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# A comparison of reciprocal teaching and scientific approaches for improving pupils' mathematical understanding

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## Abstract

This study is intended to result in instruction that will help pupils improve their mathematics understanding skills. The similarity of strategies in both the scientific and reciprocal teaching approaches makes it difficult to choose which approach is better. This investigation aims to investigate and explain (1) Improving pupils' mathematical understanding through comparison of scientific approaches and Reciprocal Teaching based on PAM; (2) The impact of the interaction between learning approaches with pupils' PAM on enriching pupils' mathematics understanding ability. It is a quasi-experimental research project that uses two experimental classes. The results of this study are (1) Pupils who learn through the scientific approach and pupils who learn through reciprocal teaching strategies based on PAM pupils have different mathematical thinking abilities, with the average value of improvement in the scientific approach class being more significant than the reciprocal teaching approach class; (2) Learning and pupils' PAM have no interaction effect. It means that learning in both experimental classes applies to all pupils overall in improving pupils' mathematical understanding ability. Based on the results of this study, this study implies that teachers can employ learning using a scientific approach as one of the learning options for pupils to increase their mathematical understanding abilities.

**Keywords:** improvement; reciprocal teaching; scientific; understanding

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## Introduction

One of the most crucial courses and a fundamental subject in school is mathematics (Raj Acharya, 2017; Siniguian, 2017; Andamon & Tan, 2018; Maulyda et al., 2019; Skipp & Dommett, 2021). However, Mathematical word problems are increasingly being used to measure pupils' mathematical understanding in high-stakes mathematics standardized tests worldwide (Trakulphadetkrai et al., 2020). One of the reasons is that pupils are given a "fast strategy" without regard for their understanding (Palupi et al., 2022). Therefore, understanding mathematics learning is essential to be taught to pupils to be successful in learning mathematics and can avoid mistakes.

Mathematical understanding can be grouped into two levels, namely: (1) Low-level comprehension ability, which is equivalent to the cognitive level of understanding in Bloom's Taxonomy (Ramdhani et al., 2017): mechanical and inductive (Anisa et al., 2021), computational (Sumarmo, 2013), instrumental (Tianingrum & Sopiany, 2017), and knowing how to (Sumarmo, 2013); (2) High-level comprehension abilities that have a higher cognitive level than understanding in Bloom's Taxonomy (Sumarmo, 2013); such as rational and intuitive (Anisa et al., 2021), functional (Sumarmo, 2013), relational (Tianingrum & Sopiany, 2017), and knowing (Sumarmo, 2013). In this study, the indicators of mathematics understanding ability were at a high level of understanding ability and are summarized by several experts described previously, namely: (1) Pupils can prove the truth of a concept (formula/theorem) (Anisa et al., 2021); (2) Pupils can perform calculations with clear procedures on broader problems (Tianingrum & Sopiany, 2017); (3) Pupils can explain a concept in their own words correctly (Sumarmo, 2013); (4) Pupils can use a mathematical concept to get a new concept (Sumarmo, 2013); (5) When it comes to problem-solving, pupils can use concepts or algorithms (Anisa et al., 2021).

Various classroom strategies employed in connecting with pupils play a critical impact in pupils' understanding of mathematical ideas and overall success in mathematics (Arends et al., 2017). By the level of pupils or pupils, pupils who study using generative models enhance their mathematical understanding abilities more than pupils who learn using traditional approaches (Ikhsan & Rizal, 2014). After several learning attempts utilizing the balancing model, most pupils did better on the post-test, indicating they had improved their understanding (Mengistie, 2020). The Think Pair Check (TPC) learning paradigm can help pupils with a Field Independent cognitive approach to understand mathematical topics better (Farhani et al., 2020). (Ulpah & Novikasari, 2020) develops Islamic context-based learning resources to help pupils understand mathematics during learning. Pupils' understanding of mathematical ideas could be improved by combining the Auditory Intellectually Repetition (AIR) and Guided Discovery learning approaches (Asfar et al., 2019). Pupils who utilize computer-based media have a better understanding of mathematical topics than control groups or pupils who engage in hands-on activities (Nurjanah et al., 2021).

