

Research Article

# The Effect of Puzzle-Based Learning Media on Students' Critical Thinking in Mathematics Lessons at SDN Kolor II

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## ABSTRACT

This research aims to examine the effect of puzzle-based learning media on students' critical and independent thinking abilities in mathematics lessons. The method used is quantitative experimental with a one group pretest-posttest design. The research sample consisted of 20 students who used pretest posttest. The instrument used was 10 valid questions. After being declared valid, it was then tested for reliability, obtaining a result of 0.785 with a medium category with a reliability coefficient of  $> 0.70$ , which had been tested for validity and reliability. Data were analyzed using the t-test. The t-count value obtained with a significance value of 0.00 resulted in a t-count of 10.583 with a sig value of 0.00. then to find the t table the researcher used the t distribution with a significance level of  $\alpha = 0.05$  or  $df = N-1$  to obtain  $t = 2.093$ . So, it can be concluded that  $10,583 > 2.093$  or  $t \text{ count} > t \text{ table}$  so it can be concluded that  $H_1$  is accepted and  $H_0$  is rejected, meaning that mediap puzzle learning has an effect on students' independent critical thinking.

**Keywords:** Puzzle Media; Critical Thinking; Mathematics Learning

## 1. INTRODUCTION

The learning process is an activity between teachers and students to achieve learning goals. The teacher determines the success or failure of attaining learning goals because teachers do not only convey learning, but more than that, a teacher must be able to guide students who grow and develop both in attitude, physically and psychologically (Zainuddin, Mulyadi & Purwitasari, 2024). In teaching and learning activities, teachers must create a pleasant atmosphere so students stay energized quickly. Given the enormous responsibility borne by a teacher, a teacher must realize that he as a teacher who is a field worker who directly carries out education and is the spearhead of the success of schooling (Ningsih, Ulfah, Mayasari, & Arifudin, 2024) stated that the use of teaching media in the teaching and learning process can arouse new desires and interests, as well as arouse motivation for students in the teaching and learning process. According to (Mohammed Ridwan & Erihardiana, 2024; Zainuddin, Shiddiq, & Agustina, 2023), a learning model is a tool as a blueprint or design for learning that is designed in such a way as to achieve the targets or objectives of learning a subject. Learning media is one of the tools that can be used to convey messages from one person to another where the message can stimulate a person's attention (Rahmawati et al., 2024; M Ridwan, Hodairiyah, & Sulistiyono, 2024). Learning media is a tool that can help the learning process so that the meaning and message to be conveyed become more apparent and learning objectives are easily achieved effectively and efficiently. The influence of the right interactive media on students in each subject is beneficial to attain learning goals and make students more enthusiastic and think critically in the teaching and learning process. Puzzles are tools that can stimulate students' critical and independent thinking. By using puzzles, students can learn in a fun and non-boring way.

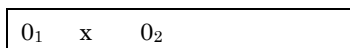
Puzzles can also help students better understand and remember the concepts taught (Valentza, 2024; Zainuddin & Wafi, 2024). The use of puzzle media in the picture puzzle learning model of addition and subtraction positively impacts students' critical thinking. Students can be actively involved in the learning process through a combination of fun physical activities and intellectual challenges provided by puzzles. In addition, this model can also increase cooperation between students because they have to work together to complete the puzzle and answer the questions given. Thus, learning becomes more meaningful and effective (Barham, Ihmeideh, Al-Falasi, & Alabdallah, 2019). Mathematics is one of the subjects that must be taught to students from elementary to high school; mathematics lessons lead students to think critically and logically in solving problems (M Ridwan et al., 2024; Wijayanti & Yanto, 2023).

