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The Effect of Using Eniksi Puzzle Media on the Arithmetic Ability of 5-6 Year Old Children

Farah Syifa' Salsabila^{1*}, Dian Kristiana², Nurtina Irsad Rusdiani³

^{1,2,3}Muhammadiyah University of Ponorogo, Indonesia

¹farahhhsyifa@gmail.com; ²dian_kristiana@umpo.ac.id; ³nurtinairsadrusdiani@umpo.ac.id

*Corresponding Author

Keywords

Children Aged 5-6, Math Skills, Eniksi Puzzle

Abstract

The purpose of this study was to determine the effect of the use of Puzzle Eniksi media on the numeracy skills of children aged 5 to 6 years. Puzzle Eniksi is a learning media specifically designed to help children aged 5 to 6 years to strengthen their numeracy skills by adopting three stages of representation according to Jerome Bruner: enactive, iconic, and symbolic. This study used a posttest-only control group design with a quantitative methodology. All children aged 5-6 years from Al-Kautsar Durisawo Kindergarten, Ponorogo Regency were included in the study population, and samples were taken from two different classes. The instrument used was a numeracy test developed based on indicators. The independent sample t-test was used after the prerequisite tests with homogeneity and normality tests were completed. The findings of the analysis showed that Puzzle Eniksi media significantly improved the numeracy skills of children aged 5 to 6 years. Based on the data, the average score of the experimental group's numeracy ability was 88.77, while the control group's score was 73.00, a difference of 15.77 points. The Sig. value. also shown in the findings of the independent sample t-Test. The null hypothesis (H_0) is rejected because the value (2-tailed) is 0.000.

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Introduction

In the era of globalization, early childhood numeracy literacy has become a crucial focus on the global learning landscape. The Programme for International Student Assessment (PISA) report, conducted by the Organization for Economic Co-operation and Development (OECD), indicates that most children in developing countries, including Indonesia, still face significant obstacles in mastering basic mathematical concepts at early school age (OECD, 2022). This situation is not merely a matter of academic achievement, but rather a fundamental challenge to the quality of future human resources. Therefore, developing numeracy skills from an early age is an essential foundation for cognitive growth and logical thinking in early childhood (Winarni, 2025). This effort aligns with the main priority of Sustainable Development Goal (SDG) 4 (Declaration & Rights, 2018), as UNESCO warns that basic numeracy cognitive deficiencies can be estimated to cause productivity losses of up to trillions of dollars annually. Therefore, efforts to improve the quality of education must be directed at high-quality learning that is aligned with the standards of early childhood development as stipulated in the Regulation of the Ministry of Education and Culture Number 10 of 2025 (Peraturan Menteri Pendidikan Dasar Dan Menengah Republik Indonesia, 2025), which covers aspects of early childhood development including cognitive aspects, and is reinforced by the Regulation of the Minister of Education and Culture Number 137 of 2014 concerning the Standards for Achieving Child Development (STTPA). Specifically, these regulations emphasize the development of symbolic thinking, where children aged 5-6 years are expected to be able to say the numbers 1-10, use number symbols to count, and match numbers with number symbols (Peraturan Menteri Pendidikan Dan Kebudayaan Republik Indonesia, 2014; O. I. Rahmawati et al., 2026).

One of the main components of numeracy skills is the ability to count, which serves as the foundation for further development of mathematical concepts. Numeracy in early childhood is the ability to recognize, understand, and utilize numbers and number concepts in the context of everyday life. This ability includes activities such as counting objects, understanding number symbols, equating quantities, arranging numbers, and mastering basic calculations, including concrete addition and subtraction. Numeracy is not just about saying numbers; it also involves understanding the meaning of those numbers and their relationship to objects around the child. With good numeracy skills, children can improve their logical, systematic, and critical thinking skills from an early age (Kristiana, 2018).

