before using smart card media was 1.555 with an average score of 77.75 (59.81%). Meanwhile, the control class was 1.414 with an average score of 70.7 (54.38). After using the media, the score of the experimental class was 1,723 with an average score of 86.15 (66.27%), while the control class was 1.571 with an average score of 78.6 (60.42%).

In the hypothesis test, students' learning interest using Mann Whitney, H_α was accepted with a significant score of 0.01. Besides, the mean score of the experimental class was 33.69, while the control class was 19.31. This difference proves that the table division and smart cart media had a significant influence on students' learning interests.

Based on a study carried out by (Ningtyas & Sembiring, 2020) there was a significant score on students' learning interest. The results of both studies indicate that H_α is accepted with a significant score of $0.000 < 0.05$ which means it is consistent. The alignment between the results of this study and previous research can provide more confidence in these findings. This also supports the belief that the use of learning media such as smart cards can increase students' interest in mathematics lessons.

Apart from that, previous research (Umar et al., 2016) showed that the average result of assessing students' learning interest in the experimental class was 90.46, which was greater than the control class, namely 85.2. This shows that the use of smart card media has succeeded in increasing students' interest in learning. This means that the media is effective in stimulating students' interest in plant movement material.

The results of this research show that the experimental class and the control class have different learning outcomes. The experimental group had a pre-test score of 53.46 which increased to 83.07 in the post-test score. Meanwhile, in the control group, the pre-test score increased from 44.61 to 66.53 in the post-test score, so there was a difference in the post-test score from the experimental and control classes of 33.46. In this way, these results show that the learning approach through digital learning is more effective in increasing students' learning outcomes.

In the experimental class, the pre-test scores indicated 6 students receiving the highest scores and 20 students receiving scores above the Minimum Mastery Criteria (KKM) while the

post-test scores indicated 25 students receiving the highest scores and 1 student receiving the lowest scores. In the control class, 3 students received high scores and 23 students received low scores while 18 students received the highest scores in the post-test and 8 students received the lowest scores. The application of different learning media, namely smart cards in the experimental class and division tables in the control class, resulted in much higher learning achievement in the experimental class.

In hypothesis testing, the significance value (0.00) < 0.05, results in the rejection of H_0 in the acceptance of Hα l. Furthermore, the Independent Sample t-test value of 4.578 is greater than the db of 2.009. This shows a significant difference in learning performance between the experimental and control groups. The average value is 81.15 for the experimental group and 65.38 for the control group, a significant difference in student learning outcomes is becoming increasingly clear. Smart card learning media effectively improves student learning achievement compared to learning table media.

The results of this research are supported by previous research (Miskiyah & Safitri, 2023) which produced data using smart card media to measure student learning outcomes. With a significance value of 0.004 < 0.05, it can be concluded that student learning outcomes are significantly influenced by the use of smart cards in learning. Rejection of H_0 and acceptance of H_α confirm that smart cards have a real impact on student learning outcomes. The significant effect of using smart cards in improving student learning outcomes, and shows that this learning method is successful in stimulating students' understanding and achievement in the subject matter.

Conclusion

Based on the results of the research and discussion, it was concluded that the smart card learning media was effectively used in supporting the learning process compared to division tables so that it could increase the interest in learning achievement in mathematics learning. As research shows, the use of smart cards during learning has a positive influence and makes students more interested in studying. Meanwhile, in hypothesis testing, the average score for the experimental group was 33.69 > that of the control group, 19.31 for students' learning interests. Meanwhile, in terms of learning achievement, the average score for the experimental group was 81.15, while for the control group, it was 65.38. The sig value of 0.01 < 0.05 has a difference in learning interest in the experimental and control groups, then the Sig value of 0.00 < 0.05 has a difference in learning achievement in the experimental and control groups. Students need a flexible learning environment that can help them learn more effectively and give them the motivation to learn actively. Finally, it can be concluded that smart card learning media is effectively used to increase students' interest and achievement in learning mathematics. This research provides suggestions to further researchers regarding the use of the resulting smart card media to suit students' needs and as a comparison material with previous research. Apart from that, in carrying out research, researchers must pay attention to factors that influence other students' interest and learning achievement so that the use of smart card media in research has an influence and is effective on interest and learning achievement in mathematics.

Declarations

Author Contribution : OPDS: Conceptualisation, Writing Original Draft, Data Analysis, Editing.

B: Review and Editing, Validation, Supervision.

Conflict of Interest : The authors declare no conflict of interest.

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