

## Meta Analysis: Reciprocal Teaching Learning Model to Improve Mathematics Learning Outcomes

Ulya Ulfiyati<sup>1\*)</sup>, Mariani Scolastika<sup>2</sup>, Isnaini Rosyida Mariani<sup>3</sup>, Emi Pujiastuti<sup>4</sup>, Mulyono<sup>5</sup>  
<sup>1,2,3,4,5</sup>Universitas Negeri Semarang  
\*) [ulyaulfiyati@student.unnes.ac.id](mailto:ulyaulfiyati@student.unnes.ac.id)

### Abstract

The success of an education is associated with the high and low learning outcomes that have been achieved. The results of mathematics learning are very important, because they measure whether the learning that has been carried out so far has been successful or not. One learning model to improve mathematics learning outcomes is the reciprocal teaching learning model. The aim of this research is to analyze articles on the topic of mathematics learning outcomes in the reciprocal teaching model. The method used in this research is the meta analysis method. The research obtained results that there were three articles with effect sizes in the medium category and three articles with effect sizes in the strong category. The average effect size value of the six articles analyzed was 1.27 in the strong category. So it shows that the reciprocal teaching learning model has a strong influence in improving students' mathematics learning outcomes. Apart from that, the results of hypothesis testing were carried out using the t test, namely  $t_{\text{test}} = 10.89 > 1,968 = t_{\text{table}}$ . This shows that the average mathematics learning outcomes of students using the reciprocal teaching learning model are better than the average mathematics learning outcomes of students using the conventional learning model.

**Keywords:** mathematics learning outcomes, reciprocal teaching.

### Introduction

Mathematics is a subject that has a central role in the world of education and individual intellectual development and its existence is very important in forming logical understanding, building problem-solving abilities, and advancing critical thinking abilities (Nainggolan, 2023). The importance of learning mathematics cannot be separated from its role in various lives, for example a lot of information and ideas are communicated using mathematical language and many contextual problems are presented with mathematical models (Ikhsan, 2019). This is in accordance with (Sidabutar, 2018) that mathematics is very useful and beneficial in everyday life.

The success of an education is associated with the high and low learning outcomes that have been achieved (Riyanti et al., 2021). Mathematics learning outcomes are the results obtained by students who have followed the mathematics learning process and are used as a benchmark for how deeply students have mastered the material (Juliyanti & Pujiastuti, 2020). The results of mathematics learning are very important, because they measure whether the learning that has been carried out has been successful or not (Ikhsan,

2019). However, quite a few students experience problems in learning mathematics which results in low mathematics learning outcomes. This is in accordance with the results of the 2018 PISA survey, showing that Indonesian students' mastery of mathematics is ranked 73rd out of 79 countries (Setyanto et al., 2023). Previous research (Ardila & Hartanto, 2017) showed that 75% of students had low learning outcomes in mathematics subjects in class VII A. Research (Riyanti et al., 2021) also explains that some of the mathematics learning outcomes for grade IV elementary school are below the cut score.

Based on this, researchers offer a solution by learning using Reciprocal Teaching. Reciprocal teaching is a learning model that is implemented so that learning objectives are achieved quickly through an independent learning process and students are able to present it in front of the class as expected, the learning objectives are achieved and students' abilities in independent learning can be improved (Hutauruk et al., 2021). This teaching procedure or approach uses reciprocal teaching to provide students with an understanding of specific to general learning strategies and can help students understand the content of mathematics subject matter well (Pradja & Firmansyah, 2020). Then in learning reciprocal teaching students will be more active and creative in finding new ideas in solving mathematical problems in learning activities (Ammy, 2022). The syntax of the reciprocal teaching model is summarizing, questioning, predicting, and clarifying (Sari, 2022).

This research aims to analyze journal articles with the theme of the influence of the reciprocal teaching learning model to improve student learning outcomes. The use of the reciprocal teaching model on student mathematics learning outcomes has been widely researched and obtained quite significant and varied results. Based on this information, in-depth and comprehensive information is needed regarding the reciprocal teaching learning model in improving student learning outcomes by analyzing existing research results.

