*Pasundan Journal of Mathematics Education*:
Jurnal Pendidikan Matematika
Vol. 13 No. 2, November 2023, hal. 179 - 194

DOI: 10.23969/pjme.v13i2.7583
https://journal.unpas.ac.id/index.php/pjme

# The Effectiveness of the Think Pair Share (TPS) Model for Increasing Students Mathematical Problem-Solving Ability

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**Abstract**

Mathematics problem-solving ability is a basic need for students to solve math problems. This study aims to investigate the effectiveness of Think Pair Share (TPS) in increasing Students' problem-solving abilities. This study uses a qualitative approach with a library research type. The data collection technique is a documentation study, with the data analysis using inductive and interpretative techniques. The analysis result shows that TPS effectively used in teaching. This can be seen from the N-gain test result that shows the increase of the mathematics problem-solving ability at the high level, The learning outcomes data find three studies that reach the complete outcomes. On the other hand, effect size data shows it reaches the medium until the high level. Furthermore, the impact of TPS on student's learning outcomes is low level, in against to other factors.

**Keywords:** Analysis, effect size, completeness of learning outcomes, n-gain, library research

## Introduction

Mathematics is one of the subjects given at all levels of education, from elementary to higher education. In learning mathematics students need to have the ability to solve problems, because the ability to solve problems is one of the goals of mathematics (Kemendikbud, 2006). Bradshaw & Hazell (2017) state that problem-solving is a student skill that can formulate unique ways to solve problems. Problem-solving is also a basic ability in the process of learning mathematics. Therefore, students need to have mathematical problem-solving skills. As stated by Branca (1980) that this problem-solving ability needs to be possessed by students because (1) problem-solving is the goal of learning mathematics in general, (2) problem-solving is related to methods, procedures, and strategy which is the

main process in the mathematics curriculum, (3) problem-solving is the initial ability in learning mathematics. In addition, according to Ruseffendi and Beigie mathematical problem-solving skills are important in mathematics and other fields as well as in everyday life or real problems (Sumartini, 2016; Beigie, 2008).

Problem-solving ability is also one of the abilities that students need to have and is the main focus in learning mathematics in many countries (Sari, 2015). However, in reality, student's mathematical problem-solving abilities are still relatively low, not a few students experience difficulties in learning mathematics (Kurniyawati et al., 2019; Kania et al., 2020). The low ability to solve mathematical problems is caused by several things, including the lack of preparation of students in learning (Ariani et al., 2017), learning still uses conventional learning (Sugiarti & Dewanti, 2018; Sutiawan et al., 2021), students have not been able to complete problems and are not used to working on non-routine questions (Sugiarti & Dewanti, 2018; Putra et al., 2018; Zakiyah et al., 2018).

To improve such conditions, teachers should provide facilities for students to build their knowledge, and to improve student's mathematical problem-solving abilities. Efforts are made to give a big influence on students by applying a more meaningful learning model. This is because the model can help educators to carry out the learning process properly so that it will affect learning outcomes. Supinah (Wandira et al., 2017) said that for learning to be more effective, teachers need to involve students so that students become more active in the learning process. Of the many alternative models that make students active in learning, this study focuses on using the Think Pair Share (TPS) model.

The TPS model is a model that has the character to solve problems (Hidayati, 2017). This TPS model is a model developed from constructivism theory which involves students in the learning process and the learning strategy is a combination of independent and group learning. So that students can be more active in the learning process because students study in groups, and have the opportunity to convey the results of their discussions to other students. Researchers make this TPS model an intermediary to improve mathematical problem-solving abilities. Because in addition to making students more active in learning, the stages in the TPS model can also train students to think about solving problems

(Suningsih, 2017; Arrosid, 2019). In addition, the TPS model also has stages that require student cooperation in solving problems and finding things (Hardiyanto & Santoso, 2018).

As the name implies, according to Marwanto (2020) this TPS model has three stages, namely: 1) Think which means thinking; 2) Pair, which means a pair; and 3) Share, which means sharing. At the Think stage, the teacher will give a problem to students then students are asked to solve the problem individually, of course, guided by the teacher. In addition, at this stage students are trained to think to understand the problems given so that they can solve them. In the Pair stage, students form groups in pairs, then discuss and exchange ideas with their group mates to solve the problems that have been given. Students are trained to work together and confirm their understanding with their group mates at this stage. And at the Share stage, students can show their participation to others. At this stage, students are trained to be able to convey their understanding and problem solving that they understand and discuss with other friends using their language (Rismayanti et al., 2020). Based on the description that has been conveyed and with the considerations and thoughts of the researcher, the researcher conducted a study with a study that aimed to describe how the effectiveness of the Think Pair Share model was towards increasing student's mathematical problem-solving abilities.