The importance of this mathematical function for student development is taught from an early age, with the aim that through education, humans can develop their potential to achieve the desired life goals as stated in Law Number 19 of 2015 concerning the national education system that the goal of national education is to educate the nation's life and develop the Indonesian people as a whole. Based on the initial observations or pre-research conducted at SDN Kolor II on May 4, 2024. It is known that the learning that was carried out went well; however, the learning carried out at SDN Kolor II, especially in class II, the low interest of students in learning mathematics, addition and subtraction material is less developed with the material received from the teacher, meaning, students' critical thinking skills are less developed, one of which is because learning is more conventional and learning media that supports students' needs is needed, one of which is interactive media such as puzzle media so that students' enthusiasm for learning grows, in mathematics subjects. Students are introduced to a system of interconnected elements with specific rules to carry out certain functions, especially those related to everyday human needs.

Based on previous research conducted by (Sellings, Felstead, & Goriss-Hunter, 2018), their study showed that using fraction puzzle media in mathematics learning can improve students' mathematics learning outcomes. This makes researchers interested in conducting research using puzzle-based learning media to improve students' critical and independent thinking at SDN Kolor II. The feature used in mathematics learning in class II is arranging puzzles correctly. Where students must arrange to find the right picture with mathematics material with the theme "addition and subtraction". Puzzles are interactive learning media that influence students' critical thinking to improve and satisfy students' learning outcomes.

## 2. RESEARCH METHOD

The type used in this study is quantitative with an experimental method involving a One-Group pretest-posttest. This design has one group that is given an experiment. This design also has a pretest before being given an experiment. Thus, the experiment's results can be known more accurately because it can compare the conditions before and after being given an experiment. The pretest-posttest design is a research design that connects the study of independent and dependent variables. In this design, the One-Group Pretest-posttest research only uses one class without a comparison class.



**Figure 1.** Pre-Experimental One-Group pretest-posttest Design

In this study, three variables are used, namely, Puzzle media, critical thinking, and mathematics learning. The research population was all class II SDN Kolor II students, with 22 students, but only 20 attended. The sample was taken using a saturated sampling technique, in which all population members were sampled. The research instrument is a tool used to measure the research variables, and it is a test instrument. The test instrument is in the form of objective test questions of the fill-in type consisting of 10 questions by arranging picture puzzles which include mathematics learning for class II SDN on addition and subtraction material; the test is used to measure student learning outcomes in the cognitive domain, the learning outcome test is carried out twice, namely pretest and posttest. A test is valid if it can measure what is being measured. So, the pretest and posttest questions will be validated before being tested on students.

### Validity test

Validity is conducting a study that requires an instrument. Which refers to how much the facts produced for the study are consistent with the strength shown in the study to determine the validity of each question item using the correlation technique (Utami, 2023); the formula is:

$$r_{xy} = \frac{n \sum ry - (\sum x)(\sum y)}{\sqrt{\{n \sum x^2 - (\sum x)^2\} \{n \sum y^2 - (\sum y)^2\}}}$$

**Formula 1.** Validity test

### Reliability Test

Reliability is a measuring instrument that is said to be reliable if the instrument is measuring a test at different times, but the results remain the same. A test that can be said to be trustworthy if several times tested consistently shows the same results; in this study, the reliability test uses the Cronbach Alpha formula with the following formula:

$$R_{11} = \left( \frac{k}{k-1} \right) \left[ 1 - \frac{\sum \sigma b^2}{\sigma_{b^2}} \right]$$

**Formula 2.** Reliability Test

### Difficulty level

A question's difficulty level calculates how easy or difficult a question is given to students. A good level of difficulty is relatively easy. The level of difficulty can be calculated using the formula;

$$Tk = \frac{\sum b}{\sum p}$$

**Formula 3.** Difficulty level test

### Different power

Discriminatory power is the ability to measure test items by distinguishing students with high and low skills. The aim is to determine the ability of the test to differentiate students who are classified as capable (high achievement) and who get high scores from students who are classified as weak achievers who get low scores and who answer correctly. So, the discriminatory power is determined using the formula:

