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The Effect of Maze Game Media and Learning Style on First-Grade Students' Understanding of Number Concepts

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ABSTRACT

Students' understanding of number concepts in early elementary grades varies, indicating the need for instructional media and approaches aligned with learners' characteristics. This study aims to analyze differences in first-grade students' understanding of natural number concepts based on learning styles (visual, auditory, and kinesthetic) using the Maze Game and number card learning media. A quantitative approach with a factorial experimental design was employed. The subjects were first-grade students from SDN WADAS 1 (experimental class) and SDN WADAS IV (control class). Data were collected using a natural-number concept comprehension test and a learning-style questionnaire. Data analysis was conducted using a two-way ANOVA to examine the effects of learning media, learning styles, and their interaction on students' conceptual understanding. The results indicate significant differences in students' understanding of natural number concepts, depending on learning style, across both learning media. Students with visual and kinesthetic learning styles achieved higher comprehension scores than those with auditory learning styles. Additionally, a significant interaction effect between learning media and learning styles was identified, suggesting that the effectiveness of instructional media depends on students' learning style characteristics. Learning styles and instructional media significantly influence students' understanding of natural number concepts. Instruction that integrates visual elements and physical activities is more effective in improving mathematics learning outcomes among early-grade elementary students. Therefore, teachers are encouraged to design adaptive learning strategies that accommodate diverse learning styles.

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1. INTRODUCTION

Basic education is the main foundation in shaping students' thinking abilities, attitudes, and skills [1], [2]. At the elementary school level, especially in grade I, mathematics learning is the initial stage in developing an understanding of basic concepts

that will determine success in the next level [3]. One of the fundamental concepts in mathematics is the concept of natural numbers. Understanding the concept of natural numbers is not only about counting but also about recognizing the meanings of numbers, sequences, and comparisons, and their application in daily life [4], [5]. However, in the practice of learning in grade I of elementary school, various problems persist. Students tend to memorize numbers without understanding the meaning behind the number symbols. Conventional, teacher-centered learning and minimal use of engaging media often make students less active and cause them to quickly feel bored [6], [7]. This condition has an impact on the limited understanding of concepts and suboptimal student learning outcomes.

One effort to improve understanding of concepts is the use of innovative learning media that align with the characteristics of early childhood students. Grade I elementary school children are at a concrete operational stage, so they need media that are visual, manipulative, and involve physical activity. Maze Game learning media is one alternative that can be used because it combines elements of gaming and learning [8]. Through the Maze Game, students not only learn to recognize numbers but also actively engage in thinking, problem-solving, and decision-making along the game path provided [9], [10].

Through the Maze Game, students not only learn to recognize numbers but also actively engage in thinking, problem-solving, and decision-making along the game path provided [11], [12]. If the learning media align with the student's learning style, the learning process will be more effective and meaningful. Therefore, it is important to examine in more detail how Maze Game learning media and learning styles affect elementary school grade I students' understanding of the concept of natural numbers. This research is expected to provide an empirical picture of the effectiveness of Maze Game media and its interaction with students' learning styles in improving understanding of basic mathematical concepts.

Theoretically, mathematics learning for elementary school-age children should focus on the principles of active, concrete, and fun learning. Cognitive development theory states that 6–7-year-olds are more likely to understand concepts through hands-on experience and play activities [13]. Maze Game, as a game-based learning medium, has characteristics that align with these principles because it integrates visual elements, motor activities, and thinking challenges [10], [14]. On the other hand, learning style theory emphasizes that learning success is determined not only by the material and methods, but also by the suitability of the approach to a student's individual characteristics. By considering visual, auditory, and kinesthetic learning styles, teachers can design more adaptive and inclusive learning.