## **Method**

This research uses the meta-analysis method. The meta-analysis method is research carried out by researchers by summarizing research data, reviewing and analyzing research data from several previously existing research results (Anugraheni, 2018). According to DeCoster in (Dhamayanti & Yudiarso, 2020) there are 5 steps in this method, namely the first step is to determine an interesting topic that you want to use as research, then search for and collect research that suits the topic and at the same time select it, calculate the

effect size, analyze the calculation results effect size and drawing conclusions and interpreting research results using meta-analysis methods.

Research data was collected by researchers by searching for articles in online journals using Google Scholar and Publish or Perish. The keywords used by researchers in searching for articles were "Reciprocal teaching" and "mathematics learning outcomes". Based on these criteria, there are 6 journal articles that will be analyzed in this research.

**Table 1.** Table Journal

J1	<b>Journal Title</b>	The Effect of Using the Reciprocal Teaching Model on the Mathematics Learning Outcomes of Class VIII Middle School Students
	<b>Journal Writer</b>	Putri Maisyarah Ammy
	<b>Year of Publication</b>	2022
	<b>Method</b>	Pretest-posstet (The Pretest-Posstest Control Group Design)
	<b>Analysis Results</b>	Based on the results of data analysis, conclusions can be given regarding the research results, namely as follows: 1. The average student mathematics learning outcome using the Reciprocal Teaching model is 83.2 and the standard deviation is 9.56. 2. The average student mathematics learning outcome using the conventional model is 77.2 and the standard deviation is 10.90. 3. The data obtained is normal and homogeneous distributed data. 4. Based on calculations carried out using the T-test, $t_{count} = 2.123$ and $t_{table} = 2.011$ , for a real level of $\alpha=0.05$ . This shows that $t_{count} > t_{table}$ , namely $2.123 > 2.011$ , then $H_0$ is rejected and $H_a$ is accepted. 5. The mathematics learning model has an effect using the Reciprocal Teaching model for junior high school students.
J2	<b>Journal Title</b>	The Influence of Reciprocal Teaching and Student Facilitator and Explaining Learning Models on Mathematics Learning Outcomes by Controlling Students' Initial Abilities
	<b>Journal Writer</b>	Dodik Mulyono, As Elly S.
	<b>Year of Publication</b>	2020
	<b>Method</b>	This research uses a quasi-experimental method with a 2x2 level treatment design.
	<b>Analysis Results</b>	The conclusions obtained from the results of this research are: (1) There are differences in students' mathematics learning outcomes between those taught using the reciprocal teaching learning model and the mathematics learning outcomes of students taught using the student facilitator and explaining model, after controlling for students' initial abilities. The difference shown is that the mathematics learning outcomes of students taught using the reciprocal teaching learning model are higher than the mathematics learning outcomes of students taught using the student facilitator and explaining model, after controlling for students' initial abilities; (2) There is an interaction effect between learning models on students' mathematics learning outcomes, after controlling for students' initial abilities.
J3	<b>Journal Title</b>	The Influence of the Reciprocal Teaching Learning Model on Two-Variable Linear Equation Systems Material on Middle School Students' Mathematics Learning Outcomes
	<b>Journal Writer</b>	Putri Maisyarah Ammy
	<b>Year of Publication</b>	2021
	<b>Method</b>	Pretest-posstet (The Pretest-Posstest Control Group Design)
	<b>Analysis Results</b>	Based on the research results and discussions that have been described, the mathematics learning model using the reciprocal teaching model is better than the

