Development of students’ understanding of mathematical concept with STAD type cooperative learning through student worksheets

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Abstract. The objectives of hierarchical learning in hierarchical learning start from understanding mathematical concepts to a higher level. Understanding mathematical concepts is the initial foundation for students to be able to achieve other mathematical goals. This shows that the ability to understand mathematical concepts is a basic ability that students must have in learning mathematics. One mathematical learning model that can help understanding mathematical concepts is to apply the STAD type cooperative learning model. The STAD cooperative learning model is a model that is able to improve students' understanding of mathematical concepts because each stage of the learning model is able to support in improving students' understanding of mathematical concepts. To find out and describe the development of students understanding of mathematical concepts with the STAD type cooperative learning model through student worksheets, a study was conducted in class VIII 3 of SMP Negeri 18 Padang. The quiz was conducted 6 quizzes and the results of the study showed that there had been an increase in understanding of students' mathematical concepts during the application of the STAD type cooperative learning model.

1. Introduction
The purpose of learning mathematics based on Permendikbud no. 58 of 2014 is understanding mathematical concepts [4]. Understanding mathematical concepts is first in the goals of learning mathematics. This shows that understanding mathematical concepts is the initial foundation in achieving other learning goals because by understanding mathematical concepts will be able to achieve the ability of reasoning, communication and mathematical problem solving. This means that the ability to understand mathematical concepts plays an important role in achieving other mathematical understanding abilities.

The ability to show a talent that is inherent in a person (individual) to do something physical or mental activity that he obtained from birth, learning outcomes and experience [7]. Understanding means understanding correctly. Understanding is the cognitive and affective depth possessed by individuals [3] or understanding is the process of individuals to receive and understand information obtained from learning that is obtained from attention [5]. Understanding can also be interpreted as mastering something with the mind. This can be stated that the notion of understanding is a way of accepting and expressing something obtained from learning using their own language.

The concept is an abstract idea that is used to classify a number of objects that have the same characteristics or the concept is an abstract idea that allows us to group objects into examples and not
examples [8]. This shows that the concept is an abstract idea that allows to be grouped into examples or not examples based on the similarity of its characteristics. Thus it can be stated that the ability to understand concepts is a talent possessed by someone to re-express the knowledge gained both in speech and writing to others using their own sentences so that other people really understand what is conveyed. With the ability of students to explain or define the student has understood the concept of a subject matter even though the explanation delivered is not the same as the concept given but the intent is the same. Based on some of the above opinions it can be stated that the ability to understand mathematical concepts is the ability of students to re-express abstract ideas or concepts from mathematical material learned using their own language so that it is not only limited to knowing and remembering concepts but has reached the stage of being able to solve mathematical problems. To train students to express abstract ideas or concepts of mathematics subject matter so that their understanding of mathematical concepts is better, one of the learning models that can be applied is cooperative learning models. According to Johnson and Johnson, cooperative learning is working together to achieve common goals [2]. Cooperative learning model is a model that activates group learning where each member together tries to achieve results that can be enjoyed by all group members. Cooperative learning emphasizes collaboration between students in groups based on the idea that students find it easier to find and understand a concept if they discuss it. This means that the success achieved by someone in the group does not only affect themselves but also the group members.

One model of cooperative learning that can determine the development of students' understanding of mathematical concepts is the cooperative learning model type Student Teams Achievement Division (STAD). The STAD cooperative model has five stages: 1) the class presentation is the stage where the teacher explains or presents the material to be studied 2) the learning team is learning done in groups by students 3) quizzes are conducted to find out the understanding of the material students have learned 4) individual progress scores are obtained from increasing individual student score scores and 5) team recognition obtained from individual student score scores towards his team. In applying the STAD type cooperative learning model, a scientific approach is used.

The scientific approach is a science-based approach and requires students to be more active in the learning process. The steps of learning with a scientific approach are basically based on the facts of the observed object, namely 1) observing facts or phenomena, in this stage students look for information, see, hear, read, and listen, 2) ask questions to build knowledge, this stage is done through group discussion activities, 3) trying to strengthen students' understanding of mathematical concepts, this is done through planning, designing, and conducting experiments and obtaining, presenting and processing data, 4) reasoning that allows students to think critically, 5) communicating what is they get.