**Method**

The research approach used is qualitative research with the type of library research. In this literature study, researchers collected some relevant literature from previous research related to the variables studied (Yaniawati, 2020). In other words, this literature study research is faced directly with the data presented, researchers only deal directly with data sources that are ready to use and the data used. The data source used in this study is a secondary data source. Secondary data sources are data collected by researchers indirectly by examining the object in question which can be collected through related books, and articles. The data collection technique that researchers use is a documentation study. A documentation study is an attempt to obtain data related to the problem under study in the form of notes or pictures (Indrawan & Yaniawati, 2017).

There are several stages used by researchers in collecting data, namely 1) editing; 2) organizing; and 3) finding (Yaniawati, 2020). At the editing stage, the researcher re-examines the data sources that have been obtained previously, especially in terms of their completeness. At the organizing stage, the researcher groups the data sources that have been obtained in the previous stage with the required framework and the researcher classifies the data sources according to research variables that are interrelated and by the problems that exist in the research. Then, at the finding stage, the researcher conducts an additional analysis of the results that have been grouped to find a conclusion which is the result of the answer to the problem formulation.

In this study there were many participants in each study. In Latifah & Luritawaty's (2020) research, 33 students were studied; Utami & Mulyani (2019) studied 76 students; Wandira et al (2017) studied 70 students; Hanifah & Nuraeni (2020) studied 46 students; Nur et al (2018) studied 343 students; Andi et al (2021) studied 64 students; Sabiq et al (2021) studied 36 students; Rahmatica (2017) studied 36 students; Dwita et al (2018) studied 62 students; Sutrisno et al (2020) studied 80 students; Satriani et al (2019) studied 30 students; Noviana et al (2020) researched classes VIII-4 & VIII-5 (this research did not state how many students were in these classes); Purnama et al (2020) studied 60 students; Tela et al (2019) studied 60 students; Noor & Munandar (2019) studied 86 students.

After collecting several data sources related to the feasibility of the TPS model, then analyzing the data. Data analysis in this study used inductive and interpretive data analysis techniques. The inductive technique is a technique that draws general conclusions from various secondary sources of research. While interpretive techniques are techniques used to retrieve data from various secondary sources in the form of diagrams/tables which will then be explained by the researcher.

In this study, testing the effectiveness of the TPS model was carried out by analyzing data from the results of the pretest and post-test, each of which was conducted in the experimental class. The pretest and post-test aim to measure whether there is a positive influence of the TPS model on student learning outcomes. In addition, researchers also process learning completeness data to see whether student learning outcomes have achieved

mastery learning or not. According to Tambunan et al. (2019), the formulation of the hypothesis for the proportion test is:

$H_0$: $\pi \leq 60\%$ (proportion of students with a poor mathematical problem-solving ability or equal to 60%)

$H_1$: $\pi \leq 60\%$ (the proportion of students with good mathematical problem-solving skills is more than 60%)

Information:

**$H_0$ accepted:** The proportion of students who use the TPS model achieve completeness

**$H_1$ accepted:** The proportion of students using the TPS model did not achieve completeness

Effect size data was collected to see how much influence the effectiveness of the TPS model has on learning outcomes and student's mathematical problem-solving abilities. Tela et al. (2019) state that the results of the large influence can be interpreted using the classification according to Cohen:

**Table 1.** Classification of Effect Size Interpretation

| Big $d$ | Interpretation |
|---|---|
| $0.8 \leq d \leq 2.0$ | Big |
| $0.5 \leq d < 0.8$ | Currently |
| $0.2 \leq d < 0.5$ | Small |

Researchers also processed the N-gain data to measure the increase in mathematical problem-solving skills through the TPS model between before and after learning. Then do the calculation of the gain index to determine the classification of increasing mathematical problem-solving abilities in the class. Agustiana et al. (2019) state that the results of the normalized gain score are classified in Table 2:

