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The Effect of Ten-Block Based Media on The Mathematics Learning Outcomes of Grade 2 Students of MI PSM Al-Amin Sumber Agung

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Abstract

Low mathematics achievement among elementary school students remains a persistent educational challenge, primarily due to the predominance of abstract instructional methods and the limited integration of concrete learning media. This issue was also identified among second-grade students at MI PSM Al-Amin Sumber Agung, where approximately 50% of students failed to achieve the Minimum Mastery Criterion (MMC) in mathematics. This study aimed to examine the effect of implementing Base Ten Blocks supported by an LCD projector on students' mathematics learning outcomes. A quantitative approach with a quasi-experimental method employing a Nonequivalent Control Group Design was adopted. The study involved 38 second-grade students selected through a saturated sampling technique, comprising 24 students in Class II A as the experimental group and 14 students in Class II B as the control group. Data were collected using validated and reliable pretest and posttest achievement tests. Statistical analyses included tests of normality, homogeneity of variance, and an Independent Samples t-test using SPSS version 24. The findings confirmed that the data satisfied the assumptions of normality and homogeneity. Hypothesis testing yielded a significance value (Sig. 2-tailed) of 0.000 (< 0.05), indicating a statistically significant difference between the two groups and supporting the alternative hypothesis. Moreover, the experimental group obtained a higher mean posttest score (81.25) than the control group (67.86). These findings demonstrate that the integration of Base Ten Blocks with LCD projector-assisted instruction significantly enhances students' understanding of place value and arithmetic operations, encourages active classroom participation, and improves overall mathematics learning outcomes.

Keywords: Base Ten Blocks, Mathematics Learning Outcomes, Elementary School, Place Value, Learning Media.

1. Introduction

Education is a systematic process aimed at optimally developing students' potential, across the cognitive, affective, and psychomotor domains [1]. At the elementary school level, education plays a crucial role in building the foundation of thinking skills, character, and skills needed for the next level of education. One subject that plays a role in developing critical, logical, analytical, and systematic thinking skills is mathematics. Mathematics is not solely oriented toward numeracy but also fosters the ability to understand patterns, relationships, structures, and quantitative reasoning, which form the basis for mastering science and technology [2].

According to Millah et al. (2023), mathematics learning in elementary schools should emphasize conceptual understanding rather than merely mastering procedures [3]. Students need to gain concrete learning experiences through exploration and visual representation before understanding abstract mathematical symbols [4]. This approach aligns with the cognitive developmental characteristics of elementary school-aged children, who are still in the concrete operational stage. Therefore, the use of learning media that connect abstract concepts with real-life experiences is crucial in mathematics learning.

One of the mathematics topics taught in lower elementary school grades is the concept of place value and arithmetic operations [5]. Understanding the concept of place value is fundamental to mastering various mathematics topics at subsequent levels. Students' inability to grasp the concept of place value can lead to persistent misconceptions in arithmetic operations. Therefore, place value learning needs to be designed in a concrete, visual, and contextual manner so that students can build a strong conceptual understanding.

However, mathematics learning in elementary schools still faces various challenges. Based on initial observations conducted at MI PSM Al-Amin Sumber Agung, second-grade students' mathematics learning outcomes are still relatively low. Of the 38 students, only 19 (50%) achieved scores above the Minimum Completion Criteria (KKM)

of 75, while the remaining 19 (50%) fell below the KKM. This indicates that students' mathematics learning outcomes have not yet reached optimal levels.

These low learning outcomes are thought to be influenced by the teacher-centered learning process, the dominance of the lecture method, and the minimal use of concrete learning media [6]. Mathematics material is often presented symbolically and abstractly, making it difficult for students to conceptually understand the relationships between numbers, place value, and arithmetic operations. Consequently, student engagement in the learning process is low, resulting in less than satisfactory learning outcomes.