$$B = \frac{\sum T_B}{\sum T} - \frac{\sum R_B}{\sum R}$$

**Formula 4.** Different power test

**Data Collection Techniques** In this study, observation is a method researchers use to obtain accurate information and data related to what will be studied (Sarie et al., 2023). In this study, researchers observed student learning outcomes with students' critical and independent thinking skills in mathematics learning materials using puzzle learning media. Furthermore, tests are to collect data on student learning outcomes (Royani & Sumantri, 2024). The test technique is used to collect data used for evaluation, distinguishing between initial and subsequent conditions. By knowing the abilities of these students, teachers will be able to determine how to deliver learning that will be carried out later in the implementation of learning in the classroom, namely by using pretests and posttests. The data analysis technique for this study using the Normality Test was carried out to determine whether the data obtained by researchers came from a normally distributed population. This is done as a requirement if the test is carried out with non-parametric statistics; it is known that the significant value is  $0.05 > 0.05$ , so it can be concluded that the data we test is usually distributed. In conducting the normality test, the researcher used Kolmogorov Smirnov with the help of the SPSS version for 24 windows. Furthermore, the Hypothesis Test in this study is a parametric test in the form of a t-test. The t-test is used to test the research hypothesis about whether or not there is a difference in increasing student learning outcomes before and after being given an experiment using puzzle media on the research subjects. The testing criteria carried out have a significance greater than 0.200, and then  $H_0$  (Null Hypothesis) is accepted,  $H_a$  (Alpha Hypothesis) is rejected, and vice versa. The t-test uses SPSS version 24 for Windows.

## 3. RESULTS AND DISCUSSION

### 3.1 Results

The study's results were based on the November 23, 2024, survey, which took place at SDN Kolor II class II in the 2024 academic year. In the study, student learning outcomes were obtained based on the results of the pretest and post-test. In this validity test, the pretest and post-test questions in this study used a correlation formula with a significance level of 0.05 or 5%. Whether or not data is valid can be declared valid if the  $r_{count} > r_{table}$  is used to facilitate calculations. Researchers use SPSS version 24.

Based on the results of the validity test of the test instrument in this study, it can be obtained that ten questions are declared valid. Furthermore, the valid questions will be tested for their reliability. Reliability testing is carried out on all statement items. The decision-making criteria for determining its reliability are if the  $r$  value (Cronbach's alpha) is more significant than 0.60, then the instrument is said to be reliable. Conversely, if the  $r$  value (Cronbach's alpha) is less than 0.60, the instrument is unreliable. The results of the instrument reliability test are shown in **Table 1**.

**Table 1.** Analysis of question validity

Question items	Correlation coefficient	Information
1	0,464	Valid
2	0,531	Valid
3	0,598	Valid
4	0,472	Valid
5	0,560	Valid
6	0,471	Valid
7	0,691	Valid
8	0,545	Valid
9	0,467	Valid
10	0,545	Valid

**Table 2.** Reliability Test Data

Reliability Statistics	
Cronbach's Alpha	N of Items
.785	10

In the **Table 2**, the result is 0.785 with a moderate category with a reliability coefficient > 0.70, meaning that the research test instrument is reliable. Analysis of the difficulty level means examining the pretest and posttest questions in terms of their difficulty so that questions that are appropriate to be given to students can be obtained to find out which questions are easy, which are moderate, and which are challenging. The following are the level test results using the help of SPSS version 24.

**Table 3.** Difficulty Level Result Data

		Statistics						
		Question 01	Question 02	Question 03	Question 04	Question 05	Question 106	Question 07
N	Valid	20	20	20	20	20	20	20
	Missing	0	0	0	0	0	0	0
Mean		9.00	9.00	6.50	8.50	6.50	6.50	7.00
Maximum		10	10	10	10	10	10	10

The results of the formula calculation of 10 questions show that eight questions are in the medium category and 2 questions are in the difficult category. Differential power analysis means examining pretest and posttest questions in terms of the test's ability to distinguish students who are included in the low category and high category. The results of the discriminatory power test are processed using the correlation index method.

**Table 4.** Distinguishing Power Result Data

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
74.50	647.105	25.438	10

**Normality test**

This study's basis for collecting customarily distributed data is if the significance is > 0.05. The population is not generally distributed if the importance is <0.05, calculated with the help of Shapiro-Wilk SPSS version 24.