The rationale for this study is that the use of Maze Game media adapted to students' learning styles will positively influence understanding of natural number concepts. Through this study, it is hoped that scientific evidence will be obtained regarding the effectiveness of the media and that differences in understanding concepts are associated with learning styles. This research has a high urgency for several reasons, namely the importance of understanding the concept from an early age. Understanding the concept of natural numbers is the basis for learning mathematics at the next level. If this basic concept is not well understood, then students will experience difficulties in more complex material. To support learning media innovation, teachers are required to present creative and interesting learning

so that students are more active and motivated [15], [16]. Maze Game can be an innovative and applicable alternative solution in grade I elementary school. The diversity of student characteristics, with each student having a different learning style, requires research examining the interaction between learning media and learning styles to produce more effective learning. Practical and theoretical contributions: The results of this research can serve as a reference for teachers in selecting appropriate learning media. Theoretically, this study can enrich research on the influence of learning media and learning styles on understanding mathematical concepts at the elementary school level. Thus, research on the influence of Maze Game learning media and learning styles on grade I elementary school students' understanding of the concept of natural numbers is important to carry out to improve the quality of mathematics learning from an early age.

2. METHOD

This study employed a quantitative, quasi-experimental design to examine differences in treatment effects between groups without full randomization of subjects [17]. The research design was a 2 × 3 factorial design involving two independent variables and one dependent variable. The first independent variable was the learning medium (Maze Game and number cards), and the second independent variable was learning style (visual, auditory, and kinesthetic), while the dependent variable was students' understanding of natural number concepts.

The research subjects consisted of first-grade students from SDN WADAS I (experimental class, n = 35) and SDN WADAS IV (control class, n = 32). The sample was determined using purposive sampling, as this technique allows the selection of groups with relatively similar academic characteristics and comparable class sizes, ensuring the feasibility and validity of comparisons in a quasi-experimental setting

Data were collected using a natural-number concept comprehension test and a learning-style questionnaire. Instrument validity was assessed through content validity by experts, while reliability testing was conducted using Cronbach's alpha to ensure internal consistency. The research procedure included pretest and posttest stages to measure students' initial and final understanding, with the treatment implemented over a specified instructional period.

Data analysis was conducted using both descriptive and inferential statistics. Descriptive statistics were used to calculate the mean, standard deviation, and distribution of the data. Prior to hypothesis testing, prerequisite tests, including normality, homogeneity, and balance tests, were performed. Hypothesis testing was conducted using a two-way ANOVA to examine the effects of learning media, learning styles, and their interaction on students' understanding of natural number concepts. When significant differences were found, post hoc tests were conducted to identify specific group differences.

Ethical considerations were addressed by obtaining permission from the school, ensuring voluntary participation, maintaining the confidentiality of student data, and using the data solely for research purposes.

3. RESULTS AND DISCUSSION

3.1. Results

Before entering the more in-depth analysis stage, it is important to understand the data collected. This initial understanding aims to provide a clear context for the data's characteristics, thereby supporting more accurate interpretation and conclusion-making. Therefore, the author begins by presenting descriptive analysis as the first step in processing research data. The initial stage was a descriptive analysis of the collected data, presented in Table 1 below by the authors.

Table 1. Descriptive Statistics

Learning Style	Class	Mean	Std. Deviation	N
Visual	Experiment_MG	82.41	5.374	17
	Control_KB	78.33	3.916	12
	Total	80.72	5.168	29
Auditori	Experiment_MG	78.33	2.160	6
	Conrtol_KB	68.80	3.114	5
	Total	74.00	5.568	11
Kinestetik	Experiment_MG	82.83	3.353	12
	Control_KB	72.87	4.627	15
	Total	77.30	6.462	27
Total	Experiment_MG	81.86	4.538	35
	Control_KB	74.28	5.341	32
	Total	78.24	6.209	67

Based on the total average score for each learning style, students with visual learning styles had the highest conceptual understanding (Mean = 80.72), followed by kinesthetic (Mean = 77.30) and auditory (Mean = 74.00). The relatively small standard deviation in the experimental class indicated that students' learning outcomes were more even than in the control class. Overall, this data corroborates that Maze Game's learning media is effective in improving understanding of natural number concepts among 1st-grade elementary school students, both across different learning styles and across different types of learning media. The normality test is a step in research to determine whether the posttest data from each group or class are normally distributed.

