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Implementation of think-pair-share to mathematics instruction

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ABSTRACT

The purpose of this research was to study the procedure of think pair share, the type of cooperative learning models, which can be implemented in mathematics instruction in Manokwari, West Papua Indonesia. This study was conducted at Senior High School in Manokwari (SMA Negeri 1), Manokwari West Papua Indonesia. The research was carried out using research and development methods. The Think Pair Share learning model was modified to get the procedure of implementation in accordance with the characteristics of students studying mathematics in Manokwari, West Papua. The results of the research showed that there were two principals in the application of the think pair share model in mathematics instruction in Manokwari West Papua, selection of group members and the determination of the number of group members. Students individually start thinking of finding answers to the assignment submitted. Group members must consist of students who already know each other well, but should not to have a similar level of knowledge, while the number of group members must start from two students.

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1. INTRODUCTION

Mathematics in Indonesia education is one of the subjects studied at all levels of education, from elementary schools to universities. This confirms that mathematics is a principal subject, especially in the development of science and technology [1]. Mathematics is also a subject that is useful for improving students' thinking abilities [2, 3]. Even so, there are many students who think that mathematics is a challenging, unpleasant, even frightening subject, so there are some students who have difficulties in solving math problems [4]. They are considering that mathematics is not a valuable lesson that has to be appropriately studied. As a result, students tend to less active in mathematics instruction. They cheat a friends' homework, rarely do the assignment, reluctant to pose a question, and they have difficulty to answer the teacher's question.

Some factors that cause mathematics students to be inactive and unable to interact with other students are differences in background, religion, ethnicity, culture [5], motivation, self-confidence, and level of intelligence, especially understanding of previous subject matter [6], and some various other factors. Based on these points, mathematics teachers have an obligation to improve student learning activities. The teachers must try a selection of approaches so that students can be active in learning.

Learning activities are interactions between teachers and students in the classroom. The teacher as the initiator, director, and supervisor, while students as objects and subjects are actively involved in all learning activities. The more active in learning activities, the more changes in students' attitudes, especially changes in knowledge, attitudes, and skills in learning. These changes will have an impact on improving learning outcomes. Therefore, the teacher has a crucial role in the success of students in their learning

achievement. One effort that can be done by the teacher is to use a learning model that can condition students to learn actively so that they can interact with other students. One of active learning model that can be used is the cooperative learning model [7].

The cooperative learning model is an instructional model that requires students to be responsible for themselves and their group. By using the learning model, students will more easily find and understand difficult concepts. They are discussing with their peers regularly working in groups to help each other in solving complex problems. So, the cooperative learning model improves not only knowledge but also social development skills and communication [8]. When learning in a cooperative model, students have to be active and participate in all of the learning processes by searching for new information to be studied independently with available materials [9].

Furthermore, students in the cooperative learning atmosphere have opportunities to help each other to improve their achievement and retention, increase self-esteem and inherent motivation, and develop more positive attitudes toward learning skills and social skills. The cooperative learning helps students to learn academic knowledge under the supervision of a teacher, and at the same time they can develop communication skills and values through collaborative interaction [10].

In a cooperative learning model, there are several types of learning techniques, such as Number Head Together, Jigsaw, Make a Match, and Think Pair Share. Think-Pair-Share (TPS) is an instructional strategy designed to providing students a topic for thinking about. The learning model is facilitating students to generate opinion individually and share it with another. TPS is a learning approach to persuade student classroom involvement. Contrary to the classical method in which a teacher poses a question and one student offers a response, TPS encourages a high degree of student's response and can help keep students on task.

The think-pair-share has some advantages. Students have a lot of time to think, respond, and help each other. The teacher only to deliver the material briefly, request a problem, and then supervises students to think more deeply about the content that has been described and experienced. This method can encourage students to be enthusiastic in working together. Therefore, by applying the type of cooperative learning, learning outcomes of students who learn on their own are better.

The think-pair-share learning activity is learner-centered instruction. The model is a collaborative teaching strategy that widely used in higher education. The TPS activity encourages student learning through a sequence of three "stages." First, students thinking about the subject matter individually, then pair with a partner in class to discuss the assignment, and finally, share thoughts from their debates with the class. TPS is considered to not only improve student learning, but it also participates in all students in discussions, including those who may be more reserved and less likely to share unprompted in the class [11]. Teachers should evaluate how students understand the assignment by walking around to listen in on some groups reflections before then facilitating a more considerable class discussion [12].