In addition to the types of learning described above, other learning approaches are also pupil-centered. Specifically, the scientific and reciprocal teaching approaches. Pupils who study using a scientific approach logo and pupils who learn using a reciprocal teaching approach strengthen their mathematical connection skills (Apryani & Hadiwinarto, 2021). Rather than Conventional Teaching (CT), Scientific Approach with What-If-Not Strategy (SA-WIN) is a type of innovative learning that can help pupils improve their ability to solve mathematical problems (Putra et al., 2020). Mathematics problem-solving abilities taught using a scientific approach are higher than those taught through a realistic mathematical approach, and pupil responses to a scientific approach are in the very positive category (Nuralam & Eliyana, 2017). Because it is a scientific thinking approach that teaches holistic and integrated thinking, teachers and pupils benefit from studying with a scientific approach (Wahyono et al., 2017).

Inline (Hidayah et al., 2021) found that Reciprocal Teaching increases higher-order thinking and science process skills. Prasetio et al. (2018), Erwanto et al. (2018), and Zaman (2019) also found that between the Reciprocal Teaching model-treated class and the standard learning class, pupils' ability to answer math problems differed significantly. Reciprocal teaching of mathematics may aid pupils in developing superior critical thinking, reasoning, and understanding abilities (Aslam et al., 2021). Reciprocal teaching has been recommended to enhance pupils' understanding and metacognitive skills (McAllum, 2014). Reciprocal teaching also resulted in significant improvements on comprehension criterion tests, regular upkeep across the period, generalization to classroom understanding test results, transfer to learning situations that utilized the skilled abilities to summarize, interrogate, and elucidate, and an increase in standard comprehension grades (Palinscar & Brown, 1984). Pupils thought the Moodle-based Reciprocal Teaching program was a helpful learning tool, and their post-test results on multiple-choice understanding assessments were higher than their pre-test scores (Chang & Lan, 2021). Pupils are taught quicker and master skills more successfully when they are permitted to interact freely in class with lecturers and their peers, work in teams, and apply to the context projects together (Guita & Tan, 2018); (Bakare & Orji, 2019).

Learning with a scientific approach referred to in this study is learning that guides pupils to use strategies from (Pahrudin & Pratiwi, 2019), (1) Observation; (2) Inquiry; (3) Information Gathering; (4) Reasoning; and (5) Communication. Meanwhile, learning with the reciprocal teaching approach referred to in this study is learning that guides pupils to use the following strategies (Meyer, 2014); (AlSaraireh & Hamid, 2016): (1) Predicting; (2) Clarifying; (3) Questioning; (4) Visualizing; (5) Connecting; (6) Calculating; (7) Summarizing; (8) Giving feedback. The observing strategy has equal relevance to predicting and clarifying processes (Meyer, 2014). Which follows the questioning plan (Pahrudin & Pratiwi, 2019) has a similar meaning to the questioning strategy (AlSaraireh & Hamid, 2016) and the information gathering strategy (Pahrudin & Pratiwi, 2019) also has a similar meaning to visualizing (AlSaraireh & Hamid, 2016). Likewise, the strategy of reasoning has a similar meaning as the strategy of connecting and calculating (Meyer, 2014), and the strategy of communicating (Pahrudin & Pratiwi, 2019) also refers to the summarising and feedback strategy (Meyer, 2014). Likenesses of strategies in both the scientific and reciprocal teaching approaches make it difficult to choose which approach is better. Therefore, to prove the comparability of the two approaches, trials must be conducted in this study.

This research also involves pupils' Mathematical Preliminary Knowledge (PAM) (Apryani & Hadiwinarto, 2021) because PAM and logical thinking skills have a significant association. In terms of PAM, the pupils' ability to reason logically differed significantly (Pamungkas et al., 2017). The same thing was also found by (Prasetio et al., 2018) that PAM provided a better role in improving pupils' mathematical self-concept reasoning abilities. Therefore, the PAM of pupils in this study involved the knowledge possessed by pupils before learning took place, which was categorized into two groups, i.e., high and low.

This research is new and has never been done by other researchers. The novelty lies in comparing the two approaches used in this study. The similarity of strategies in both the scientific and reciprocal teaching approaches makes it difficult to choose which approach is better. It is necessary to conduct trials in this study to prove the comparison of the two approaches. Therefore, the goal of this research is to investigate and discuss: (1) Improving pupils' mathematical understanding through comparison of scientific Approaches and Reciprocal Teaching based on PAM; (2) The impact of the interaction between learning approach with pupils' PAM on improving pupils' mathematics understanding skill.