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Table 2. Normality Test Results

	Shapiro-Wilk		
Class	***Statistic***	***Df***	***Sig.***
Experiment	.945	35	.079
Control	.956	32	.218

a. Lilliefors Significance Correction

Tabel 2 menunjukkan hasil uji normalitas data *posttest* dari kelas eksperimen dan kontrol. Berdasarkan tabel tersebut, hasil uji normalitas data kelas eksperimen memiliki *P-value* (*Sig.*) senilai 0,079 untuk uji normalitas *Lilliefors*. Nilai tersebut mengindikasikan bahwa hasil uji normalitas *Lilliefors* kelas eksperimen memiliki nilai lebih dari 0,05 atau *P-value* (*Sig.*) > 0,05, sehingga H_0 yang menyatakan bahwa data berasal dari sampel yang berdistribusi normal diterima. Berikutnya dilakukan uji homogenitas dengan hasil sebagai berikut:

Table 3. Homogeneity Test

		Levene Statistic	df1	df2	Sig.
PemKonsep	Based on Mean	2.535	1	65	.116
	Based on Median	2.457	1	65	.122
	Based on median and with adjusted df	2.457	1	64.185	.122
	Based on trimmed mean	2.576	1	65	.113

This test aims to determine whether the variances of the two data groups are homogeneous or heterogeneous. Based on the mean, the significance value is 0.116. Based on the median, the significance value was 0.122. Median with df adjustment, significance value of 0.122. Furthermore, based on the trimmed mean, the significance value is 0.113. All of these significance values are greater than 0.05 (Sig. > 0.05). Based on the Levene test criteria, if the Sig. value > 0.05 indicates that the data variance between groups is homogeneous. After the data were declared homogeneous, a data balance test was performed to compare two independent groups, namely those using different learning media.

Table 4. Balance Test Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig.(2-tailed)
PemKonsep	Equal variances assumed	2.535	.116	6.273	65	.000
	Equal variances not assumed			6.227	61.141	.000

In Levene's Test for Equality of Variances, a significance value of 0.116 (Sig. > 0.05) was obtained. This shows that the variances of the two groups are homogeneous, so the t-test analysis uses the Equal variances assumed line. Based on the line Equal variances not assumed, a bidirectional significance value of Sig. (2-tailed) 0.00 was obtained. The significance value is less than 0.05 (0.000 < 0.05). The results of this test show a significant difference in the average understanding of natural number concepts between the experimental and control classes at this stage of measurement. This means that the understanding of the concept of natural numbers in the experimental class with the media of the Maze Game is better than the understanding of the concept of natural numbers in the control class with the media of number cards.

The results of the analysis of learning media and learning styles in understanding natural number concepts show that learning media can improve students' understanding of these concepts. Table 5. Experimental and Control Class Values.

Table 5. Experimental and Control Class Values

Class	Ideal Value	Highest Value	Lowest Value	Average	Std. Deviation
Experiment	100	83,42	80,30	81,86	4,54
Control	100	76,21	72,36	74,28	5,34

The collected data passed the prerequisite test, which means that data processing can continue to the next stage, namely two-way analysis, used to determine the main influences of learning media, learning style, and the interaction between learning media and learning style on variables related to understanding the concept of natural numbers. Based on the research conducted, the Maze Game learning media is proven to produce a better understanding of natural number concepts than the number card media among grade I elementary school students. This is shown by the higher average scores of students' conceptual comprehension in classes that use Maze Games compared to classes that use number cards. This finding aligns with Piaget's (2002) theory of cognitive development, which posits that elementary school-age students are at the concrete operational stage, so they need media that are visual, manipulative, and provide direct experience. In addition, the concept of game-based learning, as put forward by Afrianti & Maryatun (2025), emphasizes that educational games can increase engagement and understanding of concepts through active, meaningful learning experiences.

Table 6. Tests of Between-Subjects Effects

Dependent Variable: PemKonsep					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	1427.861[a]	5	285.572	15.605	.000
Intercept	326195.032	1	326195.032	17824.583	.000
GayaBelajar	370.247	2	185.123	10.116	.000
Kelas	843.841	1	843.841	46.111	.000
GayaBelajar * Kelas	133.929	2	66.965	3.659	.032
Error	1116.318	61	18.300		
Total	412672.000	67			
Corrected Total	2544.179	66			

a. R Squared = ,561 (Adjusted R Squared = ,525)

Based on the Tests of Between-Subjects Effects table, the value of F = 15.605 with a significance of 0.000 ($p < 0.05$) was obtained in the Corrected Model row. This shows that the two-way ANOVA model is significant, indicating that the independent variables together affect the variables bound by the concept of natural numbers (PemKonsep). The R-squared value of 0.561 (Adjusted R Squared = 0.525) indicates that 56.1% of the variation in students' concept understanding can be explained by a combination of learning styles, classes (learning media), and the interaction of the two, while other factors outside the research model influence the remaining 43.9%.

