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The Effect of Using Smartboard Learning Media on Students' Learning Outcomes in the Top-Down Multiplication Unit in Grade 3 at SDN 14 Pulau Punjung

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Abstract

Low achievement in vertical multiplication is associated with students' difficulty understanding procedural steps, correctly positioning digits and carrying values, and actively engaging in classroom learning. This study examined the effect of Smart Board learning media on third-grade students' learning outcomes in vertical multiplication. A quantitative, quasi-experimental design with a nonequivalent control group was employed. The population comprised 31 third-grade students at SDN 14 Pulau Punjung, all of whom were included through saturation sampling. Class III A, consisting of 16 students, served as the experimental group, whereas Class III B, comprising 15 students, served as the control group. Data were collected through pre-tests and post-tests and analyzed using normality and homogeneity tests followed by an independent-samples t-test in SPSS 25. The experimental group achieved a mean post-test score of 82.19, compared with 65.00 in the control group. The hypothesis test yielded a two-tailed significance value of .001, indicating a statistically significant difference between the groups. These findings demonstrate that Smart Board learning media significantly improved students' learning outcomes in vertical

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multiplication. The study highlights the practical value of interactive instructional media for facilitating procedural understanding and supporting mathematics achievement in elementary education.

Keywords: Elementary Mathematics; Learning Outcomes; Smart Board; Vertical Multiplication; Quasi-Experimental Study

INTRODUCTION

Mathematics instruction in elementary school plays a crucial role in developing students' logical and systematic thinking skills and in supporting their ability to understand mathematical concepts and solve mathematical problems (Nurhaswinda et al., 2026). One of the topics that third-grade students need to master is column multiplication. This topic not only requires the ability to perform multiplication operations but also demands an understanding of place value, the correct placement of digits, the sequence of steps in the calculation, and the process of carrying the product to a higher place value. (Susanto et al., 2022). Difficulties with multi-digit multiplication can be seen in students' errors in carrying and following the multiplication procedure (Pujawati et al., 2026).

However, various problems still arise in the implementation of mathematics instruction in the third-grade class at SDN 14 Pulau Punjung. Students have difficulty understanding the steps involved in vertical multiplication, particularly in positioning the numbers correctly and following the calculation procedure. This issue is consistent with the findings of Budianti et al. (2024) which show that third-grade students have difficulty completing vertical multiplication and placing the digits correctly. In addition, student engagement in mathematics learning remains a challenge when instruction is dominated by conventional methods. Mudiana et al. (2021) state that student engagement in mathematics learning remains low because teachers tend to use conventional methods, making it necessary to develop innovative teaching approaches that can encourage student participation. The use of conventional methods can also lead to low student engagement in learning and negatively impact learning outcomes (Zumrotun & Attalina, 2020). Therefore, the limited use of instructional media capable of visualizing multiplication concepts and procedures is one aspect that requires attention in efforts to improve students' mathematics learning outcome.

However, various problems still exist in the implementation of mathematics instruction in the third-grade class at SDN 14 Pulau Punjung. Students have difficulty

understanding the steps involved in vertical multiplication, particularly in placing the digits and carrying over. In addition, student participation in learning remains low, and the learning process is still dominated by conventional methods with limited use of instructional media. These conditions contribute to low student achievement. According to Nabila et al. (2025), one approach that can be taken to address this issue is the use of learning materials that are concrete, engaging, and allow students to participate directly in the learning process. Smartboards can help students understand the concept of vertical multiplication through visual displays and hands-on activities.

Smartboard media provide students with the opportunity to see, observe, and directly practice the steps involved in multiplication (Uswah & Siregar, 2024; (Gultom et al. 2025; Gili et al. 2025). Thus, concepts that are previously abstract can be presented in a more concrete way that is easier for students to understand. The use of this media is also expected to increase students' attention, engagement, and understanding, thereby leading to improved learning outcomes.

Previous research has shown that the use of smart board learning media has the potential to improve the quality of mathematics learning for elementary school students, particularly in the area of multiplication. Smartboard media provide a more concrete and visual learning experience so that students not only receive verbal explanations but can also observe and follow the calculation process more systematically. This is important because multiplication material for elementary school students still requires the aid of media that can connect abstract mathematical concepts with more concrete learning experiences.

