The effect of Think Pair Share (TPS) using scientific approach on students’ self-confidence and mathematical problem-solving

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Abstract. This study was designed to know the effects of Think Pair Share using Scientific Approach on students’ self-confidence and mathematical problem-solving. Quasi-experimental with pre-test post-test non-equivalent group method was used as a basis for design this study. Self-confidence questionnaire and problem-solving test have been used for measurement of the two variables. Two classes of the first grade in religious senior high school (MAN) in Indonesia were randomly selected for this study. Teaching sequence and series from mathematics book at control group in the traditional way and at experiment group has been in TPS using scientific approach learning method. For data analysis regarding students’ problem-solving skill and self-confidence, One-Sample t-Test, Independent Sample t-Test, and Multivariate of Variance (MANOVA) were used. The results showed that (1) TPS using a scientific approach and traditional learning had positive effects (2) TPS using scientific approach learning in comparative with traditional learning had a more significant effect on students' self-confidence and problem-solving skill.

1. Introduction

Think Pair Share (TPS) is cooperative learning which gives more time for students to think to improve their responses [1]. This method facilitates students to learn higher level thinking skill from their peers. TPS is very useful to help students understanding concepts in learning process [2]. There are three steps in TPS: 1) Think. In this steps, a teacher asks students to think about a question or observation. The students need to think about the answers to the question in a few minutes. 2) Pair. The students discuss their answers in a pair. They compare the answers to find the best, most convincing, or unique one. 3) Share. After finding the answer, the teacher will call for the pair to share their result with the rest of the class. Those characteristics make TPS applicable to mathematics learning [3].

On the other hand, one of the most used approaches learning in Indonesia is Scientific Approach. This approach contains a set of techniques such as how to make an observation, how to interpret results, and how to generalize results to build a scientific knowledge [4]. Based on Ministry of Education and Culture Regulation number 22 the year 2016, scientific approach refers to a set of steps for building knowledge those are observing, questioning, collecting information, reasoning, and communicating. In
a mathematical learning context, this approach will guide students to learn mathematics in a scientific activity [5].

Problem-solving is an important skill for students in learning mathematics. Pimta, Tayruakham, and Nuangchalerm [6] stated that problem-solving is considered as the heart of mathematics learning because the skill is not only for learning the subject but it emphasizes on developing thinking skill method as well. Problem-solving is a vital part of mathematics learning, so its existence cannot be separated from mathematics program [7]. Students who have a problem-solving skill will face the problem confidently. They know the steps to get solutions to a problem. This skill will help students in solving a real problem in their life. In solving a problem, the student will follow steps to get a solution. According to Polya [8], there are four steps in solving the problem that is understanding the problem, devising a plan, carrying out the plan, and looking back. Those steps were used in this study to measure the students’ problem-solving skill.

In learning mathematics, students not only need skill but also attitude. Self-confidence attitude is needed in an academic environment. Self-confidence is an attitude which guides people to have a positive view of themselves and their situations [9]. Students who have self-confidence are better equipped to face a problem in school. That who have a higher level of self-confidence is more successful in solving problems [10]. Confidence students will perform appropriate actions when other people think there are challenges in a situation [11]. This attitude will make students trust their abilities in getting what they want. According to [12], there were five aspects of self-confidence those are confident in his ability, optimism, objective, responsible, rational and realistic. That five aspects were used in this study to measure the students’ self-confidence.

Unfortunately, students still struggle in mathematics due to the assumption that mathematics has a lot of formula [13]. Based on the previous study by [14], it is revealed that students did not have enough problem-solving skill. Students cannot make a complex mathematical model to solve a problem. Some of them just can solve a simple problem with one step to answer. Besides lack of problem-solving skill, students also don't have a good self-confidence. Siregar, Darhim, and Asih, [16] state that there are many students who have low self-confidence.