Some educational research results confirm that the TPS learning strategy can be applied in various scholarly disciplines of instruction. Most of these studies show that there is an increase in student learning activities and student learning outcomes when the teaching is carried out using the TPS learning model. English education is one of many subjects that apply this model in learning [13, 14]. This learning model is also used to other disciplines to improve students' learning outcomes, such as computers [15], physics, chemistry, biology, and even in statistics [10] and mathematics [16]. In mathematics, TPS can also be applied in various fields study, such as geometry [17], probability [18], and to improve multiple aspects of instruction in mathematics, such as communication ability [19], learning motivation [16, 20], and critical thinking [9].

However, there are various procedures that researchers use in implementing TPS. The learning model, according to Teacher Vision [21], is a cooperative model that encourages individual participation and is applicable across all grade levels and class sizes. During the model implementation, the students think through assignment using three distinct steps:

- Think: Students think independently about the question that has been posed, constructing their own ideas individually.
- Pair: Students are grouped in pairs to discuss their opinions. This period allows students to communicate their ideas and to consider those of others.
- Share: Student pairs share their ideas with the class. Often, students are more comfortable presenting ideas to a group with the support of a partner.

Another example TPS implementation procedures, as used by Lightner, J. and Tomaswich, L. [22] in their study are as follows:

- Think: Pose an open-ended question for students to answer and ask the students to think individually for about a minute and write down their thoughts.
- Pair: Ask them to turn to the person next to them (groups of 2 or 3 only) & share their thought process/answer with each other
- Share: Prompt students to report out on "behalf" of their group

Meanwhile, procedure used in implementing TPS is as stated by Tint, San San and Nyunt, Ei Ei [15] as follows:

- Think: Group members of student think about a problem or issue individually.
- Pair: The student then discuss their thoughts with a friend.
- Share: Finally, large group of students summarized the presentation of some students.

Based on the three examples, it can be decided that the procedure for implementing TPS is as follows: students individually think of the answers to the problems presented by the teacher. Students then pair up to convey what they have thought. They discussed to get the best solution. Finally, students then share the results of their discussions in front of the class. Other students respond and summarize the answers.

Furthermore, the researchers' experience shows that the use of TPS in mathematics has several obstacles. Low ability students were always waiting for smarter students' presentations. This situation causes the dominance of intelligent students in classroom activities. This resulted in the process of mathematics instruction by applying the TPS model, not going well [10]. As a result, all students have assignment' answers, but not all of the students involved in the process to generate the solution. Not all students are thinking to elicit a solution. Thus, this is contrary to the intended use of the learning model TPS.

Based on these problems, several questions need to be answered: How to implement TPS in mathematics instruction? Have each student free to choose a partner? How can students acquire the right partner? What is the procedure, especially in determining student pairs for mathematics teachers to apply TPS in their lesson activities in Papua? What procedures in TPS need to be modified so the model can be implemented in mathematics learning in Manokwari? Thus, the purpose of this study is to modify the procedure of TPS so that it can be applied in mathematics instruction, specifically in accordance with the character of students in Manokwari, West Papua.

2. RESEARCH METHOD

This study was carried out using Research and Development Method (R&D), which is a research method to achieve new knowledge that it might apply to create new technology, products, services, or systems [23]. The research method in education is known in several names, one of which is Design and Research Development. The purpose of the process is to develop new or improved strategies to accomplish well-specific objectives [24].

The product of this research is a new TPS learning model strategy so that its application is in line with the characteristics of mathematics instruction and mathematics students in Manokwari, West Papua. In other words, the researchers adapted the TPS so that it obtained a procedure that was appropriate to the teaching of mathematics, especially in Manokwari, West Papua.

Implementation and evaluation of the TPS procedure was carried out as follows: students individually reflect on subject matter, then pair with a partner in class to discuss the information, and finally share ideas from their discussions with the class as a whole [12].

The researcher conducted this research on SMA Negeri 1, Manokwari West Papua. There are 39 Students of Senior Higher School who participated on this study. The study was conducted in 4 learning periods. Reflection is carried out at the end of each lesson using the results of observation and tests. The results of reflection are used to modify further learning.