Rahayu et al. (2025) through their study titled "The Effectiveness of the PAPINKA (Smart Multiplication Board) Learning Medium for Third-Grade Elementary School Multiplication," demonstrated that the PAPINKA medium was developed as an alternative learning tool for multiplication to help students understand the concept of multiplication more easily. This study reinforces the importance of using learning media that are appropriate for the characteristics of elementary school students in mathematics instruction. Previously, Rahayu & Nurmilawati (2024) and Wahab & Putri (2025) also conduct a needs analysis of the PAPINKA learning material among third-grade students. The results of the analysis show that teachers and students need appropriate learning materials to help them overcome difficulties in understanding multiplication concepts, and the PAPINKA material was deemed relevant for further development.

However, research specifically examining the effect of using smart board learning media on student learning outcomes in the topic of downward multiplication in third grade at SDN 14 Pulau Punjung remains limited. Therefore, this study was conducted to obtain empirical evidence regarding the effect of using smart board media on student learning outcomes in this topic.

The novelty of this study lies in the specific application of smart board learning media in teaching the concept of downward multiplication to third-grade students at SDN 14 Pulau Punjung. This study employed an experimental approach by comparing learning outcomes between a class that used smart board media and a class that used conventional teaching methods. Then, theoretically, the use of concrete media aligns with the cognitive developmental characteristics of elementary school students, who still require direct and tangible learning experiences. The smart board is expected to help students construct an understanding of place value, the multiplication process, digit placement, and the carry-over process more easily.

This study focuses on the effect of using smart board learning media on student learning outcomes in the topic of downward multiplication in third grade at SDN 14 Pulau Punjung. Consequently, the objective of this study is to determine the effect of using smart board learning media on student learning outcomes in the topic of downward multiplication in third grade at SDN 14 Pulau Punjung.

METHODS

This study employed a quantitative approach using an experimental research design. The research design used was a quasi-experimental design in the form of a nonequivalent control group design. The study was conducted at SDN 14 Pulau Punjung, located in Jorong Ranah Lintas, Nagari Tebing Tinggi, Pulau Punjung Subdistrict, Dharmasraya Regency, West Sumatra Province. The study was conducted during the even semester of the 2025/2026 academic year. The population of this study consisted of all third-grade students in classes III A and III B at SDN 14 Pulau Punjung. The sample comprised 16 students from class III A as the experimental group and 15 students from class III B as the control group.

The sampling technique used was saturation sampling, in which all members of the population were included in the study sample. The research instrument used to measure student learning outcomes was an objective multiple-choice test. Before being used in the

study, the instrument underwent pilot testing to assess the quality of the questions through validity, reliability, difficulty level, and discriminative power tests.

Data collection was conducted through pre-tests and post-tests. The pre-test was administered before the intervention to assess students' initial abilities, while the post-test was administered after the intervention to assess students' learning outcomes following the learning process. The research data were analyzed using statistical techniques. The analysis was conducted through normality tests, homogeneity tests, and hypothesis testing using SPSS software. The Shapiro-Wilk test was used to determine the normality of the data distribution, while the homogeneity test was used to determine the equality of variances. Then, hypothesis testing was conducted to determine whether the use of smart boards as a learning medium had an effect on students' learning outcomes in the topic of downward multiplication.

RESULTS

1. Data Decryption

This research was conducted in July 2026, involving 31 third-grade students from SDN 14 Pulau Punjung as the research sample. The study aimed to collect quantitative data in the form of pre-test and post-test scores. Before the treatment was administered, students in both classes were first given a pre-test to assess their initial proficiency. Next, the treatment focused on downward multiplication, with the experimental class taught using the Smart Board, while the control class used conventional methods. After the treatment was completed, both classes took a post-test to measure student learning outcomes. The results of the two experiment sample groups can be seen to the following table 1 below.