		ordinary learning model for junior high school students.
J4	<b>Journal Title</b>	The Influence of the Reciprocal Teaching Learning Model Assisted by Visual Media on the Learning Outcomes of Class IV Students at SDN Gugus V Manggelewa for the 2020/2021 Academic Year
	<b>Journal Writer</b>	M. Faisal, Asrin, Abdul Kadir Jaelani
	<b>Year of Publication</b>	2021
	<b>Method</b>	Quasi Eksperimental Design tipe desain Nonequivalent Control Group Design
	<b>Analysis Results</b>	The results of the hypothesis test of the Reciprocal Teaching method have a significant influence on student learning outcomes. Based on the calculation of the one way ANOVA hypothesis test with the help of the SPSS for Windows 22 application, the average pretest learning result for the control and experimental classes was found to be a significant value of (0.594) more than 0.050, so there was no difference in the pre-test scores for the control and experimental classes, while the average post-test score significance of (0.000) is less than 0.050 in the control and experimental classes, so there is a difference in post-test scores for the experimental and control classes with a significance level of 5% and a confidence level 95% shows that the sig value is <0.05, then Ha is accepted and Ho is rejected. This means that there is an influence of the Reciprocal Teaching method assisted by Visual Media on the learning outcomes of class IV students at SDN Gugus V Manggelewa in the 2020-2021 academic year.
J5	<b>Journal Title</b>	The Influence of the Reciprocal Teaching Learning Model on Learning Outcomes and Mathematics Learning Independence
	<b>Journal Writer</b>	Rahmina, Tasnim Rahmat
	<b>Year of Publication</b>	2023
	<b>Method</b>	The Static Group Comparison Design dengan sampel (Random Sampling)
	<b>Analysis Results</b>	Based on the results of research carried out in class V of MIN Bukittinggi City, it can be concluded that the mathematics learning outcomes and learning independence of students who use the Reciprocal Teaching learning model are better than the mathematics learning outcomes and learning independence of students who use conventional learning.
J6	<b>Journal Title</b>	The Effect of Using the Reciprocal Teaching Model on the Mathematics Learning Outcomes of Class VIII MTsN Balang-Balang Students, Bontomarannu District, Gowa Regency
	<b>Journal Writer</b>	Reski Awaliyah, Ridwah Idris
	<b>Year of Publication</b>	2015
	<b>Method</b>	Quasi Experimental Design.
	<b>Analysis Results</b>	There is a significant influence on mathematics learning outcomes between students who are taught using the Reciprocal Teaching Model and students who are taught not using the Reciprocal Teaching Model in class VIII students at MTsN Balang-Balang, Bontomarannu District, Gowa Regency.

This meta-analysis research was carried out by collecting data by assigning code 1 to journal articles to provide an effect size. The variables used in coding are article data consisting of the researcher's name, research title, journal name and year of publication. To determine the magnitude of the influence of a research variable, the effect size value is calculated using Cohen's formula in (Izzah et al., 2021) as follows:

$$d = \frac{\bar{x}_1 - \bar{x}_2}{s_{gab}} \quad (1)$$

Information:

$d$  : effect size

$\bar{x}_1$  : average of the experimental group

$\bar{x}_2$  : average of the control group

$s_{gab}$  : control class standard deviation

The results of the effect size calculation are interpreted using classification according to (Izzah et al., 2021) as follows:

**Table 2.** Effect Size Interpretation table

Effect Size	Interpretation
$0 \leq ES \leq 0,2$	Low
$0,2 \leq d \leq 0,8$	Medium
$d \geq 0,8$	High

Hypothesis testing was carried out with the aim of testing whether there was a difference in the average of the experimental class and the control class. Test this hypothesis using the independent t-test. The testing hypothesis is as follows.

$H_0 : \mu_1 \leq \mu_2$  (the average student mathematics learning outcomes in the reciprocal teaching learning model are the same as the average student mathematics learning outcomes in the conventional learning model).

$H_1 : \mu_1 > \mu_2$  (the average student mathematics learning outcomes in the reciprocal teaching learning model are better than the average student mathematics learning outcomes in the conventional learning model).