The instruments used in this study were the observation sheet, oral test and written test. Observation are used to evaluate student learning activities, which are carried out on each lesson. In order to increase the validity of the study, the researchers conducted triangulation through structured interviews with several students. Triangulation acording to Tanujaya and Mumu is a technique that utilizes data checking something else beyond data for checking or comparison of the data. Triangulation can be done in several aspects, such as the method, time, place, data sources, and researchers [25]. In this study, to ensure the validity of the data, then conducted interviews with several students. The students interviewed are students who are very active and who are not active in learning.

Oral tests were conducted randomly, especially for students and groups of students who do not presenting the results of their discussion. Students are asked to convey what was heard in summary form. According to Tanujaya, to find out what students have learned every day, what they are known, what are they heard, and what are they've seen in learning, the teacher would have to ask the students to submit a summary of the results of the discussion [26].

Written tests are carried out every day to evaluate student learning outcomes individually. Conducting the tests every day is useful for teachers to find out the knowledge each student has. According to Tanujaya by knowing what is mastered and unknown by students, teachers can design appropriate learning until the next learning process can take place properly. Thus, the use of daily assessment in learning can improve student learning outcomes [26, 27]. The test is an achievement test, i.e. a test designed to measure the comprehension or proficiency of an individual in something that has been studied.

The result of observations and tests are the basis for determining the next learning design. Besides the test results, teachers can find some information about students understanding through some classroom activities, comments, explanations, questions, and answers [28]. If learning activities are not going well and the learning outcomes are still low, it is necessary to evaluate the learning design, especially in determining the pair of discussions.

3. RESULTS AND ANALYSIS

The results of research measured in two main indicators, student's classroom activities and learning achievement. Student classroom activities are the activities of students in the classroom when asked questions, delivered the answer, did argument and provided a suggestion, while students' learning achievement is the result obtained by the students at the time of assignment, both oral and written tests. The research results in two indicators, students' activities and students' achievement are presented in Table 1 and Table 2.

Table 1. Description of student's activities during the lesson

Time of observation	Students' activity
First lesson	Some pairs have not shown cooperation, some still ashamed, and did not dare to present the results of their discussions
Second lesson	Most of the students involved in the discussion with the pairs, but there are some groups that do not meet an agreement.
Third lesson	Discussion getting better, but still there are some groups that not willing to presented the results of their discussion
Fourth lesson	Discussion is more conducive. Almost all students have the courage to present the results of the discussion

In Table 1, it appears that there is a significant development in students' learning activities compared to the previous learning. Here is presented the improvement of student activities for four lessons.

3.1. The first lesson

The lesson was conducted using TPS procedures. After thinking about the assignment individually, students are paired with classmates or those close to them. They were asked to discuss the task before presenting the result of their discussion. Unfortunately, some students are not too involved in discussions with their pairs.

Generally, they are embarrassed to express their opinions during the discussion. The results of observation showed that these students are those who have a lower level of knowledge than others in the class. The students tend to have low self-esteem. Self esteem is evaluations made by individuals and is associated with an appreciation of himself. Individuals tend to express attitudes agree or disagree, and be sure whether he is able or not to do something.

There is a positive relationship between self-esteem and academic achievement. The higher the student's self-esteem, the higher the academic achievement. Students with low self-esteem tend to have low academic achievement as well [29]. On the other hand, the purpose of using TPS is to increase students' self-esteem [10]. Thus, if student self-esteem is still low, then there are obstacles in the implementation of learning. Therefore, the teacher needs to make some corrections so that learning can be more productive, especially to increase student self-esteem.

In order to increase the participation of all students in learning activities, especially those who have low level of knowledge, then instruction at the second lecture conducted as follows.

3.2. The second lesson

Based on result of observations at the first lesson, the choice of student pair implemented based on the level of knowledge. Students are asked to looking for a pair who has a similar level of academic performance, not sitting nearby. It is expected that the pair have the same academic ability, discussion could take place. This expectation shows something encouraging.

The results of observations on the second lesson showed that students began to conduct discussions well. Students begin to show that they had been thinking individually. But in some cases, especially in case of disagreement the discussion does not provide the right solution, and tends to dead-lock. On the other hand, a pair of students who have low level of knowledge, tend to be quiet and not do a good discussion.