Tabel 1. Results of the Two Experimental Sample Groups

Data Description	Pre-test	Post-test
N	16	16
hIghest Score	90	100
Lowest Score	45	65
Complete	5	13
Incomplete	11	3
Everage	65,31	82,19

Table 1. Results of the two experiment sample groups present the learning outcomes of the experimental class before and after the implementation of the Smart Board media in

learning downward multiplication. The data were obtained from the pre-test and post-test administered to 16 third-grade students at SDN 14 Pulau Punjung. Before the treatment, the pre-test results showed an average score of 65.31, with the highest score of 90 and the lowest score of 45. Only 5 students achieved the learning mastery criterion, while 11 students were classified as incomplete. These results indicate that most students have not yet achieved the expected level of mastery in downward multiplication before the Smart Board media was implemented.

After the treatment using the Smart Board media, the post-test results showed a substantial improvement. The students' average score increased to 82.19, with the highest score reaching 100 and the lowest score increasing to 65. The number of students who achieved mastery increased from 5 to 13 students, while the number of students who did not achieve mastery decreased from 11 to 3 students. Thus, the proportion of students achieving mastery increased from 31.25% to 81.25%.

These findings indicate that students' learning outcomes improved after the implementation of Smart Board media. The increase in the average score, the highest and lowest scores, and the number of students achieving mastery suggests that the use of Smart Board media provided a more supportive learning experience for understanding downward multiplication. However, these descriptive results alone do not establish statistical significance; the subsequent inferential analysis is needed to determine whether the improvement was statistically significant.

Meanwhile, the following table 2 below presents the learning outcomes of the control class, which consisted of 15 third-grade students at SDN 14 Pulau Punjung. The data were collected through pre-test and post-test assessments to measure changes in students' understanding and mastery of downward multiplication before and after the learning process. Unlike the experimental class, the control class was taught using conventional teaching methods without the use of Smart Board media. The pre-test was administered to identify students' initial abilities, while the post-test was conducted after the learning process to determine their subsequent learning outcomes. The comparison of the pre-test and post-test scores provides information about the extent of students' improvement in the control class and serves as a basis for comparing the effectiveness of conventional instruction with the use of Smart Board media.

Table 2. Results of the Two Control Groups

Data Description	Pre-test	Post-test
N	15	15
Highest Score	80	90
Lowest Score	30	45
Complete	3	5
Incomplete	12	10
Everage	52,67	65,00

Referring to the table 2. Results of the two control groups, it can be said that the learning outcomes of the 15 third-grade students in the control class can be compared before and after the implementation of conventional teaching methods. The pre-test was administered to assess the students' initial understanding of downward multiplication, while the post-test was conducted to measure their learning outcomes following the instructional process. The comparison between the two assessments provides an overview of the students' progress in mastering downward multiplication after receiving conventional instruction.

The pre-test results show that the control class obtained an average score of 52.67, with the highest score of 80 and the lowest score of 30. Only 3 students achieved the learning mastery criterion, while 12 students were classified as incomplete. This indicates that most students had not yet achieved the expected level of mastery before the learning process. After the learning process, the post-test results showed an increase in students' learning outcomes. The average score increased from 52.67 to 65.00, while the highest score increased from 80 to 90 and the lowest score increased from 30 to 45. The number of students achieving mastery increased from 3 to 5 students, whereas the number of students who remained incomplete decreased from 12 to 10 students. In percentage terms, the mastery level increased from 20% to 33.33%.

To further compare the learning outcomes between the two groups, the following table 3 below presents the post-test scores of the experimental and control classes after the learning process. The table provides a comparison of the students' achievement based on the number of participants, highest and lowest scores, learning mastery, and average scores. This comparison illustrates the differences in learning outcomes between students who were taught using Smart Board media and those who received conventional instruction.

Table 3. Post-Test Scores of the Experimental and Control Class

Data Description	Post-test eksperimen	Post-test Kontrol
N	16	15
Highest Score	100	90
Lowest Score	65	45
Complete	13	5
Incomplete	3	10
Everage	82,19	65,00

Based on the table 3. Post-test scores of the experiemental and control class, it can be compared that the post-test learning outcomes of students in the experimental and control classes after the learning process. The experimental class consisted of 16 students who were taught using Smart Board media, while the control class consisted of 15 students who were taught using conventional teaching methods.