There are also aspects of early childhood numeracy skills, as described in a scientific study (Nur et al., 2022), including the ability to recognize number symbols as the main foundation for understanding numbers. This is followed by the ability to match numbers to the number of objects, thus not only understanding the symbols but also mastering their concrete meaning. Furthermore, children also begin to group objects based on color, shape, and size, which functions as part of the logical thinking process. In line with this development, children can perform simple calculations, including addition and subtraction, using concrete objects. Furthermore, children begin to identify and predict patterns after observing certain sequences, which serves as a foundation for understanding and recognizing patterns and relationships.

The advantages of numeracy skills developed from an early age include fostering logical and systematic thinking patterns in children, enhancing simple analytical skills, and increasing their confidence in solving numerical problems in everyday life. Furthermore, children who are accustomed to numeracy have strong symbolic thinking skills, making them better prepared for subsequent levels of mathematics learning (Kristiana & Nurhidayah, 2022). However, numeracy also presents several challenges. Early childhood children tend to have difficulty connecting number symbols with the number of objects (the concept of one-to-one correspondence), mastering number sequences, or operating with numbers abstractly. These challenges are generally caused by an overly cognitive educational approach that fails to incorporate concrete experiences appropriate to the child's developmental stage (Rozali et al., 2023). Therefore, numeracy activities should be packaged in the form of games or concrete activities so that early childhood can understand number concepts naturally and enjoyably.

This is explained by the cognitive development theory proposed by Jean Piaget, which shows that children aged 5-6 years are in the preoperational phase (Nugraha & Nuriadin, 2025). According to Piaget, learning at this stage requires an approach that is not merely passive, but must actively involve young children in building understanding through concrete interactions with their environment. The need for concrete experiences is in line with Jerome Bruner's learning theory, which emphasizes that the process of acquiring knowledge occurs gradually through three stages of representation: enactive, iconic, and symbolic (Bruner, 1997). In the context of developing numeracy skills, the integration of these two theories implies that meaningful understanding of mathematical concepts must begin through direct activities with real objects, before moving on to visual representations, and finally being able to move on to understanding numeracy symbols abstractly.

To facilitate learning aligned with the cognitive developmental stages of children aged 5–6 years, learning media plays a crucial role as a bridge connecting abstract understanding with concrete experiences (Achievement, 2026). Learning media not only functions as a visual aid but also as an active element that stimulates children's attention, interest, and thinking skills through direct exploration (Hasanah et al., 2021). One highly relevant medium for this purpose is puzzles, an educational game that integrates motor and cognitive aspects to foster logical thinking (Permai, 2025). This aligns with findings (Garut & Garut, 2024), which show that number puzzle games are effective in improving the numeracy skills of children aged 5–6 years.

In this study, a learning media tool was developed, namely the Eniksi Puzzle, which is specifically designed to support the development of numeracy skills in children aged 5–6 years, by adopting three stages of representation according to Jerome Bruner: enactive, iconic, and symbolic. In the enactive stage, children learn concepts through direct manipulation of objects, such as moving and attaching strawberry-shaped puzzle pieces that have magnetic adhesive features. Then, in the iconic stage, children begin to understand the concept of number through images or visual representations arranged on the media. And in the symbolic stage, children demonstrate abilities by writing or recognizing number symbols based on calculation results, for example, using an erasable marker on a predetermined part

of the media. By integrating interactive design and the principles of cognitive development, the Eniksi Puzzle provides a learning process that is not merely oriented towards mechanical results or automatic responses, but rather towards a progressive, meaningful, and enjoyable understanding of mathematical concepts for early childhood (Juhaevah & Tahmir, 2025).