The Class variable shows the value of F calculated 46.111 > F table 4.00 with a significance of 0.000 ($p < 0.05$). This finding confirms that the learning media applied in each class has a significant influence on the understanding of the concept of natural numbers, meaning that there is a difference in understanding of concepts between students who learn using different learning media, such as Maze Game media and Number Card media, meaning that there is an influence of the learning media on the understanding of natural number concepts. In the Learning Style variable, the value of F was obtained > 10.116 F table 3.15 with a significance of 0.000 ($p < 0.05$). These results show that there is a significant influence of learning style on the understanding of the concept of natural numbers. Students with

different learning styles, such as visual, auditory, and kinesthetic, have significantly different levels of understanding of natural number concepts. Based on these data, there is an influence of learning style on the understanding of the concept of natural numbers.

The results of the interaction test between Learning Style and Class (learning media) showed an F value of 3.659 > F table 3.15 with a significance of 0.032 ($p < 0.05$). This indicates that there is a significant interaction between learning styles and learning media on the understanding of the concept of natural numbers. The effectiveness of learning media does not stand alone; it depends on the student's learning style and the learning media used, so there is an interaction between the learning media and the learning style.

The results of the interaction test between Learning Style and Class (learning media) showed an F value of 3.659 > F table 3.15 with a significance of 0.032 ($p < 0.05$). This indicates that there is a significant interaction between learning styles and learning media on the understanding of the concept of natural numbers. The effectiveness of learning media does not stand alone; it depends on the student's learning style and the learning media used, so there is an interaction between the learning media and the learning style. Because in the previous calculation, there was a difference in the average understanding of the concept of natural numbers between students in the experimental and control classes.

Table 7. Multiple Comparisons

Dependent Variable: PemKonsep

Scheffe

(I) Learning Style	(J) Learning Style	Mean Difference (I-J)	Std. Error	Sig.
Visual	Auditori	6.72*	1.515	.000
	Kinestetik	3.43*	1.144	.015
Auditori	Visual	-6.72*	1.515	.000
	Kinestetik	-3.30	1.530	.107
Kinestetik	Visual	-3.43*	1.144	.015
	Auditori	3.30	1.530	.107

Based on observed means.

The error term is Mean Square(Error) = 18.300.

*. The mean difference is significant at the .05 level.

Based on the results of Scheffe's follow-up test on learning style variables versus natural number concept understanding variables, the average difference in concept understanding between learning style groups was obtained, namely, visual, auditory, and kinesthetic. The comparison between visual and auditory learning styles showed a mean difference value of 6.72 with a significance value of 0.000 (< 0.05). This shows a significant difference in average performance between the two learning styles. Students' conceptual understanding with visual learning styles has a higher average score than that of students with auditory learning styles. There is an average difference in the understanding of natural number concepts between students with visual and auditory learning styles. It is evident that visual learning styles lead to a better understanding of natural number concepts than auditory learning styles.

The comparison between visual and kinesthetic learning styles yielded a mean difference of 3.43, with a significance value of 0.015 (< 0.05). These results show a

significant difference in average understanding of concepts between the two learning styles: the visual learning style has a higher average understanding than the kinesthetic learning style. There is also an average difference in the understanding of natural number concepts between students with visual and kinesthetic learning styles. Visual learning styles result in a better understanding of natural number concepts than kinesthetic learning styles. The comparison between kinesthetic and auditory learning styles showed a mean difference value of 3.30, but the significance value obtained was 0.107 (> 0.05). This shows that there is no difference in understanding the concept of natural numbers between students with kinesthetic and auditory learning styles, and that this difference is not statistically significant; thus, there is no difference in the average understanding of the concept of natural numbers between students with auditory and kinesthetic learning styles.