## Methods

A quasi-experimental design is used in this work, which uses two experimental classes. This study treated all research subjects in each sample class, and subjects were not chosen at random to overcome hurdles to the existing school learning schedule (Ruseffendi, 2005). The scientific approach was given to students in the first experimental class, and a reciprocal teaching approach was given to students in the second experimental class. This research also included prior mathematical knowledge (PAM), which contains the set of pupils with a high PAM and a group of pupils with a low PAM. The same pre-test and post-test were administered to both experimental classes, hence testing mathematics understanding ability. The design used in this study is Pretest Posttest Two Treatment Design (Cohen et al., 2007). The ability to understand mathematics is the dependent variable of the study. The independent variable employs a scientific approach and a reciprocal teaching strategy. The pupil's PAM was used as a predictor in this study. The Weiner Table depicts the link between the dependent variable, independent variable, and predictor (Apryani & Hadiwinarto, 2021).

In this study, the research subjects were all Bandung level VIII SMP pupils who must have applied to the 2013 Curriculum. The purposive sampling strategy determined the research sample for both experiment groups with the same PAM. A purposive sampling strategy is based on specific considerations (Sugiyono, 2007). The selection of pupils for the two experimental classes will not be based on true randomness, only based on the existing classes. The researcher cannot form a new class, so the researcher takes the smallest sample unit, namely the class. There were 32 research participants in the group that got scientific treatment, whereas 30 inside the group got reciprocal teaching treatment. The number of study subjects was chosen because each class required a minimum of 30 research subjects (Apryani & Hadiwinarto, 2021). The mathematical comprehension ability test consists of a pre-test and a post-test. Giving tests in this study aims to compare the increase in mathematical ability to a treatment. Mathematical understanding ability assessments are organized as descriptions and administered to pupils at various intervals. The test questions for mathematical comprehension ability are organized and constructed inside a question grid of different questions based on the indicators of the assessed ability. A trial is conducted first before testing mathematical understanding capacity is utilized to ensure that the test instrument satisfies the criteria of validity, reliability, difficulty level, and differentiating power (Apryani & Hadiwinarto, 2021).

The data obtained from this study is quantitative in the form of scores of mathematical understanding abilities on the pre-test and post-test. Ms. Excel and software SPSS Verse 22.0 for Windows were used to process the data in this study. The following phases were used to conduct quantitative data analysis: Pupils were divided into two groups based on PAM, high and low, in the initial stages. The second step is to grade the pupils' pre-test and post-test responses using the answer keys and grading criteria that were provided. Additionally, the quantity of the improvement in ability is measured using the normalized gain formula <g> (Hake, 1999). The third stage involves applying the Weiner model to produce descriptive statistics of pre-test, post-test, and normalized gain <g> scores (Apryani & Hadiwinarto, 2021). The Shapiro Wilk statistics test checks for normalcy on the g> score in the fourth stage (Ahad et al., 2011). Levene's test is used to check for variance homogeneity in the fifth phase. The last stage is testing the research hypothesis. There are two hypothesis tests used in this study: (1) t-test for the hypothesis that reads: "there is indeed a difference in gaining mathematics comprehension abilities between pupils who are taught using a scientific approach and pupils who are taught using a reciprocal teaching strategy based on their PAM (high and low)". (2) Two-way ANOVA test for the hypothesis that reads: "there's also a significant interaction on growing pupils' mathematics understanding abilities among instruction (scientific and reciprocal teaching) and their PAM (high and low)".

## Results

Normalized-gain <g> data was used to improve pupils' mathematical understanding. (Hake, 1999). The following Table 1 is a summary of the results of the calculations that have been carried out.