**Table 5.** Normality Test Data

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.177	20	.099	.909	20	.061
Posttest	.149	20	.200*	.918	20	.090

The normality test obtained from the pretest and posttest in class II of SDN Kolor II was stated to be normally distributed. Hypothesis testing using Paired sample t-test. This hypothesis test determines puzzle media's effect on students' critical and independent thinking. The hypothesis testing criteria use the t-test, namely, if  $t_{count} < t_{table}$ , then  $H_0$  is accepted, and  $H_1$  is rejected. If  $t_{count} > t_{table}$ , then  $H_1$  is accepted, and  $H_0$  is rejected. Hypothesis testing is carried out with the help of

SPSS 24 software.

**Tabel 6.** t-test Data  
Paired Samples Test

		Paired Differences			95% Confidence Interval of the Difference
		Mean	Std. Deviation	Std. Error Mean	Lower
Pair 1	Before Treatment After Given Treatment	-38.250	16.163	3.614	-45.815

The results obtained a t count of 10,583 with a sig value 0.000. To find the t table, the researcher used a t distribution table with a significance level of  $\alpha = 0.05$  or  $df = N-1$  to obtain the t table = 2.093. So it can be concluded that  $10,583 > 2.039$  or  $t \text{ count} > t \text{ table}$  so that it can be concluded that H1 is accepted and H0 is rejected, meaning that puzzle learning media affects students' critical and independent thinking in mathematics subjects in grade II of SDN Kolor II. To find out the results of the R-squared (R2) analysis regarding the effect of puzzle media on students' critical and independent thinking. It was carried out using SPSS 24. Based on the results of R2, it can be concluded that puzzle media has a 56% effect on students' critical and independent thinking. R2 shows that using puzzle media can potentially improve students' critical and independent thinking skills.

### 3.2 Discussion

This research is an experimental quantitative research that aims to determine the effect of puzzle media on students' critical thinking. Previously, the researcher conducted an instrument trial that included validity, reliability, difficulty level, and question distinguishing power. After the instrument trial, the researcher conducted a study by giving a pretest and post-test. This study was conducted on a research sample consisting of 20 students from class II. For the pretest, students were given learning without using puzzle media to determine students' critical and independent thinking skills, while for the post-test, learning was given using puzzle media. Studies have shown that using puzzle media in mathematics learning can improve students' critical and independent thinking skills. A study conducted by (Farida, Afifah, Nurmalitasari, & Naim, 2023) showed that students who used math puzzles routinely experienced a significant increase in their ability to solve more complex math problems because they were used to thinking more analytically and logically. Another study (Permatasari & Huda, 2024) also found that students involved in puzzle-based learning showed increased learning independence. They rely less on teacher assistance and often seek solutions or ask their friends. After conducting the research, the study's results were obtained from students before and after the experiment. The research data showed that the lowest pretest score was 30, while the highest was 70. The lowest post-test score was 50, and the highest score was 100. Judging from the pretest and post-test scores, it was concluded that students' critical thinking skills increased using puzzle learning media, making them more active, independent, creative, and interested in following the lesson.

### 4. CONCLUSION

Based on the results of the study and discussion, puzzle media has a positive influence on improving students' critical and independent thinking skills in mathematics lessons. Using puzzles in learning can stimulate students to be more active in solving problems, thinking logically, and finding solutions independently. With the challenges provided by puzzles, students are encouraged to develop analytical and creative abilities, which contribute to improving the quality of their learning. Integrating puzzle media in mathematics learning can strengthen critical thinking skills and increase student motivation and participation in the learning process. This is shown from the results of data calculations using SPSS version 24, including pretest and posttest, to assess the instrument's validity. The validity test was carried out using a standardized test with a significance level of 0.05 or 5%. Reliability testing was carried out on all items in the questionnaire. The reliability test is based on the criteria of having r (Cronbach's alpha) higher than 0.60, indicating that the instrument is reliable. The reliability result is 0.785 with a category and reliability coefficient  $> 0.70$ , indicating the instrument is reliable.

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