By determining the level of significance used, namely  $\alpha=0.05$ . The formula used to test this hypothesis is as follows.

$$t_{hitung} = \frac{\bar{x}_{1gab} - \bar{x}_{2gab}}{s_{gab}' \sqrt{\frac{1}{n_E} + \frac{1}{n_{kontrol}}}} \quad (2)$$

With

$$s'_{gab} = \sqrt{\frac{(n_{eks} - 1)s_{1gab}^2 + (n_{kontrol} - 1)s_{2gab}^2}{(n_{eks} + n_{kontrol} - 2)}} \quad (3)$$

Information:

$\bar{x}_{1gab}$  : average experimental class

$\bar{x}_{2gab}$  : average control class

$n_E$  : banyak data kelas eksperimen

$n_{kontrol}$  : banyak data kelas control

$s_{1gab}^2$  : varians kelas eksperimen

$s_{2gab}^2$  : varians kelas control

The t test decision is made by rejecting  $H_0$  if  $t_{count} > t_{table}$  with the degrees of freedom of the t distribution, namely  $n_1 + n_2 - 2$ .

## Results and Discussion

The data in the article that will be analyzed in the research are as follows.

**Table 3.** Analysis Table

Code	Experiment Class			Control Class		
	n	$\bar{x}$	SD	n	$\bar{x}$	SD
J1	25	83,2	9,56	25	77,2	10,90
J2	16	68,06	9,32	16	50,19	8,41
J3	25	83,2	9,56	25	77,2	10,90
J4	27	81,85	9,42	19	68,16	12,61
J5	30	76,99	17,21	30	69,59	12,95
J6	32	79,84	10,88	32	41,71	13,77

It is necessary to calculate  $SD_{gab}$  of all the articles used before calculating the Effect Size of each article, the results are as follows.

**Table 4.** Analysis Table

Code	Experiment Class			Control Class			$SD_{gab}$
	n	$\bar{x}$	SD	n	$\bar{x}$	SD	
J1	25	83,2	9,56	25	77,2	10,90	10,25
J2	16	68,06	9,32	16	50,19	8,41	8,87
J3	25	83,2	9,56	25	77,2	10,90	10,25
J4	27	81,85	9,42	19	68,16	12,61	10,83
J5	30	76,99	17,21	30	69,59	12,95	15,22
J6	32	79,84	10,88	32	41,71	13,77	12,40
	155	78,85	11,65	147	64,01	12,01	

The influence caused by the reciprocal teaching learning model on students' mathematical reasoning abilities can be seen in the Effect Size of each article which has been analyzed and described in the following table.

**Table 5.** Analysis Table

Article Code	Effect Size	Category
J1	0,55	Medium
J2	2,12	Strong
J3	0,51	Medium
J4	1,08	Strong
J5	0,57	Medium
J6	2,76	Strong

Meanwhile, the  $t_{table}$  value is obtained based on the t distribution list with  $dk = 155 + 147 - 2 = 300$  with  $\alpha=0.05$ .

$$t_{tabel} = t_{(0,95;300)} = 1,968$$

Based on the calculation results above, the value obtained is  $t_{hitung} = 10,89 > 1,968 = t_{tabel}$ . So  $H_0$  is rejected. This means that the average student learning outcomes in the reciprocal teaching model are better than the average student learning outcomes in the conventional learning model.

The results of the Effect Size analysis of each article studied show that there is a moderate influence and a strong influence of treatment using the reciprocal teaching model on student learning outcomes. The effect size is in the medium category in the research of Putri Maisyarah Ammy (2021), Putri Maisyarah Ammy (2022) and Rahmina, Tasnim Rahmat (2023). Meanwhile, the effect size is in the strong category in research by Dodik Mulyono, As Elly S. (2020), M. Faisal, Asrin, Abdul Kadir Jaelani (2021), and research by Reski Awaliyah, Ridwah Idris (2015).

The medium effect size category, namely in Putri Maisyarah Ammy's research (2021), obtained an effect size of 0.55. In accordance with the category results, the article is classified in the medium effect size category, which means that the reciprocal teaching learning model has a significant influence on student learning outcomes. This research also shows that the average learning outcomes of students who use the reciprocal teaching model are better than the average learning outcomes of students using conventional learning models.