**Table 1.** Normalized gain data recapitulation of pupils' mathematical understanding

| **PAM** | **Experiment 1** | | | **Experiment 2** | | |
|---|---|---|---|---|---|---|
| | $\bar{x}$ | $s$ | $n$ | $\bar{x}$ | $s$ | $n$ |
| High | 0.6354 | 0.11085 | 9 | 0.4554 | 0.15832 | 15 |
| Low | 0.6168 | 0.15474 | 21 | 0.4609 | 0.21778 | 17 |
| Whole | 0.6224 | 0.14134 | 30 | 0.4583 | 0.18922 | 32 |

Table 1 shows that pupils who participated in scientific instruction (experiment 1) gained a higher average value of normalized gain in mathematics understanding than pupils who got reciprocal teaching (experiment 2). The differential in the normalized gain's average value has not yet been able to reveal a substantial difference, to see that there was a significant contrast between the different experimental classes in terms of normalized increases in mathematics comprehension, the average difference must be tested. The analysis carried out on the normalized gain data was carried out to test the research hypothesis, “there is indeed a difference in gaining mathematics comprehension abilities between pupils who are taught using a scientific approach and pupils who are taught using a reciprocal teaching strategy based on their PAM (high and low)". Before completing the average difference test, the normality test of the distribution of normalized gain scores for mathematical understanding was tested using the Shapiro-Wilk, as Table 2 below.

**Table 2.** Normalized gain test for mathematical understanding based on PAM

| PAM | Class | N | Statistics | Sig. | $H_0$ Conclusion |
|---|---|---|---|---|---|
| High | Scientific | 9 | 0.955 | 0.743 | **$H_0$ is accepted** |
| | Reciprocal Teaching | 15 | 0.958 | 0.661 | **$H_0$ is accepted** |
| Low | Scientific | 21 | 0.876 | 0.012 | $H_0$ is rejected |
| | Reciprocal Teaching | 17 | 0.981 | 0.962 | $H_0$ is accepted |
| Whole | Scientific | 30 | 0.908 | 0.013 | $H_0$ is rejected |
| | Reciprocal Teaching | 32 | 0.983 | 0.881 | $H_0$ is accepted |

$H_0$: Data is normally distributed

Table 2 shows that data with normal distribution only occurs in high PAM, while in other PAM data, the distribution is not normal. Therefore, the high PAM will continue with the homogeneity test, while in the other PAM, the hypothesis is directly tested with a non-parametric test, namely the Mann-Whitney test. Furthermore, the homogeneity test at high PAM was tested with the Levene test resulting in the value of (sig = 0.367) > ($\alpha$ = 0.05), which means that the data variance for high PAM is the same (homogeneous). Thus the hypothesis on high PAM will be continued with the t-test. Following Table 3 is the results of hypothesis testing for all PAM categories.

**Table 3.** Results of a PAM-based test of averaged differences in normalized gain data

| PAM | Average ($\bar{x}$) | | Statistic test | Sig. | $H_0$ Conclusion |
|---|---|---|---|---|---|
| | Scientific | Reciprocal Teaching | | | |
| High | 0.6354 | 0.4554 | t-Test | 0.007 | $H_0$ is rejected |
| Low | 0.6168 | 0.4609 | Mann-Whitney Test | 0.013 | $H_0$ is rejected |
| Whole | 0.6224 | 0.4583 | Mann-Whitney Test | 0.000 | $H_0$ is rejected |

$H_0$: The average normalized gain grade of mathematics understanding skills does not differ.

Table 3 shows that a significant value of less than $\alpha$ = 0.05 exists for PAM levels (high, low, and whole), this means $H_0$ is rejected, meaning that the normalization increase of mathematics understanding differs between classes taught using a scientific approach and classes taught using an approach based on reciprocal teaching. Examining the overall mean for every PAM in greater depth, it's shown that classrooms that use a scientific approach to education have a higher increase in average than classes that use a reciprocal teaching approach to education. For the three PAM categories, this reveals that the class that learned using a scientific approach improved their mathematical understanding more than the class that learned with a reciprocal teaching strategy. Thus, in terms of the pupils' PAM (high and low), the two groups of pupils who are each given the scientific approach and reciprocal teaching approachologies have different increases in mathematical understanding.

In this study, two elements contributed to the growth of pupils' mathematics comprehension skills: the learning factor used with each experiment group and even the pupil's PAM categorization factor. Further analysis needs to be done to find out whether the learning factors and PAM grouping contribute to improving mathematical understanding abilities, along with how such PAM grouping elements interact with learning variables. The analysis carried out on the normalized gain data was carried out to test the research hypothesis, namely, "there is also a significant interaction on growing pupils' mathematics understanding abilities among instruction (scientific and reciprocal teaching) and their PAM (high and low)". They tested the hypothesis using a two-way analysis of variance (ANOVA) test. Normality and homogeneity testing was first carried out as a requirement for the analysis. The normality test for the distribution of normalized gain scores for mathematical understanding was tested using the Shapiro-Wilk. It can be seen in Table 4 below.