One alternative that can be used to address these issues is the use of Base Ten Blocks. This media is a manipulative teaching aid designed to concretely represent the concept of place value through units, tens, and hundreds. The use of Base Ten Blocks allows students to directly manipulate objects, enabling abstract numerical concepts to be understood through more concrete and meaningful learning experiences.

Various studies have demonstrated the effectiveness of using Base Ten Blocks in improving mathematics learning outcomes. Research conducted by Azizh et al. (2025) showed that the use of Base Ten Blocks significantly improved students' mathematics learning outcomes compared to conventional learning [5]. Similar findings were also reported by Erlita et al. (2020), who stated that students learning using Base Ten Blocks achieved higher learning outcomes than the control group [7]. Furthermore, research by Maghfiroh et al. (2022) showed that the use of this media not only improved understanding of mathematical concepts but also increased student motivation and engagement in learning [8].

However, a review of previous studies reveals a research gap. Most research on Base Ten Blocks focuses on the use of conventional manipulative media in small groups or on the use of physical props without the support of visual technology. Previous research generally only examined the effectiveness of Base Ten Blocks as a concrete aid, while its use integrated with learning technology to support classical concept visualization is relatively limited. However, in lower elementary school classes, visualizations that can be observed by all students simultaneously are essential for more effective mathematical concept formation.

Based on these conditions, this study offers a novel approach in the form of using Base Ten Blocks combined with an LCD projector in mathematics instruction for second-grade Islamic elementary school (MI). The integration of concrete manipulative media and visual technology allows teachers to present place value representations, number grouping processes, and arithmetic operations more clearly, interactively, and simultaneously for all students to observe. Therefore, this study not only tests the effectiveness of Base Ten Blocks but also examines the optimization of its use through the support of visual technology in mathematics instruction in Islamic elementary schools (Madrasah Ibtidaiyah). Furthermore, research on the use of Base Ten Blocks with LCD projectors for second-grade Islamic elementary school students is still very limited, thus this study makes an empirical contribution to enriching the study of elementary school mathematics learning.

Based on this description, this study was conducted to analyze the effect of Base Ten Blocks on mathematics learning outcomes for second-grade students at MI PSM Al-Amin Sumber Agung. This research is expected to provide empirical evidence regarding the effectiveness of Base Ten Blocks with LCD projectors in improving students' mathematics learning outcomes, particularly in the topic of place value and arithmetic operations.

2. Research Methods

This study used a quantitative approach with a quasi-experimental design [9]. The design used was a Nonequivalent Control Group Design, involving an experimental group and a control group. Both groups were given a pretest and posttest, but only the experimental group received instruction using Base Ten Blocks media with an LCD projector, while the control group received conventional instruction.

The study was conducted at MI PSM Al-Amin Sumber Agung in the even semester of the 2025/2026 academic year. The study population was all 38 second-grade students. The sampling technique used saturated sampling, so the entire population served as the study sample. The sample consisted of 24 second-grade students in the experimental group and 14 second-grade students in the control group.

The independent variable in this study was the use of Base Ten Blocks media with an LCD projector, while the dependent variable was students' mathematics learning outcomes [10]. Data were collected using multiple-choice learning achievement tests administered during the pretest and posttest. The research instrument was developed based on indicators of place value and arithmetic operations. It was then tested for validity, reliability, discriminating power, and difficulty level before being used in the study.

Data analysis was conducted through prerequisite tests, including a normality test using the Shapiro–Wilk test and a homogeneity test using the Levene Test. Furthermore, the hypothesis was tested using an Independent Samples t-Test with SPSS at a significance level of 5% ($\alpha = 0.05$). The research hypothesis was accepted if the significance value (Sig. 2-tailed) < 0.05 , indicating the effect of using Base Ten Blocks on students' mathematics learning outcomes.

3. Results and Discussions

Result

3.1. Instrument Test

3.1.1. Validity Test

Validity testing was conducted to ensure the instrument accurately measured the research variables. Content validity was assessed through expert judgment by Novia Rahma Rista Utami, M.Pd. The validation results indicated that 13 items were valid and 7 needed revision.