STAD cooperative learning activities are a learning model that is designed so that students can form abstract ideas or concepts about the material they learn through student worksheets, then finally can express these ideas in class discussions to other students. Student worksheets serve as a guide for students to find out and show the existence of individual actions so that they can measure students' abilities [1]. This is in line with a scientific approach that requires students to actively construct concepts, laws or principles through the stages of observing, asking questions, trying, reasoning and communicating. The first stage of the STAD type cooperative learning model with a scientific approach, the teacher explains the material to be learned by providing information that students must be able to master the concept of the material to be learned through student worksheets. Students listen to the information provided by the teacher and arouse students' curiosity. The teacher guides students to be able to ask questions.

The second stage is the learning team assisted by student worksheets. In the worksheet students learn the lesson being studied by asking each other questions and trying to find back the concept of the material being studied. The activity of asking, trying and reasoning greatly supports the success of this stage. The results of student group discussions are discussed classically where students confirm each other the results they obtain in understanding students' mathematical concepts. The third stage is a quiz...
given to each student to find out how far students understand the concept of mathematics subject matter concepts they have learned. The fourth stage is to assess the results of the progress of individual student scores in each quiz conducted and the fifth stage is the assessment of group scores on improving individual scores. Based on these stages, this study aims to determine and describe the development of students' understanding of mathematical concepts with the STAD type cooperative learning model through student worksheets in class VIIIth grade, VIII 3 of SMP Negeri 18 Padang.

2. Methods and design
This research is a descriptive study that describes the results of an application of the STAD type cooperative learning model with the research subjects of class VIII 3 students of SMP Negeri 18 Padang, amounting to 34 people. The formation of student discussion groups based on heterogeneous academic abilities formed from semester exam results. The discussion group is divided into 8 groups, each group consisting of 4 or 5 people.

Learning in groups is used student worksheets that contain steps that guide students to rediscover the concept of the subject matter being studied. To obtain data on the results of the study used a quiz conducted 6 times. Quiz questions given based on indicators understanding mathematical concepts include 1) restate a concept 2) classifying objects based on whether or not the conditions that compose the concept are met 3) identifying the nature of operations or concepts 4) applying the concept logically 5) giving examples or counter examples (not examples) of the concepts being studied 6) presenting concepts in various kinds of forms of mathematical representation, 7) linking various concepts in mathematics and outside mathematics 8) developing the necessary and sufficient conditions of a concept. The subject matter is algebra with the main subject matter of tribal algebra. To get the student's initial score, a quiz is conducted. Quiz given as much as 2 or 3 essay questions. Assessment of the results of student quiz answers used scoring rubric with a score of 0 to 4 which is then converted to the assessment of the final value is (score obtained / ideal score) multiplied by 100. The first quiz is the initial score of students used to score individual progress with a comparison of the score of the second quiz. The score of the second quiz results as the initial score used for individual progress with the comparison of the third quiz score and so on. Individual progress points [4] are

| Success criteria                          | Point Acquisition |
|------------------------------------------|-------------------|
| More than 10 points below the base score | 0 point           |
| 1 to 10 points below the base score      | 10 points         |
| 1 to 10 points above the base score      | 20 points         |
| More than 10 points above the base score | 30 points         |
| Perfect work (regardless of basic score)| 30 points         |

Awards for the recognition stage are used for grouping awards [4]

| Average Score | Qualification     |
|---------------|-------------------|
| 0 ≤ N ≤ 5     | -                 |
| 6 ≤ N ≤ 15    | good teams        |
| 16 ≤ N ≤ 20   | very good teams   |
| 21 ≤ N ≤ 30   | super teams       |

3. Result and discussion
The development of students' understanding of mathematical concepts with the STAD type cooperative learning model can be known based on the results of the quiz. The ability to understand students' mathematical concepts can be seen from whether or not indicators of concept understanding
are achieved in each quiz results. The question indicators that are tested are different for each quiz. In the first quiz given 3 questions. The first problem with indicator one aims to find out whether students are able or not to restate the concept of the material they have learned about variables, coefficients, constants in algebraic terms. The second problem with indicator four is to apply the concept of addition operations, logical algebraic reduction and the third problem with indicator two, which classifies objects based on whether or not the requirements that form the concepts of similar tribes and many terms are met. The results of students' understanding of mathematical concepts in the first quiz obtained the highest student score of 91 and the lowest of 40.