The results show that the experimental class achieved a higher average post-test score of 82.19, compared with 65.00 in the control class. The experimental class also obtained a higher highest score of 100, while the highest score in the control class was 90. In addition, the lowest score in the experimental class was 65, which was higher than the lowest score of 45 obtained by the control class. These results indicate that the overall performance of students in the experimental class was better than that of students in the control class.

The difference can also be observed in the students' learning mastery. In the experimental class, 13 out of 16 students (81.25%) achieved the mastery criterion, while only 5 out of 15 students (33.33%) in the control class achieved mastery. Conversely, only 3 students (18.75%) in the experimental class were classified as incomplete, compared with 10 students (66.67%) in the control class

It can be said that, the post-test results indicate that students who learn using Smart Board media achieve better learning outcomes in downward multiplication than those who learn through conventional methods. The higher average score, higher minimum score, and substantially greater percentage of students achieving mastery in the experimental class provide descriptive evidence of the potential effectiveness of Smart Board media. However, an inferential statistical test is still required to determine whether the difference between the two groups is statistically significant.

1. Data Analysis

a. Normality Test

The normality test was conducted using SPSS 25 with the Shapiro-Wilk test. If the p-value is greater than 0.05, the data are considered normally distributed. If the p-value is less than 0.05, the data are not normally distributed. The data tested for normality were the pre-test and post-test scores. The table 4 below shows the results of the normality test.

Table 4. Two Classes of Normality Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	df	Sig.	Statistic	df	Sig.
HasilBelajarSiswa	Pre-test Eksperimen	.179	16	.183	.939	16	.334
	Post-test Eksperimen	.116	16	.200*	.954	16	.558
	Pre-test Kontrol	.241	15	.019	.887	15	.060
	Post-test Kontrol	.174	15	.200*	.943	15	.417

Based on the table 4. Two Classes of Normality Test above, it can be said that the results of the Shapiro-Wilk test show the significance values ("Sig.") for each data set as follows:

1. Experemental Class:

- Pre-test score: Sig. = 0,334 > 0,05.
- Post-test Score: Sig. = 0,558 > 0,05.

2. Control Class:

- Pre-test score: Sig. = 0,060 > 0,05.
- Post-test Score: Sig. = 0,417 > 0,05.

Since all pre-test and post-test data for both the experimental and control groups have p-values greater than 0.05, it can be concluded that the students' learning outcome data in both groups are normally distributed. With this assumption of normality met, hypothesis testing (inferential statistics) can proceed using parametric statistics, specifically the independent samples t-test.

b. Homogeneity Test

After the data are normally distributed, the next step is the homogeneity test. The homogeneity test is used to determine whether the population variances of two or more groups are the same or different. The criterion for the homogeneity test is that if the significance value is > 0.05, the data can be considered homogeneous; however, if the

significance value is < 0.05, the data are not the same or are different. The table 5 presents the results of the homogeneity test analysis.

Table 4. Results of Homogeneity Test

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Hasil belajar siswa	Based on Mean	1.803	1	29	.190
	Based on Median	.970	1	29	.333
	Based on Median and with adjusted df	.970	1	25.809	.334
	Based on trimmed mean	1.768	1	29	.194

Based on the results of the data analysis in Table 5, it can be seen that a significance value of 0.190 is obtained. Since the significance value of 0.190 is greater than 0.05, it can be concluded that the two sample groups (the experimental group and the control group) have homogeneous (equal) data variances. Thus, the assumption of homogeneity has been met, so the subsequent parametric statistical test (Independent Samples t-Test) can proceed.

c. Hypothesis Testing

After conducting the normality test, the next step is the hypothesis test. The hypothesis test is conducted to determine whether the proposed hypothesis is accepted or rejected. In this study, the hypothesis test was conducted using an independent samples t-test. The following table 6 below presents the hypothesis test and the independent samples t-test results.