**Table 2.** Classification of N-gain Value Interpretation

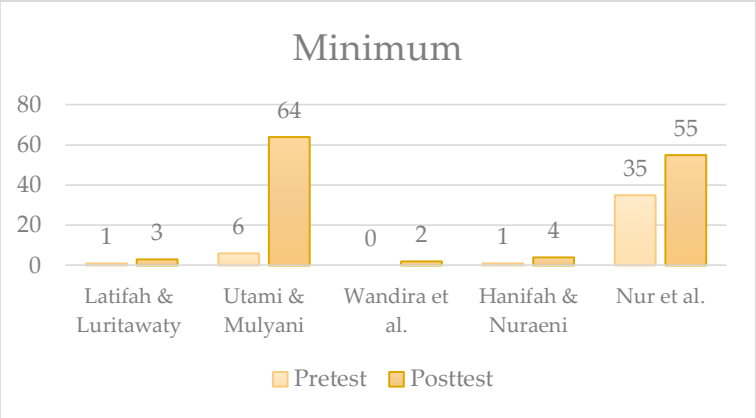
| N-gain Value | Interpretation |
|---|---|
| $g > 0.70$ | Tall |
| $g < 0.30$ | Currently |
| $g \leq 0.30$ | Low |

**Research Results and Discussion**

This research is based on the value data before being treated with the Think Pair Share (TPS) model or commonly called the pretest, the value after being given treatment or

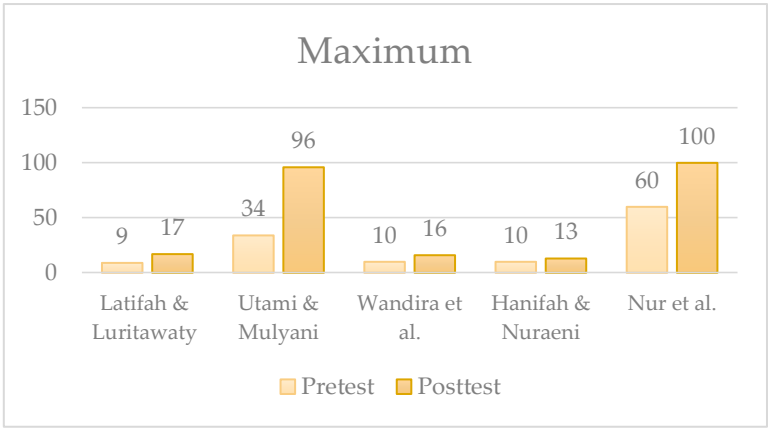
commonly called the post-test, N-gain data, learning completeness data, and effect size data. In the TPS model, some stages make students more active and enthusiastic, and compact it will foster enthusiasm which has an impact on better learning outcomes. Students are also given more time to think about which solution to take when discussing with their group mates, and from that time students can develop their knowledge. In line with what was said by (Pakpahan & Sapta, 2020; Panjaitan, 2019; Kusuma & Maskuroh, 2018) which states that learning using the TPS model can make students more interactive in their groups.

The results of the research that the authors obtained from several articles containing pretest and post-test learning outcomes using the Think Pair Share (TPS) model aim to see the effect of the Think Pair Share model on student learning outcomes. The following is the value data on the students' pretest and posttest.