**Table 4.** Normalized gain test for mathematical understanding

| Factor | Class | N | Statistics | Sig. | $H_0$ Conclusion |
|---|---|---|---|---|---|
| Class | Scientific | 30 | 0.908 | 0.013 | $H_0$ is rejected |
| | Reciprocal Teaching | 32 | 0.983 | 0.881 | $H_0$ is accepted |
| PAM | High | 24 | 0.977 | 0.831 | $H_0$ is accepted |
| | Low | 38 | 0.957 | 0.152 | $H_0$ is accepted |

$H_0$: Data is normally distributed

Table 4 reveals that the parametric test assumption is not met since its normalized gain data enabling mathematical understanding is not normally distributed. Nevertheless, only descriptive data analysis of normalized gain should be done because there is no acceptable non-parametric test to substitute the two-way ANOVA test with just an independent sample as in this experiment (Apryani & Hadiwinarto, 2021).

Pupils who got scientific learning improved their mathematics understanding capacity substantially more than pupils receiving instruction utilizing a reciprocal teaching approach are shown in Figure 1. In the class that received scientific learning, the pupils with a high PAM had the most significant growth in mathematics understanding, whereas the low PAM group had the least. It demonstrates that throughout the class that learned about the Circle issue using a scientific way, there was no change in the order of obtaining mathematics understanding abilities. High PAM pupils continue to better comprehend mathematics than low PAM kids. Meanwhile, a reciprocal teaching approach was used to teach the class. The low PAM pupil had the biggest gain in mathematical understanding ability, while the high PAM pupil group had the slowest growth in mathematical understanding ability. It shows that there has been a shift in the sequence of growing mathematical understanding abilities for a Circle theme inside the group, which is learned through reciprocal teaching. Pupils with low PAM can outperform pupils with high PAM in mathematical knowledge.

Descriptive analysis of Figure 1 can be established that the learning class elements employed, and the PAM grouping factors of the pupils interact. The crossing of a mean marginal line among high and low PAM pupils indicates an interaction. However, this interaction has no significant effect on increasing pupils' mathematical understanding abilities. It suggests that learning variables and PAM grouping elements have no joint influence on improving pupils' mathematics comprehension abilities. The sequence of growing pupils' mathematical comprehension abilities in PAM only changed in groups that obtained reciprocal teaching, whereas there was no change in the scientific class. It suggests that the learning implemented in each experimental class can be applied to all pupils, both those with a high PAM and those with a low PAM, to increase pupils' mathematical understanding abilities.