Tabel 6. Hypothesis Testing of Two Sample Classes

Group Statistics

	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Hasil	Post-test Eksperimen	16	82.19	11.101	2.775
	Post-test Kontrol	15	65.00	13.887	3.586

Reffering from the table 6. Hypotehsis testing of two sample classes, it can be said that the experimental class obtains a mean score of 82.19, with a standard deviation of 11.101 and a standard error mean of 2.775. Meanwhile, the control class obtains a lower mean score of 65.00, with a standard deviation of 13.887 and a standard error mean of 3.586. The difference in mean scores between the two groups is 17.19 points, indicating that students who receive instruction using Smart Board media achieve higher post-test scores than students who receive conventional instruction.

The standard deviation indicates the variation in students' scores within each group. The control class has a slightly larger standard deviation (13.887) than the experimental class (11.101), indicating that the students' scores in the control class were more varied. In contrast, the lower standard deviation in the experimental class suggests that the students' post-test scores were relatively more consistent.

It can be summed that the descriptive statistics indicate that the experimental class performed better than the control class after the learning treatment. The substantially higher mean score in the experimental class provides preliminary evidence that the use of Smart Board media may have contributed to better learning outcomes in downward multiplication. However, to determine whether this difference is statistically significant, the results of the Independent Samples t-test need to be examined.

To further determine whether the difference in post-test scores between the experimental and control classes is statistically significant, an Independent Samples t-test was conducted. This analysis was used to compare the mean learning outcomes of the two independent groups after the learning process. The results of the statistical independent samples test are presented in the table 7 below, which includes the Levene's Test for equality of variances and the Independent Samples t-test for equality of means.

Table 7. Independent Samples Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Hasil	Equal variances assumed	1.803	.190	3.819	29	.001	17.188	4.501	7.982	26.393
	Equal variances not assumed			3.791	26.816	.001	17.188	4.534	7.881	26.494

Based on table 7. Indepenedent samples test above, it can be seen that a significance value of sig. (2-tailed) of 0.001 is obtained at a 95% significance level (α=0.05). Since the sig. (2-tailed) value of 0.001 is less than 0.005, the test decision is to reject H0 and accept Ha.

These results indicate that there is a statistically significant difference in learning outcomes between the experimental and control classes. This is supported by the post-test mean score in the experimental group of 82.19, which is significantly higher than the control group's mean score of 65.00. Thus, it can be concluded that the use of smart boards has a significant effect on improving student learning outcomes.

DISCUSSION

Based on the results of the study, the use of smart boards as a learning medium have a significant effect on student learning outcomes for the topic of downward multiplication in third grade at SDN 14 Pulau Punjung. This is evident from the post-test results, where the experimental class achieved an average score of 82.19, while the control class achieved an average score of 65.00. The results of the hypothesis test using the Independent Samples t-Test yielded a significance value of $0.001 < 0.05$, so H_0 is rejected and H_1 is accepted. This means that the use of smart board learning media has a significant effect on student learning outcomes.

The improvement in learning outcomes in the experimental class indicates that smart board media can help students understand the concept of vertical multiplication (Purwandini & Siwanto, 2026). The smart board provides students with the opportunity to directly observe and practice the steps involved in multiplication, particularly in understanding number placement and the carry-over process. This aligns with Piaget's theory of cognitive development, which states that elementary school students are in the concrete operational stage; therefore, to understand a concept, students require tangible objects or experiences that they can manipulate directly.

The use of smart boards also makes learning more concrete and visual. The concept of vertical multiplication which was previously considered abstract can be presented using the board, number cards, and components that students can manipulate directly. As a result, students find it easier to understand the relationship between place value, the multiplication process, and the concept of carrying. This aligns with the theoretical framework of the study, which explains that smart boards are visual and manipulative tools that allow students to see, observe, and directly practice the steps of vertical multiplication. The results of this study are consistent with the research by Dewi et al. (2025); Mayuni et al. (2025), which show that the use of the "Smart Board" (Papin) multiplication teaching aid have a significant effect on improving the mathematics learning outcomes of third-grade students. The use of this teaching aid help students concretize the previously abstract concept of multiplication, making it easier to understand visually. These findings reinforce the conclusion of this study that the Smart Board can help improve students' learning outcomes in multiplication.

