Improving concept comprehension ability in mathematics by using mathematical model: Think-pair-share approach

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Abstract. This study aims to investigate whether or not there is the difference between students’ mathematics concept comprehension ability by using Think Pair Share (TPS) approach and by using direct learning reviewed based on their preliminary ability (high, medium, and low level). This research was a quasi experiment by using post-test only control group design that aimed to investigating the cause and effect by treating one of classes, and comparing the result of the class that was treated differently. Methods of data collection in this study through observation, documentation and test, involving 42 students of senior high school in Pekanbaru in the even semester of 2017. T test was used to analyse the data. The results showed that there are difference between students’ mathematics concept comprehension ability by using TPS approach and by using direct learning reviewed on their preliminary ability to learning outcomes. Classes with TPS approach give better learning outcomes than the ones in direct learning classes. Thus, in general the implementation of TPS approach influenced students’ mathematics concept comprehension ability reviewed based on their preliminary ability at Senior High School in Pekanbaru.

1. Introduction
In the process of learning mathematics, understanding mathematical concepts is a basis for continuing to the other main material. If a student does not understand the basic concepts in the process of learning mathematics, then for the next stage it will be more difficult, because in mathematics learning, the learning materials with one another are interrelated [1]. The preliminary ability of mathematics is one of the abilities that can be the basis for achieving the goals of understanding mathematical concepts. The preliminary ability of mathematics is the foundation for the formation of new concepts in learning. The preliminary ability of students is the process carried out in order to know the knowledge mastered by students before participating in the learning process, not to determine the pre-requisite ability in selecting students before participating in the learning process [2].

One of the causes of the lack of understanding of concepts in mathematics learning is that students just stay quiet and do not dare to ask when they do not understand the new material given by the teacher. This results in students forgetting the concept of material that has been studied before. For that, the teacher needs to design a learning that familiarizes students to construct their own knowledge, so that students better understand the concepts being taught. Concept understanding is a competency shown by students in understanding the concept and in performing procedures (algorithms) in a flexible, accurate, efficient and appropriate manner [3].
Based on preliminary studies conducted, researchers found that students’ conceptual understanding was still low. Students tend to only understand the mathematical concepts explained by the teacher, if a mathematical concept is not explained in advance, students are not motivated and do not try to understand a given concept. The failure of the purpose of a mathematics learning process is not only due to difficult mathematics, but is caused by several factors, including students themselves, teachers, learning methods / media and learning environments that are interconnected with each other.

An innovation or models in learning is quite necessary to make students actively in the learning process. The learning model cooperative learning types Think-Pair-Share (TPS) is one of the learning models that work in groups to help each other solve complex problems by grouping students in the group small [4]. Each group consists of 2 students who are different (heterogeneous), there are men and there are women in academic ability, there is a smart, moderate and weak. Members in each group of mutual learn together to accomplish academic tasks [5].

TPS has been recommended for its benefits of allowing students to express their reasoning, reflect on their thinking, and obtain immediate feedback on their understanding [6]. The result of Rosita and Leonard’s study showed that TPS has a significant effect on student’s mathematics concept comprehension ability [7]. The result of Azlina’s study also showed that there is a significant effect by using TPS with Contextual Teaching and Learning (CTL) approach on student’s mathematics concept comprehension ability [1].

Based on the background of the problem, we are interested in doing research on an analysis of student’s mathematics concept comprehension ability based on their preliminary ability by using TPS model. The purpose of this research is to analyse the influence of the application of the cooperative learning type TPS against mathematical concept understanding capabilities are reviewed based on the ability of the students.

2. Method
The design of this research was quasi experiment by using post-test only control group design which classifies the class into 2; they are experimental class using TPS approach and control class using direct learning on the trigonometric material. Sample of this research is 42 students of class X as many as 2 classes in senior high schools in Pekanbaru in the even semester of 2017. The sampling technique used in this study was purposive sampling. Methods of data collection in this study through observation, documentation and test. The researcher made observations by using observation sheets to observe the activities of students who were expected to appear in mathematics learning using TPS approach performed every time face to face. The test were used as the preliminary ability test and the final test. In the case of reviewed based on the preliminary ability, all of students were given a preliminary ability test to determine each level (high, medium or low), then grouped according to each level. The test with trigonometric material was used as the final test.