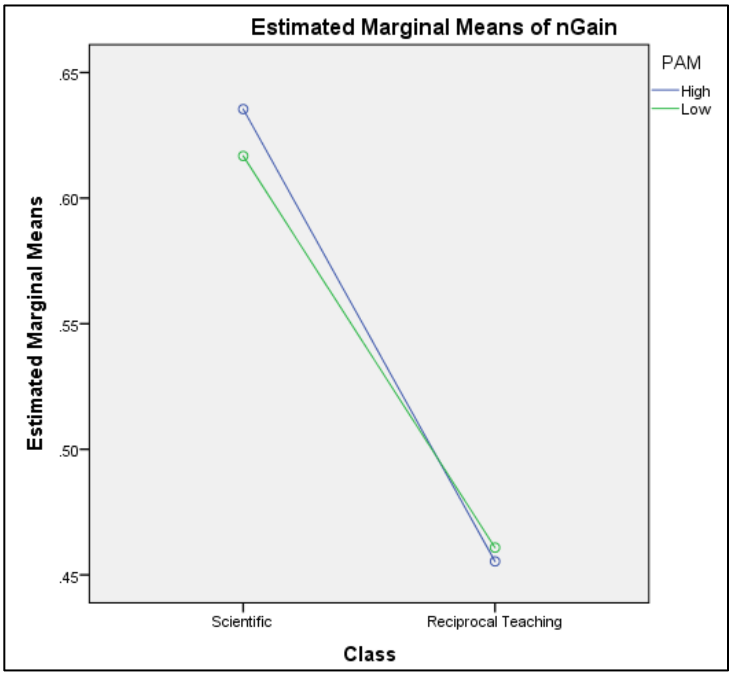


**Figure 1.** Graph of Teaching Approaches and PAM Interaction

## Discussion

The study revealed that at both high and low PAM, there were differences in the evolution of mathematics knowledge among pupils who were taught using a scientific approach and pupils who learned through a reciprocal teaching approach and PAM overall. This outcome is based on the previously proposed premise, i.e., "there is indeed a difference in gaining mathematics comprehension abilities between pupils who are taught using a scientific approach and pupils who are taught using a reciprocal teaching strategy based on their PAM (high and low)". The results of this study are in line with (Apryani & Hadiwinarto, 2021), who revealed that pupils who learned utilizing scientific approaches versus kids who studied utilizing reciprocal teaching approaches depending upon their PAM improved their mathematical connecting skills in various ways. In general, pupils receiving learning through a scientific approach have demonstrated a more significant improvement in their mathematics understanding abilities than pupils receiving learning through a reciprocal teaching strategy. Because of the scientific approach, the teachers could carry out what was done before learning activities, and their learning activities may have aided the pupils' learning (In'am & Hajar, 2017).

Further analysis, this condition has a link between indicators of mathematics comprehension capacity and the tactics used in each approach, both scientific and reciprocal. Indicator (1) proves the truth of a concept (formula or theorem), assisted by the Questioning approach in a scientific approach since pupils are taught to challenge a material/concept received through this strategy. Pupils not only accept the truth of a concept to arouse pupils interest and curiosity about a problem that is being discussed or the material being discussed (Mulyasari & Sudarya, 2017). In addition, pupils who are allowed to ask questions and follow their interests can improve their ability to generate well-investigated questions and increase pupils' understanding (Avsar Erumit et al., 2019). While the reciprocal teaching approach is not the case, although there is a strategy that is almost the same as the scientific approach, namely the Questioning strategy (asking), the strategy in reciprocal teaching is only used to monitor and evaluate pupils' understanding of questions that are neither factual nor hypothetical, so that pupils less accustomed to systematic and scientific thinking to prove a concept (formula/theorem) (Meyer, 2014).

Indicator (2) performs calculations with clear procedures on broader problems facilitated by a strategy of Gathering Information on a scientific approach. Pupils are used to create material/concepts that have been acquired using this approach. It can be through experimentation, reading materials other than textbooks, witnessing objects/events, conducting interviews with experts, and so on (Pahrudin & Pratiwi, 2019). Teachers should explicitly describe the necessity of keeping records, and before beginning Observation, in journaling, constructing tables, and charting the results, pupils can collect data in great depth (Etheredge & Rudnitsky in (LeBlanc et al., 2017)). Thus, pupils can develop and perform calculations with straightforward procedures when finding problems that are broader than the material/concepts received during the learning process. While the reciprocal teaching approach is different, although there are almost the same strategies, namely Visualizing, in this strategy, pupils are only facilitated to clarify the results of the material read by making diagrams, pictures, tables, or other representations to solve problems (Meyer, 2014). The reciprocal training paradigm prepares pupils to be engaged and self-sufficient in addressing the issues raised by the questions (Hutauruk et al., 2021).

Indicator (3) explains an idea appropriately expressed in their own words, aided by the Communicating approach of a scientific approach. Pupils are accustomed to presenting the outcomes of observations and conversations and conclusions on the analysis's findings, vocally, in the paper, or through other media, in this approach. So pupils are accustomed to explaining concepts/materials using their own words in discussions with other pupils. The viewpoint of Higgins (O'Connell, 2007) states that kids are more capable of comprehending and interpreting the concepts that are the goals of learning if pupils carry out discussions and explain to each other in the ongoing learning process and elaborate. Pupils are assisted in the Summarizing process when using the reciprocal teaching approach (making a summary), which can determine the essence of reading texts from mathematics learning materials (Meyer, 2014). Based on observations, when determining the essence of reading texts, pupils are still not trained to use their own words. Pupils often use words contained in books, so to explain a concept in their own words, pupils are still not familiar with the reciprocal teaching approach.