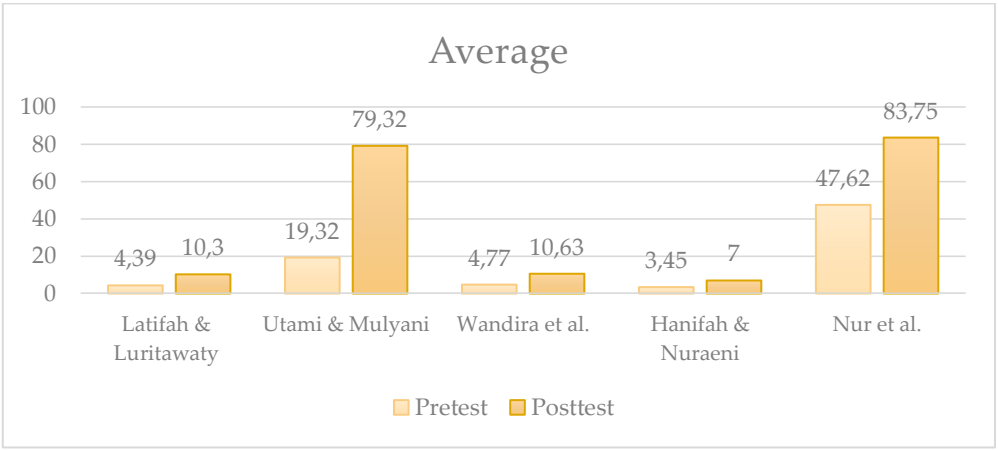

**Graph 1.** Student's Pretest and Posttest Minimum Scores

In Graph 1, if you pay close attention, there are quite large differences between the studies. The research by Utami & Mulyani (2019) is the research that is the center of attention because the minimum scores before and after being treated by the TPS model are very high and are the highest among other studies, which has increased by 58 scores. Then, research (Latifah & Luritawaty, 2020; Wandira et al., 2017) is the study with the lowest increase. This is because students have smart friends to complete their group assignments, the questions given are considered difficult to work on, students experience confusion, and students are confused in determining steps to understand the material and solve problems. Not much different from Hanifah & Nuraeni's (2020) research, the minimum increase in scores before and after being treated by the TPS model is also very low. This is because students still feel unfamiliar with the questions given.




**Graph 2.** Student's Pretest and Posttest Maximum Scores

In Graph 2 the research conducted by Nur et al. (2018) became the center of attention because it experienced the highest increase with a maximum pretest score of 60 and a maximum post-test score of 100. In addition, research by Wandira et al. (2017) is the study with the lowest increase in the maximum value. Unfortunately, the two studies did not mention why their research obtained high and low maximum values and experienced low and high increases.




**Graph 3.** Average Score of Students Pretest and Post-test

Based on Graph 3 shows that the TPS model can affect student learning outcomes. Where the average pretest and posttest scores have increased, although not all studies have experienced a high increase in learning outcomes as in research (Hanifah & Nuraeni, 2020; Latifah & Luritawaty, 2020; Wandira et al., 2017). In Hanifah & Nuraeni's research (2020) the study had the lowest increase in learning outcomes because students in this study were still not used to working on the questions given by researchers, the model was considered new when applied to students, so students were not used to doing it. In addition, the time to get a

learning schedule also affects student learning outcomes, whereas in this study students get a mathematics learning schedule during the day so that students absorption of the material decreases slightly.

Furthermore, based on the results of the analysis carried out by the author to determine the increase in mathematical problem-solving abilities through the results of the pretest and posttest scores. Based on the results of research on articles that have been analyzed by the author, the N-gain results are summarized in Table 3.

**Table 3.** N-gain Data Series

| Researcher | N-gain |
|---|---|
| Andi et al. | 0.17 |
| Sabiq et al. | 0.82 |
| Utami & Mulyani | 0.74 |

Based on Table 3 it is known that there is an average quality of student problem-solving in the high interpretation, in the range $g > 0.70$. As for 1 other study, the quality of students' problem-solving abilities using the TPS model is in a low interpretation, with an N-gain value of 0.17 in the range $g \leq 0.30$. This is because students still do not understand and cannot solve the questions given by researchers. Students are also not used to solving routine and non-routine questions. In addition, this study collaborated between the TPS model and the autograph software. While the largest N-gain value is found in the research by Sabiq et al. (2021) 0.82 which is in the high classification with a range of $g > 0.70$. This is because in this study the model in the comparison class used a scientific approach, so this TPS model was better than the scientific approach.

Then, the research results that the authors got from several articles containing the completeness of student learning outcomes that were given learning through the TPS model aimed at analyzing whether students learning using the TPS model of student learning outcomes were complete. Based on the formulation of the proportion test, the results of the data analysis of the completeness of student learning outcomes are presented in Table 4.

**Table 4.** Completeness Test Data Series of Student Learning Outcomes

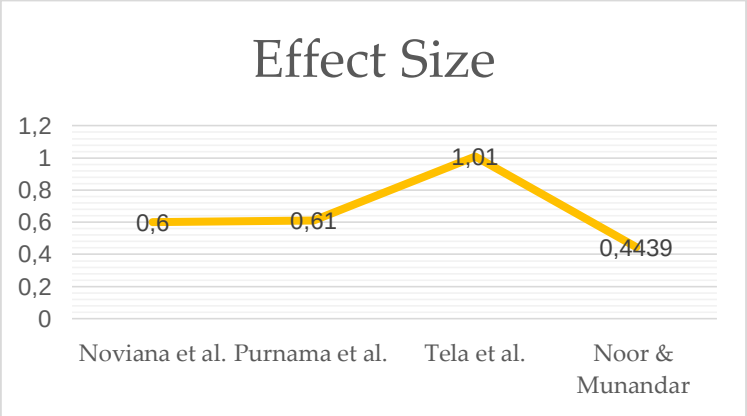
| Researcher | $z_{count}$ | $z_{table}$ | Test Decision |
|---|---|---|---|
| Rahmatika | 2.2622 | 1.64 | $H_1$ accepted |
| Dwita et al. | -0.59 | 1.64 | $H_0$ accepted |
| Sutrisno et al. | 0.34 | 1.645 | $H_1$ accepted |

| | |
|---|---|

| Researcher | $z_{count}$ | $z_{table}$ | Test Decision |
|---|---|---|---|
| Satriani et al. | 2.87 | 1.64 | $H_1$ accepted |