Previous studies have indicated that learning within TPS group is effective regarding self-confidence [16] and problem-solving [17]. Step “think” and “pair” will facilitate students to improve their problem-solving skill [18] and step "share" will help the student to be confident. On the other hand, D’Amico, and Gallaway [19] states that scientific approach can be used as a way to get a solution of the problem. According to Carey and Wainwright [20], the scientific approach leads students to think about things from a scientific perspective that matches the problem-solving in daily life. It means that if scientific approach conducted well, it would improve students problem-solving skill. This approach also has a potential to develop students’ self-confidence because it has a step "communicating" which will train the student to bravely share his idea. Based on these findings, we decided to examine whether the combination of TPS and scientific approach is effective in term of students’ self-confidence and problem-solving skill.

Using the purpose of this study into consideration, the following hypotheses were developed: (1) Think Pair Share using a scientific approach and traditional learning is effective in term of mathematical problem solving and self-confidence. (2) When Think Pair Share using a scientific approach and traditional learning are compared regarding problem-solving and self-confidence, the TPS using scientific approach is more effective.
2. Methods

This study was quasi-experiment research, the study to estimate the causal impact of an intervention on its target population. Pre-test post-test non-equivalent group method was used as a basis for design study. To see the effect of the learning method, it was carried out in five meetings for each class. Observation sheets were used to observe and record the implementation of the two learning methods. Problem-solving test and Self-confidence questionnaire mathematics test used as both pre-test and post-test measuring tools. The problem-solving test was an essay test with five problems about sequence and series. The self-confidence questionnaire was a Likert scale questionnaire which consists of 25 items. Content validity was established by three-expert judgment, who ensured that the items were properly constructed and relevant to the aspects we developed. By measuring Cronbach’s Alpha coefficient on 101 students in the initial phase study, the mathematics problem-solving pre-test ($p=.621$), post-test ($p=.625$), and self-confidence questionnaire ($p=.835$) were reliable. The learning method learning would be effective in students' problem-solving and students' self-confidence if the value of the post-test student in good criteria or very good criteria based on Table 1.

| Problem-solving Category | Self-confidence Category | Criteria     |
|--------------------------|--------------------------|--------------|
| $X > 43$                 | $X > 85$                 | Very Good    |
| $32 < X \leq 43$        | $70 < X \leq 85$        | Good         |
| $22 < X \leq 32$        | $55 < X \leq 70$        | Pretty Good  |
| $11 < X \leq 22$        | $40 < X \leq 55$        | Less Well    |
| $X \leq 11$             | $X \leq 40$             | Not Good     |

Where $X$ is total student’s problem-solving / self-confidence score.

2.1 Population and Sample

The population in this study was 101 first grade students in religious high school student (MAN) in Indonesia who are distributed in three class. They take religious lessons in addition to regular school lessons. All the participants were between of 16 and 18 years old. Using random cluster design, two class was randomly chosen as a sample. The first class that consists of 34 students was treated as an experimental class and the second class which also consist of 34 was treated as control class.

2.2 Treatment

The cooperative learning method Think Pair Share (TPS) using scientific approach was applied to the first class, and traditional learning method based on mathematics book was applied to the second class. In the first class, student worksheet was given to each student. This worksheet contains not only the materials but also the instruction on how they should study in the pair. In the second class, the teacher was asked to use his owns conventional instructional method using mathematics book.
2.3 **Think Pair Share (TPS) using Scientific Approach**

The application steps of TPS using Scientific Approach are presented below.

**Step 1 Think (Observing)**

In the first step, teacher facilitated students to observe (seeing, reading, and listening) a case on their worksheet. Teacher-guided the students to make a better observation so they will close to the goal of the lesson.

**Step 2 Think (Questioning)**

Students made questions based on their observation. Teacher-guided students to construct the questions by giving a sample question. The question would guide students through the next steps. In this steps, students worked on their worksheet individually.