However, in practice, the use of interactive learning media still faces various challenges. At Al-Kautsar Durisawo Kindergarten, the learning process is still largely conducted through worksheets, verbal explanations, and less interactive media, resulting in less active engagement for young children. While this learning process is effective for delivering material in a group context, challenges arise when young children require more concrete learning experiences to understand abstract numerical concepts (S. C. Rahmawati et al., 2025). The limited variety of media that support direct interaction results in young children having less opportunity to explore independently to build their mathematical understanding. As a result, the potential of media such as puzzles as educational tools has not been optimally utilized to improve numeracy skills. Therefore, innovative learning media are needed that can present mathematical concepts in a more concrete and engaging manner, so that children can develop their numeracy skills through more meaningful learning experiences (Arifudin et al., 2021).

To bridge this gap, innovative learning media are needed that can integrate the stages of cognitive development of children aged 5-6 years into play activities (Rupnidah & Suryana, 2022). This study introduces "Puzzle Eniksi" as a learning medium designed by combining the enactive, iconic, and symbolic stages. Through direct interaction in assembling the puzzle, children are guided to understand the concept of number visually before finally mastering numerical operations of symbols and numbers. This approach is expected to shift the learning paradigm from mere memorization to active and meaningful understanding. Based on the description above, this study was conducted to determine the effect of using Puzzle Eniksi media on the numeracy skills of children aged 5-6 years at Al-Kautsar Durisawo Kindergarten, Ponorogo Regency.

Method

Research design

This study uses a quantitative approach with a posttest-only control group design to determine the effect of using Puzzle Eniksi media on the numeracy skills of children aged 5–6 years through a comparison of the posttest results between the experimental group and the control group.

Table 1. Research Design: Posttest-only control group design

Group	Treatment	Posttest
Experimental (B3)	X	O ₁
Control (B4)	-	O ₂

Description:

X = Use of Puzzle Eniksi media in the experimental group

- = The control group was not given Puzzle Eniksi media but was given the image media on the whiteboard

O_1 = Posttest in the experimental class

O_2 = Posttest in the control class

Based on the research design above, this study consisted of treatment in the experimental group using Puzzle Eniksi media, while the control group was given media images on the whiteboard. Posttest activities were carried out based on research instruments consisting of numeracy ability tests developed based on indicators, such as number recognition, counting objects, matching numbers with numeric symbols, and solving simple problems. The tests were presented in the form of illustrated multiple-choice questions, matching tests, and simple fill-in-the-blanks that were adapted to the characteristics of early childhood, and had been validated by material experts based on the indicators that had been formulated, thus ensuring the quality of the data obtained could be trusted (Abigail Soesana, Hani Subakti, Karwanto, Anisa Fitri Sony Kuswandi, Lena Sastri & Novita Aswan, Ferawati Artauli Hasibuan, 2023).

Research sample

The study population consisted of all children aged 5–6 years at Al-Kautsar Durisawo Kindergarten, Ponorogo District. Field research was conducted between January 29 and February 19, 2026, in the even semester of the 2025/2026 academic year. The sample was determined using a purposive sampling method to ensure fair subject characteristics (Leah, 2024). Class B3 was designated as the experimental group with 22 children, while Class B4 was designated as the control group with 22 children.

Research procedure

The research involved administering a treatment, consisting of the use of Puzzle Eniksi media for the experimental group, while the control group used images on a whiteboard. Both groups then underwent a test to measure their numeracy skills.

Data analysis

The data obtained were analyzed using SPSS. Prior to hypothesis testing, the data were first tested using normality and homogeneity tests as prerequisites. Next, an independent sample t-Test was used to determine significant differences between the posttest results of the experimental and control groups at a significance level of $\alpha = 0.05$.

Results and Discussion

Results

This study aimed to determine the effect of using Puzzle Eniksi media on the numeracy skills of children aged 5 to 6 years. Two classes were selected as samples: Class B3, the experimental group, using Puzzle Eniksi media to implement classroom learning, while Class B4, the control group, used pictures on a whiteboard. Twenty-two children in the experimental

group and twenty-two children in the control group completed the entire learning process. This study was conducted over three sessions, two of which focused on the implementation of the learning process and one meeting was devoted to the posttest.