Next, construct validity testing was conducted through a pilot test of the instrument on third-grade students of MI PSM Al-Amin Sumber Agung. Analysis using SPSS Statistics 24 showed that of the 20 items tested, 12 were valid and 8 were invalid. A description of the validity test results can be seen in the tabulation below:

Table 1. Validity Test

Item No.	Calculated r (r-value)	Critical r (r-table)	Status	Decision
1	0.245	0.344	Invalid	Not Used
2	0.163	0.344	Invalid	Not Used
3	0.361*	0.344	Valid	Not Used
4	0.499**	0.344	Valid	Used
5	0.113	0.344	Invalid	Not Used
6	0.499**	0.344	Valid	Used
7	0.207	0.344	Invalid	Not Used
8	0.093	0.344	Invalid	Not Used
9	0.436*	0.344	Valid	Used
10	0.235	0.344	Invalid	Not Used
11	0.521**	0.344	Valid	Used
12	0.535**	0.344	Valid	Used
13	0.104	0.344	Invalid	Not Used
14	0.498**	0.344	Valid	Not Used
15	0.547**	0.344	Valid	Used
16	0.353*	0.344	Valid	Used
17	0.356*	0.344	Valid	Used
18	0.436*	0.344	Valid	Used
19	0.024	0.344	Invalid	Not Used
20	0.526**	0.344	Valid	Used

Calculation of 20 question numbers shows that 12 items have valid status and 8 other numbers are disqualified due to the $r_{\text{count}} < r_{\text{table}}$. The scope of question numbers that pass the criteria includes numbers 3, 4, 6, 9, 11, 12, 14, 15, 16, 17, 18, and 20. Conversely, rejection occurred in question numbers 1, 2, 5, 7, 8, 10, 13, and 19.

3.1.2. Reliability Test

The consistency of the measuring instrument was ensured by computing reliability values using SPSS 24 for Windows. The reliability figures are visualized in the following illustration:

Reliability Statistics	
Cronbach's Alpha	N of Items
.578	20

Figure 1. Reliability Test

The reliability of the test in this study reached a coefficient of 0.578, which is classified as sufficient. Testing guidelines stipulate that if the α index is > 0.41 , a valid instrument is considered stable. Finding an α value of 0.578 > 0.41 confirms that this test instrument is reliable for use in subsequent information gathering stages.

3.2. Prerequisites Test

3.2.1. Normality Test

Data distribution analysis was performed to detect the normality of the score distribution, processed using SPSS 24 for Windows. The computational visualization is shown below:

Tests of Normality							
	KODE	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
NILAI	1.1	.178	24	.047	.923	24	.067
	1.2	.176	24	.052	.919	24	.055
	2.1	.188	14	.196	.937	14	.381
	2.2	.238	14	.031	.889	14	.079
a. Lilliefors Significance Correction							

Figure 2. Normality Test

The Shapiro-Wilk algorithm calculation shows the significance number of the experimental pretest data (code 1.1) is $0.067 > 0.05$, while the significance quantity of the experimental group posttest data (code 1.2) is at $0.055 > 0.05$. On the other side, the significance gain of the control pretest (code 2.1) touched $0.381 > 0.05$, along with the significance value of the control posttest of $0.079 > 0.05$. Since all significance gains exceeded the threshold > 0.05 , all official data groups were declared normally distributed.

3.2.2. Homogeneity Test

The homogeneity aspect was tested to ensure equality of variance across the populations from which the data samples were collected. The operationalization of the test was assisted by the SPSS 24 for Windows program, with a visual summary as follows:

3.2.2.1. Pretest Homogeneity Test

Test of Homogeneity of Variances			
Nilai			
Levene Statistic	df1	df2	Sig.
.125	1	36	.725

Figure 3. Pretest Homogeneity Test

The results of the homogeneity test on the pretest distribution showed a significance value of $0.725 > 0.05$. Therefore, it can be said to be homogeneous with a significance value > 0.05 .