**Step 3 Think (Collecting Information)**

After having questions list, students then had a chance to find the information. They could search the information online or from textbooks. Using their information, they tried to solve the problem.

**Step 4 Pair (Reasoning)**

Students discuss their thinking result in the pair. They tried to find the connection between the information to judge the truth of their problem-solving. After that, they should make a conclusion based on their process.

**Step 5 Share (Communicating)**

Some pairs present their result in front of the class. The other pair gave feedback by asking or comparing their result. The teacher guided the discussion class to the goal of the lesson using simple, direct questions.

2.4 **Traditional Learning**

In the control class, traditional method was used. This class used the same goal lesson and the same mathematics books as in the experimental group. Teacher teach the student using his daily instructional method. The method based on three principles, i.e., explaining, practicing, and memorizing.

The teacher explained materials based on the mathematics books, gave a worked example of mathematics problem solving, then asked students to solve the same type of the problems. The steps of problem-solving were explained by the teacher in detail. Later, students had a chance to ask a question about the explanations. Students who had been memorized the problem-solving algorithm then worked some exercise in the book. While the student worked the exercise, the teacher walked among the students and helped students to solve the problem. After student finished the exercise, the teacher asked some students to solve the mathematics problems on the board. Meanwhile, the teacher would help students to solve the difficult problem. After the lesson, the teacher gave homework to the students, which was discussed in the next class.
2.5 Data analysis

We used an alpha level of .05 for all statistical tests. For the analysis of the problem-solving and self-confidence data a One-Sample t-Test, Multivariate of Variance (MANOVA), and Independent Sample t-Test were made. First, univariate normality and homogeneity test was carried out. Normality test was conducted using Kolmogorov–Smirnov test and homogeneity test was conducted using Leven's test. The result revealed that all data were normally distributed and homogeneous. One sample t-test was carried out to observe the effect of the TPS using a scientific approach and traditional learning methods.

After that, the multivariate normality and homogeneity tests were made. Mahalanobis test showed that the data were normally distributed. Box's M test showed that the data were homogenous. MANOVA was used to determine whether the means of the problem solving and self-confidence pre-test score of the two groups differed significantly. The result showed that there was no significant difference between the means of pre-test score. However, MANOVA test on problem-solving and self-confidence post-test data showed that there was a difference between means. Because of these result, Independent Sample t-Test was carried out to determine the direction and observe any signification of the differentiation.

3. Result and Discussion

The hypotheses in introduction can be separated into four which are: 1) TPS using scientific approach is effective, 2) Traditional method is effective, 3) compared with students who are taught in traditional method, students who are taught in TPS using scientific approach had better problem-solving skill, 4) compared with students who are taught in traditional method, students who are taught in TPS using scientific approach have better self-confidence. Using Kolmogorov–Smirnov and Leven’s tests, it is known that the data are normally distributed and homogeneous. Because of these result, One-Sample t-Test is carried out to ensure that both methods have a positive effect on students' self-confidence and problem-solving skill. TPS using scientific approach learning is effective in term of students’ problem-solving ($M=41.21$, $SD=5.12$), $t(34)=10.481$, $p=.000$ and self-confidence ($M=75.97$, $SD=4.834$), $t(34)=7.203$, $p=.000$. Traditional learning is also effective in term of students’ problem-solving ($M=37.76$, $SD=5.788$), $t(34)=5.714$, $p=.000$ and self-confidence ($M=73.30$, $SD=5.593$), $t(34)=3.393$, $p=.002$. It is confirmed that the first and the second hypothesis were right.

After that, multivariate normality and homogeneity test was carried out. Mahalanobis distance test shows that before and after treatment data was normal. Box’s M test shows that all data was homogeneous on before treatment data ($p=.337$) and on after treatment data($p=.17$). As the data had a normal distribution and homogenous, MANOVA test using $T^2$ Hotelling criteria was used to determine whether there was a significant difference between the means of the pre-test and post-test of the two groups. MANOVA test result showed that there was no significant difference between the means of pre-test score ($p=.380$). Because of this, the next MANOVA test was carried out using after treatment data. The result shows that there was a significant difference between the means of the post-test score ($p=.03$). To determine the direction and observe any signification of the differentiation, Independent Sample t-Test was used.