3.2. Discussion

Based on the research results, the understanding of the concept of natural numbers among grade I elementary school students differs depending on the learning style used in each medium, both the Maze Game and the number card media. The analysis showed that, across both learning media, students with visual and kinesthetic learning styles had a better understanding of the concept of natural numbers than those with auditory learning styles. In the Maze Game learning media, the visual learning style shows the best results in understanding concepts. This is because Maze Game emphasizes strong visual elements, such as game paths, number symbols, colors, and shapes, which make it easier for visual students to understand the sequence and meaning of natural numbers. In addition, students with kinesthetic learning styles also gain a better understanding of concepts because Maze Games involve hands-on activities and student interaction in the learning process. [18], [19][20] emphasized the importance of designing learning that combines visual elements and physical activity, even when using different media. This means that it is not only the media that is important, but also how it aligns with the characteristics of the student's learning style. Through physical engagement and exploration of the game, kinesthetic students can understand the concept of numbers in a concrete and meaningful way. Meanwhile, in the number card learning media, visual and kinesthetic learning styles also show better understanding of concepts than auditory learning styles. Visual students will find it easier to understand the concept of numbers through the display of number symbols and illustrations on number cards.

The results of this study show that the use of the Maze Game learning media significantly influences students' understanding of the concept of natural numbers in grade I. This is evident in students' increased ability to recognize, sort, and understand the meaning of numbers more concretely. Media Maze Game provides a fun and meaningful learning experience, so students not only memorize numbers but also understand the concepts through exploratory activities. Pedagogically, these findings align with constructivist learning theory, which holds that students build knowledge through direct experience [21]. Maze Game provides students with the opportunity to learn while playing, fostering active involvement in the learning process. This involvement is especially important for elementary school students, especially in grade I, who are still in the concrete operational stage. Thus,

the use of game-based media can help bridge abstract concepts into more easily understood ones. In addition, the study's results show that learning style influences understanding of the concept of natural numbers. Students with visual learning styles tend to understand concepts more easily through images and paths in the Maze Game, while students with kinesthetic learning styles show strong understanding due to the game's hands-on activities. Meanwhile, students with auditory learning styles can still participate in learning, but require additional support in the form of verbal explanations from teachers.

Furthermore, there is an interaction between the Maze Game learning media and students' learning styles in understanding the concept of natural numbers. This means that the effectiveness of learning media does not stand alone; students' individual characteristics influence it. Maze Game is proven to be more optimal when it accommodates various learning styles, for example, by combining visual, movement, and verbal instruction elements in a single learning activity. This shows that selecting the right learning media should consider the diversity of student learning styles in the classroom.

These findings are supported by several previous studies that stated that game-based learning media can improve student motivation and learning outcomes [22]. The use of educational games not only increases student engagement but also helps develop logical thinking and problem-solving skills [23], [24], [25]. Thus, the Maze Game can be an innovative learning media alternative that is effective in improving understanding of basic math concepts. However, this study has some limitations. First, the research was conducted at only one grade level and within the scope of a specific school, so the generalizability of the results was still limited. Second, other factors that can affect understanding of concepts, such as students' initial abilities, the learning environment, and teacher roles, have not been analyzed in depth in this study. Therefore, further research is recommended to examine these variables on a broader scale. Overall, the results of this study confirm that the use of Maze Game learning media, combined with an understanding of students' learning styles, can more effectively improve understanding of natural number concepts. The implication of this study is the importance of teachers developing and using innovative learning media and adapting them to students' characteristics so that the learning process becomes more optimal.

4. CONCLUSION

The findings indicate that the use of Maze Game learning media significantly improves first-grade students' understanding of natural number concepts, particularly when aligned with students' learning styles. Visual and kinesthetic learners demonstrated higher levels of conceptual understanding than auditory learners, and a clear interaction effect shows that the Maze Game's effectiveness is influenced by learning style characteristics. These results highlight the importance of integrating interactive, student-centered media while accounting for individual learning differences. In practice, teachers are encouraged to adopt innovative instructional tools, such as the Maze Game, and to design adaptive learning strategies that accommodate diverse learning styles to enhance mathematics learning outcomes in early grades. Future research should further explore this approach using broader samples and mixed methods to strengthen generalizability and deepen understanding of its effectiveness across different educational contexts.

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