There are three studies (Rahmatika, 2017; Sutrisno et al., 2020; Satriani et al., 2019) in line with research (Mursalim, 2018; Kadir, 2019) which suggests that by obtaining the TPS model students' mathematics abilities and learning outcomes achieve completeness. But different, Dwita et al. (2018) obtained mastery test results $z_{count} = -0.59 < z_{table} = 1.64$, meaning that less than 60% of students whose learning used the TPS model did not achieve completeness. This is because when learning takes place there are several obstacles. Some smart students tend to be individualistic and don't want to discuss with their partners so students who have weaknesses in learning mathematics do not have the opportunity to discuss to improve their mathematical abilities. In addition, the lack of time in the learning process so that the use of the TPS model is implemented less than optimally.

Furthermore, if the TPS model has a positive influence, then we will look for the value of the influence of the TPS model on mathematical problem-solving abilities and student learning outcomes. Based on the results of the analysis, the influence of the TPS model on students' mathematical problem-solving abilities is obtained in Graph 4.




**Graph 4**. Effect Size Data Series

The results of research calculations by Tela et al. (2019), obtained an influence of 1,01 which is in the category of large influence. This means that 84% is influenced by the TPS model and the remaining 16% is influenced by other factors. The magnitude of the influence in this study is a higher influence than the other two studies, this is because students' attitudes towards learning mathematics and the TPS model are very positive. This is evidenced by the results of the questionnaire that was conducted to obtain 4,32 in the range

| | |
|---|---|

$3 < 4{,}32 \leq 5$ for students' attitudes towards learning mathematics and 4,35 in the same range for students' attitudes towards the TPS model, meaning that student attitudes are very positive towards the TPS model. From these results, it is expected that the TPS model is one of the many ways to improve students' problem-solving abilities.

Other factors that influence student learning outcomes can be in the form of motivation to learn from outside or within themselves, self-confidence, interests and ways of learning, and so on (Rahmawati & Setiawan, 2022). This is supported by Zaura & Zubaidah (2018) who states that students' interests and learning methods contribute to and or influence 67.24% of learning outcomes in mathematics. In addition, Saputra (2019) states that one of the factors that influence student learning in solving problems is learning motivation with an effect of 60.8%. Firmansyah et al. (2020) also stated that the level of student motivation will affect their learning outcomes.

Apart from this TPS model having a positive influence, sometimes this TPS model is inferior or less good compared to other learning models. Based on the research by Hasibuan & Juliyanti (2020) that explain the existence of this TPS model is lower than the TAPPS model because students who learn to use the TPS model in their group assignments are less clear so that a lot of time is wasted because misunderstandings often occur between students in their groups. In addition, the application of the TPS model in this research did not make students active in the learning process. This resulted in the TPS model in this research being less effective for use in learning.

**Conclusion**

Based on the results of the research conducted, it can be concluded that the Think Pair Share (TPS) model is effectively used in learning and can improve students' mathematical problem-solving abilities. The effectiveness of the TPS model is seen through the pretest and posttest values, where the average score in all studies has increased in the medium to high category. The N-gain test results data shows that the average increase in mathematical problem-solving abilities is in the high category and the completeness learning outcomes data shows that three studies have obtained complete learning outcomes. In addition, from the effect size data, the influence of the TPS model on mathematical problem-solving abilities

| | |
|---|---|

is in the medium to high range. And for the effect of the TPS model on student learning outcomes is in the low range, almost half of which is influenced by other factors. Even though learning outcomes are influenced by the TPS model in the low range, it is hoped that students can still improve their learning outcomes. The results of this study are used as input for educators and prospective educators, to improve themselves in relation to the learning that has been carried out and the learning outcomes that have been achieved by taking into account the appropriate method or model and the influencing factors to improve learning outcomes.

**Implication**

This TPS model can be used as an alternative in the learning process in order to improve students' solving abilities and can also improve the quality of learning.

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