3.2.2.2. Posttest Homogeneity Test

Test of Homogeneity of Variances			
Nilai			
Levene Statistic	df1	df2	Sig.
.381	1	36	.541

Figure 4. Posttest Homogeneity Test

The homogeneity test results for the posttest distribution showed a significance value of $0.541 > 0.05$. Therefore, it can be said to be homogeneous with a significance value > 0.05 .

3.2.2.3. Hypothesis Testing

The primary objective of this research is to demonstrate the impact of Base Ten Blocks on the mathematics learning outcomes of second-grade students at MI PSM Al-Amin Sumber Agung. The comparative formula was performed using the Independent Sample t-Test menu using the SPSS 24 for Windows computer system. The calculation output is documented below:

Independent Samples Test									
		Levene's Test for Equality of Variances					t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
N/AI	Equal variances assumed	125	.725	.305	36	.762	1.131	3.713	-6.409 8.661
	Equal variances not assumed			.308	28.384	.760	1.131	3.667	-6.376 8.638

Figure 5. Independent Sample t-Test Pretest

An Independent Sample t-Test comparison was intentionally applied to the pretest scores to detect any gaps in students' initial competencies between the two test groups before the classroom treatment began. The objectivity of the final research findings depends heavily on ensuring equivalence in these students' basic understanding.

The basis for drawing conclusions is the 2-tailed significance level (Sig.) from the independent sample t-test output for the pretest data. The absence of significant disparities in students' initial competencies between the experimental and control classes is indicated by a significance level above 0.05. The independent sample t-test recorded a significance coefficient (Sig.) of $0.762 > 0.05$. This value proves there was no difference in pretest achievement between the experimental and control groups. Therefore, students' initial competencies in both groups were at an equivalent level.

Independent Samples Test									
		Levene's Test for Equality of Variances					t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
N/AI	Equal variances assumed	.381	.541	4.040	36	.000	13.393	3.315	6.670 20.116
	Equal variances not assumed			4.203	30.705	.000	13.393	3.186	6.892 19.894

Figure 6. Independent Sample t-Test Posttest

To determine whether there was a difference in learning outcomes between the experimental and control classes after the instructional intervention, an independent sample t-test was conducted on the posttest data. This evaluation aimed to gauge the impact of the learning treatment on student outcomes.

The researchers used the 2-tailed significance value (Sig.) from the independent sample t-test of posttest scores as the benchmark for decision-making. The rejection of H_0 and acceptance of H_a occurred when the significance value (Sig.) was below 0.05. This criterion confirmed that the stimulation in the experimental class successfully triggered a jump in student learning outcomes beyond those in the control class. Evidence of a significant difference in posttest data between groups was presented through a significance value (Sig.) of $0.000 < 0.05$. Consequently, the conclusion was that H_0 was officially rejected and H_a was absolutely accepted.

Discussions

This study was designed to determine the effect of using Base Ten Blocks on the mathematics achievement of second-grade students at MI PSM Al-Amin Sumber Agung. Data processing using an independent sample t-test yielded a significance level (Sig. 2-tailed) of $0.000 < 0.05$. This finding validates the significant effect of Base Ten Blocks on the mathematics achievement of second-grade students at MI PSM Al-Amin Sumber Agung. Consequently, the alternative hypothesis (H_a) is accepted, and the null hypothesis (H_0) is rejected.

The average posttest score for the experimental group exceeded that of the control group. The experimental group achieved a mean score of 81.25, while the control group's score remained at 67.86. This difference in scores indicates that the combination of Base Ten Blocks and an LCD projector positively contributed to students' mastery of place value and arithmetic operations.

The accelerated learning outcomes in the experimental class were driven by Base Ten Blocks' role in concretizing mathematical understanding. In the old model, verbal and symbolic lectures from teachers dominated the classroom, resulting in some children struggling to connect numbers with their place value. When using Base Ten Blocks, students began to become more engaged with the learning medium. Students became more active in learning, directly observing visualizations of units, tens, and hundreds in real-life situations using Base Ten Blocks. Students were more active in asking questions to the teacher and discussing with their peers. They began to be more confident in answering questions and expressing their opinions in class.