Furthermore, the study by Siregar & Siregar (2025) and Setiyo et al. (2025) show that the use of the "Sorong" multiplication smartboard as a learning medium had a positive

impact on students' ability to follow a systematic calculation process. These medium help students follow the calculation process step by step, thereby reducing errors in performing arithmetic operations. These findings are consistent with the results of this study because third-grade students at SDN 14 Pulau Punjung also experienced difficulties in understanding the steps of vertical multiplication, particularly in the placement of numbers and the carry-over process. A study by Oktarina et al. (2024) also shows that the use of smartboards can improve students' understanding of the basic concepts of multiplication. Students' direct interaction with the medium makes it easier for them to understand the basic logic of multiplication before learning more complex calculation methods. This supports research findings that students' direct engagement with smartboards can help improve their understanding of downward multiplication.

In addition, a study by Rahayu et al. (2025) show that the PAPINKA medium is effective in improving student learning achievement. The effectiveness of this medium is related to its attractive visual presentation and its interactive nature, which helps maintain students' attention throughout the learning process. These findings are consistent with the results of this study, as the use of smart boards provides a more engaging learning experience and directly involves students in the learning process. The findings of this study are also supported by Dewi et al. (2025) who state that the development of an innovative smartboard-based learning medium for multiplication can increase third-grade students' interest in learning. This increased interest in learning can support a more optimal mathematics learning process. With engaging and interactive learning materials, students become more active participants in the learning process, which can have a positive impact on their learning outcomes.

Based on the above discussion, it can be seen that the results of this study are consistent with several previous studies, which similarly demonstrate the benefits of using smart boards in mathematics instruction. The use of smart boards not only helps students understand the material in a concrete way but also makes them more active participants in the learning process. Thus, smart boards can serve as an alternative instructional tool that teachers can use to help improve students' learning outcomes in the topic of downward multiplication. During the research process, several challenges arose regarding the use of smartboards, such as limited class time and a fairly active classroom environment when students were playing games in groups. However, these challenges could be overcome through structured classroom management and direct guidance provided to students.

Thus, based on the research results, the theory used, and support from previous studies, it can be concluded that the use of smart board learning media has a significant effect on student learning outcomes in the topic of downward multiplication in third grade at SDN 14 Pulau Punjung. This is evidenced by the experimental class's post-test average score of 82.19, which is higher than the control class's score of 65.00, as well as a significance value of 0.001 < 0.05. The research results indicate that the use of smart board learning media has a positive effect on student learning outcomes. This can be seen from the difference in post-test average scores between the experimental class and the control class. The experimental class, which received instruction using the smart board, had an average score of 82.19, while the control class had an average of 65.00. This difference indicates that instruction using the smart board is more effective in helping students understand the concept of vertical multiplication than conventional instruction.

Smartboard technology allows students to have a more concrete learning experience. Students not only listen to the teacher's explanations but can also see and practice the steps of multiplication firsthand. This helps students understand number placement, place value, and the carry-over process in vertical multiplication. The results of this study align with previous research showing that concrete and interactive learning media, such as smart boards, have a positive impact on elementary school students' mathematics learning outcomes. Research done by Rahayu et al. (2025) indicates that the PAPINKA medium is effective in improving cognitive achievement in mathematics. Research by Firnanda & Faizah (2024) also show that smart boards for multiplication can increase students' interest in and achievement in mathematics. The results of this study reinforce these findings because the use of smart boards in teaching vertical multiplication has been shown to produce higher learning outcomes compared to conventional teaching methods.

In practical terms, the results of this study have implications for elementary school teachers: the use of concrete and interactive learning media can be one way to improve students' mathematics learning outcomes. Teachers can use smartboards to help students understand the concept of vertical multiplication, particularly in areas where errors frequently occur, such as digit placement and the carry-over process. For students, the use of smart boards provides a more engaging learning experience and helps them understand the concept of multiplication more concretely. For schools, the results of this study can serve as a basis for consideration in developing innovations in mathematics instruction.