On the other hand, in learning mathematics, mathematics students are expected to express what is thought in the discussion. The better the ability to think, the more successful students are in learning

mathematics. Students who study mathematics should think mathematically individually [26, 30]. They have to learn mathematics by/for themselves [23, 31].

Because the instruction is still not going well, some modifications were made in the selection of discussion pairs, as did the following instruction.

3.3. The third lesson

As in the previous lesson, before establishing a group pair, each student works out the assignment individually. Students are then asked to form groups by finding friends who know each other well. They both don't have to have a similar level of knowledge. Once the group is established, the discussion is running well.

However, there are some pairs who lacked the courage to express opinions. At the time asked to present the results of their discussion, they just smiled and did not dare to presented the results of their discussion. Some groups of students did not dare to present their answers because they were not sure of the answers. They do not have enough confidence to express their ideas in public.

Unlike self-esteem which refers to how a person feels about himself, self-confidence is how someone feels about his abilities. Self-confidence is defined as believing in their capabilities, dare to express an opinion, independent, optimistic, and responsibility for completing the task [32]. The confidence that can vary from one situation to another, but there is a positive relationship between self-confidence and mathematics achievement. Students who have low self-confident in learning tend to have low learning outcomes [33]. Therefore, it is necessary to improve the self-confidence of students.

Self-confidence of a student can be improved in several ways, one through the help of friends who have better academic ability [34]. Therefore, to increase students' confidence in being able to present what they produce during paired discussions, it is necessary to form larger groups. New group members should have higher academic ability than existing group members.

3.4. The fourth lesson

As a result of reflection on previous lessons learned, before the students presented the results of their discussion, then formed a new group. The new group consisting of three students, two students from the initially group, one student from another group of higher academic ability than two people in the initially group. If needed, a new group is formed by adding one more member so that each group consists of 4 students.

New members in each group to provide additional information in order to strengthen the answers that have been produced. New group members can also contribute correct answers. It increases self-confidence of each student to present the results of their discussion.

Discussions on this fourth lesson went very satisfactorily. Most of the students involved in the discussions. Almost all students have the courage to present the results of their discussion. They also did not hesitate to give a rebuttal if a friend was mistaken when delivering the results of their discussion. Learning more ideal on this fourth day.

The success of this learning can not be separated from the ability of teachers to reflect and find solutions to improve the quality of learning, particularly in the preparation of a discussion group. The ability of teachers to establish groups is one of the important factors in determining the success of an instruction. Incorrect group formation can cause discussion in the implementation of cooperative learning models to be useless [35].

Table 2. Description of students' achievement during the lesson

Time of observation	Students' achievement
First lesson	Less than 50% of students were able to answer correctly
Second lesson	About 70% of students were able to answer questions correctly
Third lesson	About 75% of students were able to answer questions correctly
Fourth lesson	About 90% of students were able to answer questions correctly

Table 2 confirmations that there were increase in the number of students who answered problems correctly, from one lesson to another lesson. This table shows that there is a tendency for a positive correlation between students' learning activities and students' achievement in learning. The more active students are in learning, the higher the student's learning achievement.

The students' achievement progress, as shown in Table 2, is consistent with some research, which states that there is a match between increasing student learning activities and attitudes towards mathematics [36], and which concluded that student learning activities affect the learning outcomes [37]. Thus, it can be

stated that the TPS learning model used is useful in increasing learning activities. The TPS learning model has improved the learning activities, as well as improve student learning achievement.

As a type of cooperative learning, TPS helpful to increase students' classroom activities [10]. Cooperative learning is not only to promote the student's achievement but also to inculcate the self-development as a comprehensive person. Each student contributes in the groups to promote all students' performance. Students involve classroom activities and changed their learning behaviors, stimulated their cognitive activity, and improved their relationships [38].

4. CONCLUSION

Think-Pair-Share, a type of cooperative learning model can be implemented to mathematics instruction in senior high schools in Manokwari West Papua. The implementation needs some modifications to the procedure, particularly in the choice of pairs. When the implementation of the model, students should be paired in groups of two before they were randomly grouped in bigger groups, for example, groups of three, then groups of four. The bigger groups were formed after the smaller groups finish discussing the teacher's assignments. Pairs of students are those who already know each other well, should not have a similar level of academic performance.

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