Based on the results of the numeracy tests administered to the experimental group using Puzzle Eniksi media and the control group using pictures on a whiteboard, descriptive statistical analysis of the numeracy skills of children aged 5-6 years is presented in Table 2.

Table 2. Descriptive Statistics

Group Statistics					
class		N	Mean	Std. Deviation	Std. Error Mean
Nilai	Posttest_Kontrol	22	73,00	11,393	2,429
	Posttest_Eksperimen	22	88,77	7,316	1,560

Source: An Output SPSS

Based on Table 2, there is a difference of 15.77 points in the average score between the experimental group (88.77) and the control group (73.00). This difference in average scores provides an initial indication that the numeracy skills of children who received the Puzzle Eniksi media intervention were higher compared to children who received learning using the picture media on the blackboard.

Table 3. Frequency Distribution

Value Interval	Interpretasi	Experimental (f)	%	Control (f)	%
$x > 90$	High	10	45,45	1	4,55
$70 \leq x \leq 90$	Medium	12	54,55	13	59,09
$x < 70$	Low	0	0	8	36,36
Total		22	100	22	100

The frequency distribution of arithmetic ability scores for children aged 5-6 years is grouped into three categories: high, medium, and low. The results of the frequency distribution of arithmetic ability scores are presented in Table 3. Based on Table 3, in the experimental group learning using Puzzle Eniksi media, 10 children (45.45%) were classified as high, 12 children (54.55%) as medium, and no children as low. Conversely, in the control group learning using pictures on the whiteboard, only 1 child (4.55%) was classified as high, 13 children (59.09%) as medium, and 8 children (36.36%) as low.

Based on the results of the descriptive statistics and frequency distribution, a prerequisite test, namely the normality test, was conducted to determine whether the arithmetic ability data for children aged 5-6 years in the experimental and control groups were normally distributed. The Shapiro-Wilk test was used in this study, considering the sample size was less than 50. Data were considered to have a normal distribution if the significance level (Sig.) exceeded 0.05. The following is an interpretation of the normality test results presented in Table 4.

Table 4. Normality Test of Numeracy Ability

		Tests of Normality		
class		Shapiro-Wilk		
		Statistic	df	Sig.
Hasil	posttest A (KONTROL)	,949	22	,301
	posttest B (EKSPERIMEN)	,937	22	,174

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Source: An Output SPSS

Based on the table above, the Shapiro-Wilk column significance value (Sig.) for the control group's posttest data is 0.301, while for the experimental group it is 0.174. It can be concluded that the numeracy data from the control and experimental groups are normally distributed because the significance value for both groups is greater than 0.05 (> 0.05).

To determine whether the variances of the two groups are equal, a homogeneity test was conducted. The Levene's test was used in this study, and if the significance level is higher than 0.05, the data values are considered homogeneous. The results of the homogeneity test, as shown in Table 5, are interpreted as follows.

Table 5. Homogeneity Test
Test of Homogeneity of Variances

Numeracy Ability Test Score			
Levene Statistic	df1	df2	Sig.
3,522	1	42	,068

Source: An Output SPSS

Table 5 shows that the Sig. value is 0.068. H_0 is accepted because this value is higher than 0.05 (> 0.05). Thus, it can be concluded that there is a homogeneous (equal) variance in the numeracy data from the experimental and control groups.

Hypothesis testing can begin after the prerequisite tests confirm that the data are homogeneous and normally distributed. The Independent Sample t-Test is used to test the hypothesis to assess the significance of the variation between the experimental and control groups. Table 6 provides an explanation of the results of the Independent Sample t-Test.

Table 6. Hypothesis Test of Numeracy Ability
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	95% Confidence Interval of the Difference	
Equal variances assumed	3,522	,068	-5,464	42	,000	-15,773	Lower	Upper
							-21,598	-9,947

Source: An Output SPSS

The results of the analysis show that the significance value (2-tailed) is 0.000 based on Table 6. According to the decision-making rules of the Independent Sample t-Test, H_0 is rejected and H_a is accepted if the significance value (2-tailed) is less than 0.05 (< 0.05).