Independent Sample t-Test on problem-solving data confirm the third hypothesis. Students who are taught in TPS using scientific approach had higher problem-solving score ($M=41.21$, $SD=5.12$) than students who are taught in traditional method ($M=37.76$, $SD=5.788$), $t(34)=2.585$, $p = .012$. Based on self-confidence data, the fourth hypothesis also confirmed that students who are taught in TPS using
scientific approach had higher self-confidence score \((M=75.97, SD=4.834)\) than students who are taught in the traditional method \((M=73.30, SD=5.593)\), \(t(34)=2.091, p=.04\).

The superiority of TPS using scientific approach compared with traditional learning can be explained with its support to cognitive development. In TPS learning with the scientific approach, the students will be facilitated with the advantages possessed by the TPS learning and scientific learning. In steps “Think” students making an observation, making questions, and collecting information. These three processes will train students to determine the appropriate steps in the process of building their knowledge. The ability to determine appropriate steps will increase students’ self-confidence [11].

Lauster [12] states that one's self-confidence will be gained through the experience it has. Students who have experience in solving a problem will be confident in his ability to solve other problems. It is trying to be trained through observation, questioning, gathering information, concluding and communicating on TPS using the scientific method. In Think Pair Share method students are responsible for their learning outcomes (in the process of think) and they are accountable to the group to achieve goals together (in the process of a pair) [16]. This situation will increase student responsibility in individual or group work. At the steps “think” students were asking and gathering information that will train them to think in a realistic and rational way [21]. They use their logic to identify the right questions based on the problem. Furthermore, to solve the problem, students are gathering information. They select information relevant to the problems they are facing. This activity will improve students’ optimism because this aspect is needed in creative mathematical problem solving [22]. At the step "share" the student delivers the results of his discussion and receives feedback from the other pair. This process will help students to improve their objectives, especially in addressing each input given. Because confident in his own ability, responsible, optimism, objective, realistic and rational are the aspect of self-confidence so when those aspects were increasing by TPS using scientific approach the self-confidence will also increase in the same time.

During the TPS learning process, students will also develop problem-solving skills. At the "think" step students practice understanding the problems they are facing [16]. This skill is facilitated through an observation process by the students. When Students have a good understanding, they will able to devise a suitable solution plan. Furthermore, at “pair” step, they made the process of reasoning to solve a problem. In reasoning process, students used principles and their experience that allows them to at a conclusion [18]. Step "share" helps students to improve their looking back skill because at this step they will get recommendations from their friends. Therefore, students’ problem-solving skills will increase.

Whereas in traditional learning, the teacher directly teaches the material so that students will more quickly understand. Also, teachers also provided opportunities for students to solve problems directly in front of the class [23]. This process will improve students’ problem-solving skill and self-confidence. Other studies have also shown similar results with these results. Mutakinati, Mudzakir, and Supriyanti [17] showed that TPS could improve students' problem-solving skills compared with the traditional method. Also, Sampsel [16] stated that TPS could increase students' self-confidence in mathematics and ability to contribute to the class discussion more than the traditional learning.

4. Conclusion

This study examined the effect of Think Pair Share using scientific approach learning method on improving students' self-confidence and problem-solving skill. The result supported the hypothesis of the study. Data analysis in problem-solving test and self-confidence questionnaire indicated that TPS
using scientific approach learning method and traditional learning method were effective. However, students who are tough in TPS using scientific approach learning had better problem-solving skill and self-confidence compared with students who were taught in traditional learning. This learning method may provide opportunities to improve students' problem-solving skill and self-confidence.

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