Despite these contributions, several limitations should be acknowledged. First, this study is conducted in only one elementary school and involves a relatively small sample of 31 third-grade students. Therefore, the findings may have limited generalizability to students from other schools, grade levels, or educational contexts. Second, the study focuses specifically on the use of Smart Board learning media for teaching downward multiplication to third-grade students. The relatively limited intervention period also means that the study does not provide sufficient evidence regarding the long-term sustainability of the observed learning improvements or whether similar effects would occur when Smart Board media are applied to other mathematics topics. The last one but not the least, the study primarily measures learning outcomes using pre-test and post-test scores. Consequently, other potentially important learning outcomes, such as students' conceptual understanding, motivation, engagement, problem-solving skills, and attitudes toward mathematics, are not examined comprehensively. Future studies could therefore incorporate longer intervention periods, follow-up assessments, and multiple measures of learning outcomes to provide a more comprehensive understanding of the effectiveness of Smart Board learning media.

CONCLUSION

Based on the research findings and discussion, it can be concluded that the use of smart board learning media has a significant effect on student learning outcomes in the topic of downward multiplication in third grade at SDN 14 Pulau Punjung. This is evidenced by the difference in post-test average scores between the experimental class and the control class. The experimental class, which used the smart board as a learning medium, achieved an average score of 82.19, while the control class, which used conventional teaching methods, achieved an average score of 65.00. Furthermore, the results of the hypothesis test yielded a Sig. (2-tailed) value of $0.001 < 0.05$, so H_0 was rejected and H_1 was accepted. Thus, the smart board can serve as an effective alternative learning medium to help students understand the concept of vertical multiplication and improve the mathematics learning outcomes of third-grade elementary school students.

This study contributes to knowledge in elementary mathematics education by providing empirical evidence that Smart Board learning media can significantly improve students' learning outcomes in vertical multiplication. The study extends previous research on multiplication learning media by demonstrating the effectiveness of Smart Board media

in a specific instructional context, namely third-grade students learning vertical multiplication at SDN 14 Pulau Punjung. The higher post-test achievement of the experimental group compared with the control group indicates that concrete, visual, and interactive learning media can support students in understanding place value, digit placement, multiplication procedures, and the carry-over process.

The study also contributes theoretically by supporting the use of concrete and manipulative learning experiences for elementary school students. Smart Board media provide opportunities for students to observe and practice mathematical procedures directly, thereby making abstract multiplication concepts more concrete and understandable. This finding reinforces the relevance of learning media that correspond to the cognitive characteristics of elementary school students.

Practically, this study contributes an alternative instructional strategy for elementary school teachers, particularly in teaching vertical multiplication. Smart Board media can be used to address common student difficulties, especially errors in number placement and the carry-over process, while also encouraging more active student participation in mathematics learning. Thus, the findings provide a basis for teachers and schools to consider the integration of concrete and interactive learning media into elementary mathematics instruction.

Future research should examine the effectiveness of Smart Board learning media with larger and more diverse samples involving students from different schools, grade levels, and educational contexts. Such studies would provide broader evidence regarding the generalizability of the findings beyond the specific context of third-grade students at SDN 14 Pulau Punjung.

Future studies are also recommended to investigate the effectiveness of Smart Board media across different mathematics topics, particularly other arithmetic operations and mathematical concepts that require students to understand sequential procedures, place value, or abstract relationships. Comparative studies involving different types of concrete, visual, and interactive learning media could further identify which characteristics of instructional media contribute most to students' mathematics learning.

In addition, future researchers could employ longer intervention periods and follow-up assessments to examine whether improvements in learning outcomes are sustained over time. Researchers may also investigate other learning outcomes, such as conceptual

understanding, mathematical problem-solving skills, learning engagement, motivation, and students' attitudes toward mathematics. This direction is particularly relevant because the present study identifies increased student participation and engagement as important potential benefits of Smart Board use, while the research itself primarily measures learning outcomes through pre-test and post-test scores.

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