Learning, which was initially abstract and predominantly lecture-based, shifted to a more concrete approach. Students were able to directly observe and manipulate numbers in place value lessons using Base Ten Blocks. Students no longer learned by listening to the teacher but also by directly observing representations of numbers through the media used. This situation aligns with the cognitive development theory proposed by Wardani (2022), who states that the concrete operational phase characterizes elementary school-aged children [11]. During this period, material absorption occurs optimally when the learning process involves visualization, real objects, and manipulative activities.

Class dynamics demonstrated a surge in student engagement compared to conventional models [12]. Students began to boldly respond to questions, practice independent calculations, and engage in dialogue with their classmates about block quantities. This intense engagement gradually sharpened their conceptual mastery. Direct participation in learning made information feel essential and retained in memory.

Given the hierarchical nature of mathematics, conceptual mastery is a crucial foundation at the elementary school level. Failure to grasp the foundations of place value will certainly hinder mastery of arithmetic operations at subsequent levels. Therefore, utilizing real-world instruments like Base Ten Blocks is an effective way to guide students in gradually constructing their thinking from the concrete to the abstract.

These findings further reinforce Gusmarlia's (2025) idea, which emphasizes that the primary orientation of elementary school mathematics should be based on conceptual mastery through real-world and visual experiences [13]. Manipulative media facilitates children's in-depth understanding of number structure, compared to learning that focuses solely on memorizing procedures. Through this experiment, students successfully mastered the essence of number values based on positional numerals, going beyond simply memorizing counting techniques. This finding reinforces the idea of Van de Walle et al. (2023), who emphasized that the primary orientation of elementary school mathematics should be based on mastering concepts through real-world and visual experiences [13].

During the learning process, students also became more enthusiastic. When media was displayed via an LCD projector, students' attention became more focused on the lesson, creating an interactive and conducive classroom atmosphere. This aligns with the findings of Sinaga et al. (2026), who concluded that the Block Dienes media increased learning motivation and boosted academic achievement [14].

In general, the integration of Base Ten Blocks media with an LCD projector yielded a number of positive impacts on elementary mathematics education [15]. First, the teacher's presentation of material was more coherent and realistic. Second, the understanding of place value accelerated, along with increased student participation. Third, students' attention and enthusiasm for learning were boosted throughout the lesson thanks to the visual stimulus.

The underlying principle of this research confirms that the decline in elementary school students' mathematics achievement is often not driven by low intelligence, but rather by teachers' incorrect strategies and media choices. When educators carefully integrate media that align with students' developmental characteristics, classroom effectiveness is guaranteed, and student achievement will soar.

Therefore, Base Ten Blocks, integrated with an LCD projector, is a suitable choice for mathematics education for lower-level elementary school students, particularly for topics such as arithmetic operations and place value. Through this visual aid, students' understanding of mathematical concepts can be developed in a more concrete, engaging, and contextual way, which in turn boosts their academic achievement.

4. Conclusion

Through a series of research and studies that have been completed, it was concluded that the mathematics learning achievement of second-grade students of MI PSM Al-Amin Sumber Agung was significantly influenced by the application of Base Ten Blocks media via LCD projector. This proof refers to the output of the independent sample t-test with a significance figure (Sig. 2-tailed) of $0.000 < 0.05$, which resulted in the rejection of H_0 and acceptance of H_a . In addition, the average posttest score of the experimental group outperformed the control group, with a

comparison of 81.25 compared to 67.86, respectively. Students' understanding of the material on arithmetic operations and place value became more visual and real thanks to the contribution of Base Ten Blocks media via LCD projector. Active involvement, focus, and enthusiasm for learning of students during mathematics sessions were also triggered by the presence of this aid, thus triggering an increase in their academic performance.

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