Indicator (4) uses a mathematical concept to get a new concept, and indicator (5) applies a concept or algorithm to problem-solving scientifically, assisted by the Reasoning strategy. Pupils are habituated to information processing obtained in this approach, which is confined to the outcomes of accumulating activity and the results of observation and gathering information activities (Pahrudin & Pratiwi, 2019). This task is done to figure out how one piece of information relates to another. This strategy refers to the theory of association learning or associative learning, which means that the frequency of memorable experiences is an important part (Basri & Neviyarni, 2021). The reciprocal teaching approach employs similar strategies, like connecting and calculating. Pupils recollect the same material while still relevant to the subject/issue with the Connecting; then, pupils employ and explain a problem-solving strategy in the Calculating strategy. (Meyer, 2014). Therefore, based on observations in the field, pupils taught in a reciprocal approach are still inexperienced with both of these strategies, resulting in much fewer outcomes. The fact that learning occurs during the daytime impacts pupils' thinking power and focus, whereas, with this approach, pupils must think critically. Pupils who follow a scientific approach, on the other hand, learn in the morning so that it gives maximum results. It follows the opinion of Biggers (Magdalena et al., 2020), who explains that studying in the morning is more effective than studying at other times.

Regarding strengthening mathematics understanding abilities, seeing the advantages of studying with a scientific approach versus studying with a reciprocal teaching approach, learning using a scientific approach is probably more effective at building mathematical understanding abilities than learning through reciprocal teaching. However, the outcome is not optimal in terms of achieving the needed mathematical understanding ability. It demonstrates that studying mathematics requires nurturing high-level mathematical thinking processes. Although, it is indisputable that pupils who are taught using a scientific approach logo improve more than pupils who are taught to use a reciprocal approach. It indicates that if learning with a scientific approach is applied consistently, it is feasible to develop kids' mathematical understanding to its maximum potential (Yanti et al., 2019).

The following discussion is related to the relationship between learning courses and PAM grouping, revealing that the teaching class factors employed and the pupils' PAM grouping variables interact. Each scientific and reciprocal teaching approach class has a crossing of such margin average lines between kids with high PAM versus low PAM, indicating an interaction. However, this interaction does not significantly affect pupils' mathematical comprehension skills; this suggests that learning variables and PAM grouping elements have no joint influence on improving pupils' mathematics comprehension abilities. The results of this study are supported by (Agustin et al., 2018), who found that the Search Solve Create Share learning models, which were evaluated based on children's initial understanding of mathematical themes, had no interaction. (Warsito et al., 2020) also found that learning and PAM had no impact on the achievement of mathematical abstraction but found an interaction between growing mathematics abstraction among PAM and learning.

In PAM, the sequence of improving pupils' mathematical comprehension abilities changed only in groups that got reciprocal teaching, whereas there was no change in the scientific class. In addition, there are differences in the learning approaches used, and the differences in the PAM pupils have (Mulyati, 2016). Therefore, it can be concluded that to improve pupils' mathematics comprehension abilities, the teaching done to each experiment group can be used and applied however to all pupils, both high and low PAM groups.

## Conclusion

The study successfully compared the scientific approach and the reciprocal teaching approach in enhancing pupils' mathematical comprehension capacity in class VIII. The research sample should be taken randomly in each class, but in this study, using existing classes based on the considerations of the school teacher and the permission given by the school where the study was conducted. According to the study's findings, there were differences in the ability to comprehend mathematics in the two approaches. The average improvement value in the scientific approach class was more significant than in the reciprocal teaching approach class. Teachers can employ learning using a scientific approach as one of the learning options for pupils to increase their mathematical understanding abilities. More research is needed to investigate the causes of disparities, thus in the development of comprehension skills in mathematics by comparing pupils taught using a reciprocal teaching strategy regarding the pupils' PAM and pupils taught using a scientific approach. Learning and pupils' PAM have no interaction effect. It means that learning in both experimental classes applies to all pupils overall in improving pupils' mathematical understanding ability. These reasons for the lack of interaction effect among instruction (scientific & reciprocal teaching) with pupils' PAM (high and low) on developing the pupils' mathematical understanding abilities should be looked into further.

## Conflicts of Interest

The current article's task substances were actively completed by all researchers. They are also fully responsible for the content. This manuscript publishing has no conflicts of interest for the researchers. The researchers will then bear complete responsibility if ethical issues arise, such as data and content fabrications, fraudulence, plagiarism, copyright breaches, repeated submissions or publications, and redundancies.

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