Discussion

Based on the research results, there was a significant difference in learning outcomes between the experimental group that used Puzzle Eniksi media and the control group that used pictures on the blackboard in teaching counting skills to children aged 5-6 years at Al-Kautsar Durisawo Kindergarten. In the experimental group, children showed more active involvement in learning because they were directly involved in activities such as arranging and matching objects, so that the learning process became more meaningful. In contrast, in the control group, children's involvement tended to be limited because learning focused more on explanations through pictures on the blackboard and assignments to be given. This difference in learning conditions illustrates that media that involve direct manipulation activities can facilitate children's understanding of counting concepts more effectively. The following Puzzle Eniksi media used in this study is presented in Figure 1 below:

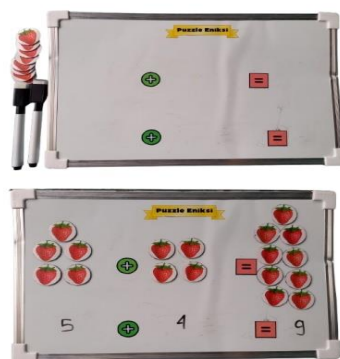


Figure 1. Puzzle Eniksi Media

With an average value of numeracy ability in the experimental group reaching 88.77, while in the control group it was 73.00, with a difference of 15.77 points. This is supported by the results of the Independent Sample t-Test, which showed a Sig. (2-tailed) value of 0.000, so H_0 was rejected. These results prove that learning using Puzzle Eniksi media can improve the abilities of children aged 5-6 years in counting objects, understanding number symbols, equating quantities, arranging numbers, and being able to master basic calculations including addition and subtraction in a concrete manner. This finding is consistent with Jean Piaget's cognitive development theory, which states that early childhood is in the preoperational stage, where they still need concrete objects to understand abstract concepts (Anak & Dini, 2023; Istiqomah et al., 2021). In addition, Jerome Bruner's learning theory supports the findings of this study, as the learning process through Puzzle Eniksi media involves enactive, iconic, and symbolic stages that facilitate a gradual understanding of the concept of counting (Rahmania et al., 2025). These results are in line with the perspective of (Alifah et al., 2019) which states that number puzzle games can improve counting skills in children aged 5-6 years. In addition, these findings are reinforced by (Chandra, 2019), which shows the effect of

using puzzle media on the ability of early childhood to recognize numbers (1–10). This confirms that interactive and concrete learning media play an important role in helping early childhood to master basic mathematical concepts.

However, this study has limitations in the form of a small sample size and a scope of implementation that only covers one educational institution, so the results cannot be generalized widely. In addition, the long-term effectiveness of using the Puzzle Eniksi media cannot be evaluated in depth due to the limited duration of the study, only three learning meetings. Therefore, it is recommended that further researchers investigate the effectiveness of the Puzzle Eniksi media continuously, as well as develop media variations or explore other aspects of development in early childhood. Thus, it can be concluded that the numeracy skills of children aged 5–6 years who learned using the Puzzle Eniksi media are superior compared to the group that used the picture media on the blackboard.

Conclusion

Based on the results of the research and discussion, it can be concluded that the use of Puzzle Eniksi media has a significant influence on the counting ability of children aged 5–6 years. The results of the hypothesis test using the independent sample t-Test showed a significance value of 0.000 (Sig. < 0.05), which indicates a significant difference between the two groups. In addition, the average score of counting ability in the experimental group was higher than the control group, thus proving that the use of Puzzle Eniksi media was successfully implemented in Al-Kautsar Durisawo Kindergarten, Ponorogo Regency, especially in class B3, because it can effectively help children aged 5–6 years understand the concept of counting better.

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