In implementing the TPS approach, the researchers carried out three main steps as a characteristic of this model, namely think, pair, and share. Table 1 describe activities with TPS approach.

| TPS  | Activities |
|------|------------|
| Think | The teacher asks a question or problem that is related to the lesson, and asks students to use a few minutes to think for themselves the answer or problem. Students need an explanation that talking or doing is not part of think. |
| Pair | The teacher asks students to pair up and discuss what they have gained. Interaction during the time provided can unify the answer if a question is asked or unify the idea if a specific problem is identified. Normally the teacher gives no more than 4 or 5 minutes to pair up. |
| Share | The teacher asks couples to share with the whole class they have talked about. It is effective to get around the room from a partner to a partner and continue until around a couple of couples have the opportunity to report. |
The instrument consisting 5 items, but only 3 items will be discussed in this study. The three tasks are presented in Table 2. Tasks 1, 2 and 3 are intended to collect and process information to make conclusions and using procedures to solve problems related to sine rules.

Table 2. Trigonometry tasks used in current study.

| No | Trigonometry tasks |
|----|--------------------|
| 1  | In the $\Delta ABC$ known length $b$ is 10 cm, the angle $A$ is $30^\circ$ and the angle $B$ is $45^\circ$. Calculate side length $a$ |
| 2  | It is known $\Delta PQR$ with $\angle P = 120^\circ$, side length $QR = 8$ cm and $PR = 4\sqrt{3}$ cm. The angle of $R$ is. |
| 3  | Three people are in three places, for example at point A, point B and point C in a field, so that the angle and the large angle. The first person who is at point A moves towards C with a speed of 12 km/hour, while the second person is in B moving to C too. The first person and the second person move at the same time and arrive at the same time. Determine the second speed that moves from B to C. |

The time given to complete everything that is 90 minutes. Finally, we analysed student written work and compared these empirical to theoretical expected result. The analysis included analysing students’ ability of identifying the use of various related concepts in the solution process. The research instrument used is validated test by expert and then tested the validity using Product Moment correlation formula, reliability using Alpha formula, difficulty level, and discrimination index test. The data analysis used in this research is T-test.

3. Result and discussion

This section present result of the data analysis of the three tasks and compare them with student’s preliminary ability: Tasks 1, 2 and 3 assessing student problem solving skills of trigonometric material. We found that the three tasks are difficult for most of participated students. Of the 22 students in the experimental class, five students solved Task 1, two students solved Task 2 and three students solved Task 3 correctly. Similarly, of the 20 students in the control class, two students solved Task 1, two students solved Task 2 and one students solved Task 3 correctly. The results showed that experimental and control class students lack of ability in dealing with trigonometric problems although the number of experimental class students who answered three questions correctly more than the number of control class students.

Figure 1 shows an example of a student’s answer to Task 1. On Task 1, this solution process requires students to apply the concept of sine rule $\frac{a}{\sin A} = \frac{b}{\sin B}$ to solve this sine rule to obtain $a = \frac{1}{\sqrt{2}} \cdot s$ and to obtain $a = \frac{1}{\sqrt{2}} \cdot \frac{3}{4}$, but this is not the final solution for Task 1. Students need to rationalize the denominator of the root shape $a = \frac{1}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ so get the final result of Task 1 that is $a = 5\sqrt{2}$ cm. We found that student inabilities to produce correct solution process is caused students often forget to rationalize the denominator of the root shape when faced with the same task. Using picture will help students in carrying out the tasks.
Figure 1. Student’s answer to Task 1.

Figure 2 shows an example of a student’s answer to Task 2. On Task 2, this solution process requires students to apply the concept of sine rule \( \frac{E}{s} = \frac{a}{s} \) to solve this sine rule to obtain \( \frac{E}{s} = \frac{4\sqrt{3}s}{1} \) and to obtain \( \sin Q = 0.75 \), but this is not the final solution for Task 2. Students need to find the arc value of \( Q \) angle and another angle that is \( R \) by summing the two angles then reduced by 180° caused the number of angles of the triangles is 180°, so get the final result of Task 2 that is \( R = 11° \). We found that student inabilities to produce correct solution process are caused students forget to find the arc value of an angle and to find the arc value from an angle usually use a calculator so that students are limited by the calculator itself.

Figure 2. Student’s answer to Task 2.