Putri Maisyarah Ammy's research (2022) obtained an effect size of 0.51, which means it is also included in the medium effect size category. This research shows that the mathematics learning model using the reciprocal teaching model is better than the ordinary learning model for junior high school students. Then Rahmina's research, Tasnim Rahmat

(2023) was also categorized as medium effect size, because it had an effect size result of 0.57. This research shows that the mathematics learning outcomes and learning independence of students who use the Reciprocal Teaching learning model are better than the mathematics learning outcomes and learning independence of students who use conventional learning.

The high effect size category, namely research by Dodik Mulyono, As Elly S. (2020), obtained an effect size of 2.12. In accordance with the category results, the article is classified in the high effect size category, which means that the reciprocal teaching learning model has a significant influence on student learning outcomes. This research shows that there are differences in students' mathematics learning outcomes between those taught using the reciprocal teaching learning model and the mathematics learning outcomes of students taught using the student facilitator and explaining model, after controlling for students' initial abilities. The difference shown is that the mathematics learning outcomes of students taught using the reciprocal teaching learning model are higher than the mathematics learning outcomes of students taught using the student facilitator and explaining model, after controlling for the students' initial abilities.

Research by M. Faisal, Asrin, Abdul Kadir Jaelani (2021) resulted in an effect size of 1.08. In accordance with the category results, the article is classified as a high category, which means that the reciprocal teaching learning model has a significant influence on student learning outcomes. The results of this research show that there is an influence of the Reciprocal Teaching method assisted by Visual Media on the learning outcomes of class IV students at SDN Gugus V Manggelewa in the 2020-2021 academic year. This is similar to research by Reski Awaliyah, Ridwah Idris (2015), which obtained an effect size of 2.76. Based on the results of these categories, the article is classified in the high category, which means that the reciprocal teaching learning model has a significant influence on student learning outcomes. The results of this research show that there is a significant influence on mathematics learning outcomes between students who are taught using the Reciprocal Teaching Model and students who are taught not using the Reciprocal Teaching Model in class VIII students at MTsN Balang-Balang, Bontomarannu District, Gowa Regency.

In the t-test results it was found that  $t_{hitung} = 10,89 > 1,968 = t_{tabel}$ . So  $H_0$  is rejected. This means that the average student learning outcomes in the reciprocal teaching model are better than the average student learning outcomes in the conventional learning



model. This is in line with research (Vahlia & Sudarman, 2015) that learning using the reciprocal teaching learning model can improve mathematics learning outcomes for class VII students. In the learning process, students are more active in discussing and finding various ways to solve problems. Research (Hidayah et al., 2019) also shows that there is an influence of the reciprocal teaching model on student mathematics learning outcomes. So the reciprocal teaching learning model can help optimize student learning outcomes. Furthermore, research (Khaeri et al., 2015) also shows that applying the reciprocal teaching learning model can improve the learning outcomes of class VIII students on the surface area and volume of cubes and blocks. Overall, from the 6 articles studied in this research it can be said that the reciprocal teaching learning model can improve student learning outcomes. Therefore, for elementary and middle school levels, it can be said that the reciprocal teaching learning model has a positive effect on student learning outcomes.

### Conclusion and Suggestion

Based on the meta-analysis results of 6 previous research articles regarding the influence of the reciprocal teaching learning model on student learning outcomes, it was found that the reciprocal teaching learning model had a positive effect in improving student learning outcomes. This can be seen based on the difference in the average scores of the control class and the experimental class, which are 64.01 and 78.85 respectively. Then you can see the effect size results obtained in the medium and strong categories. The average effect size value of the six articles analyzed was 1.27 in the strong category. Apart from that, it can also be seen from the results of the t-test statistical calculations, namely that the value obtained is  $t_{hitung} = 10,89 > 1,968 = t_{tabel}$  So that  $H_0$  is rejected, which means that the average student learning outcomes with the reciprocal teaching learning model are better than the average results. student learning with conventional learning models. So it can be concluded that the reciprocal teaching learning model can improve student learning outcomes, especially at the elementary and middle school levels. Based on the research that has been conducted, the reciprocal teaching learning model can be used as an alternative to improve student learning outcomes.

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