Figure 3 shows an example of a student’s answer to Task 3. On Task 3, this solution process requires students to another angle that is \( F \) by summing the two angles that has known from the problem then reduced by 180°. Then, students apply the concept of sine rule \( \frac{a}{s} = \frac{b}{s} \) to solve this sine rule to obtain \( a = \frac{1}{s} \), and to obtain \( a = \frac{\sqrt{2}}{3} \), but this is not the final solution for Task 3. Students need to rationalize the denominator of the root shape \( a = \frac{1}{s} \) so get the final result of Task 3 that is \( a = 10 \frac{k}{f} \). We found that student inabilities to produce correct solution process is caused students often forget to rationalize the denominator of the root shape when faced with the same task.
The T-test is used to analyse whether or not there the difference between students’ mathematics concept comprehension ability by using TPS approach and by using direct learning reviewed based on their preliminary ability (high, medium, and low level). Result in Table 3 shows comparison of the value of $t$ and $t_{0.05}$ for each level of student’s preliminary ability.

|     | $S_x$ | $S_y$ | $t$  | $d$ | $t_{0.05}$ |
|-----|-------|-------|------|-----|------------|
| High | 4     | 3,3215 | 2,156 | 3   | 3,182      |
| Medium | 8,7052 | 4    | 2,540 | 27  | 2,052      |
| Low  | 2,2361 | 1    | 26,122 | 6   | 2,447      |

From Table 3 shows the value of $t$ in experimental class and control for the high level, we found that $t_0 < t_f$, $t_0 = 2,156$ and $t_f = 3,182$ [see Table.3]. Based on hypothesis testing criteria, $H_0$ is accepted if $t_0 < t_f$. So there is no significant influence on the high level. This is caused by students with high level have good preliminary abilities, so that if given treatment will not affect. For the medium level, we found that $t_0 \geq t_f$, $t_0 = 2,540$ and $t_f = 2,052$ [see Table.3]. Based on hypothesis testing criteria, $H_0$ is rejected if $t_0 \geq t_f$. So there is significant influence on the medium level. This is caused by students with medium level are easier to be directed so that with TPS approach, students with medium level can follow it well and have significant effect on student learning outcome. For the low level, we found that $t_0 \geq t_f$, $t_0 = 26,122$ and $t_f = 2,447$ [see Table.3]. Based on hypothesis testing criteria, $H_0$ is rejected if $t_0 \geq t_f$. So there is significant influence on the low level. This is caused by students with low level are motivated to improve learning outcome with the TPS approach which encourages students to work together in group and help each other in completing tasks [4].

Based on the result of the analysis, it can be concluded that there are differences in applying TPS approach and direct learning to learning outcome. Learning using TPS in learning activities provide better learning outcomes than direct learning. This condition can occur because there are differences in characteristics in direct learning and TPS approach. Table 4 shows the differences characteristics of the two lesson. The character difference in both learning influence students’ response during classroom learning.
Table 4. Table of direct learning characteristics and TPS.

|                     | Direct Learning | TPS                      |
|---------------------|----------------|--------------------------|
| Learning center     | Teacher centered and teachers is a source of learning | Students centered and teacher as a facilitator |
| Classroom environment | Students work individually | Students work in group |
| Learning activities  | Teachers perform the learning steps of explaining material, examples, and exercises. | Students active to look for trigonometry problem and solved the problem in the group and then present the group results. |

Students’ difficulties to solving problem in trigonometric material can help by work together in groups so that communication occurs [4]. Students who have difficulty can ask in groups. This condition causes students not bored so that it can successfully solve the problem. When students in group are looking for problems related to trigonometric material then completing the group and presenting the results, making students more confident. Because TPS approach was better than direct learning, this implies that TPS approach is suitable for learning with trigonometric material. We found that TPS approach was better than direct learning, which means TPS approach increase students’ mathematics concept comprehension ability and allowing students to express their reasoning, reflect on their thinking, and obtain immediate feedback on their understanding [6].

4. Conclusion
Learning with the TPS approach can provide better learning outcomes than direct learning. The implementation of TPS approach influenced students’ mathematic concept comprehension ability reviewed based on their preliminary ability at Senior High School in Pekanbaru. This learning causes students feel not bored because can be actively involved and happen mutual cooperation. Students also become more courageous to express opinion because there is mutual respect. Based on research findings, the author suggested that learning using TPS approach can applied in the learning of trigonometric material. Limitations in this study are that TPS approach teachers have difficulty forming groups when the number of students in the class is odd. The TPS approach is not suitable for all learning material, therefore researchers is expected to adjust the model that matches the material.

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