In the second quiz, 3 questions were given. The first problem with the second indicator classifies objects based on whether or not the conditions that compose the concept of algebraic division of terms. The second problem with indicator four is to use the concept of a pascal quadrilateral in terms of two algebra and problem seven with indicator seven, which is to link various mathematical concepts outside of mathematics. The results of students' understanding of mathematical concepts ability obtained the highest student score of 100 and the lowest 27. In the third quiz given 2 questions. The first problem with indicator four is applying the concept of distributive law in the algebraic factorization. The second problem with indicator two is to classify objects based on whether or not conditions are met which form the algebraic factoris $x^2 - 2xy + y^2$. The results of students' understanding of mathematical concepts in the third quiz obtained the highest student scores 100 and the lowest 42.

In the fourth quiz given 2 questions. The first problem with indicator four is to apply the concept of algebraic factorization and the second problem with the indicator classifying objects based on whether or not the conditions that form the concept of the difference between the two squares. The results of students' understanding of mathematical concepts in the fourth quiz obtained the highest student scores 100 and the lowest 41. For the fifth quiz, there are 3 questions. The first problem with indicators is to develop the necessary and / or sufficient conditions for factoring algebra. The second problem with the indicator applies the concept of the algebraic factorization logically and the third problem with the indicator links the various concepts in mathematics and outside mathematics about the algebraic factorization. The results of students' understanding of mathematical concepts in the fifth quiz obtained the highest student score of 100 and the lowest 70. Furthermore, for the sixth quiz given 2 questions with details of the first problem with indicators classifying objects based on whether they are fulfilled or not, which form the concept of addition operations on algebraic fractions. The second problem with indicators is to apply the concept logically about the simplification of fractions of algebra. The results obtained from this sixth quiz with the highest score of 100 and the lowest 60.

The application of the STAD type cooperative learning model to students' mathematical concept comprehension can be measured based on the average value of student quizzes. Based on 6 quizzes, the quiz results are presented as follows:

| Quiz | Score Max | Score Min | Mean  |
|------|-----------|-----------|-------|
| 1    | 91        | 40        | 64.53 |
| 2    | 100       | 27        | 68.85 |
| 3    | 100       | 42        | 75.76 |
| 4    | 100       | 41        | 84.56 |
| 5    | 100       | 70        | 88.38 |
| 6    | 100       | 60        | 81.74 |

Based on the data in Table 3 there can be an increase in the average results on the first quiz until it occurs and there is a decrease in the sixth quiz. The increase in student quiz results is quite significant on average. Individually these results indicate the difference between high-ability students and low-
ability students have very wide choice differences. This shows the diverse abilities of students in the class are quite diverse.

The results of the first quiz based on questions related to indicators understanding students' mathematical concepts found that there were still many students who were constrained in grouping similar tribes and performing algebraic addition and subtraction operations but the distribution of student scores was dominated by the acquisition of a score of around 60. The first score was as a score the basis for observing student grades individually and as a team. The result of the second quiz was found that there was a student who got 27 points and 2 students who got 100 points. The distribution of scores obtained by students spread widely. The increase in individual and team scores occurred quite well where the highest score for the team of 27.5 was obtained for only one group. This shows that only the team won the super team award. Obtaining the results of the second quiz becomes the initial score to see the results of improvements individually or in teams.

The third quiz results there are 5 students who get the lowest score of 42 and there are 4 students who get the highest score of 100. The difference in score is also quite large which shows that the ability of students is quite diverse. However, on average there was an increase from the results of the second quiz. This shows that there has been an increase in understanding of students' mathematical concepts. Increased individual and team scores occur quite well where the acquisition of the highest score of 22.5 and won the super team. Super team award winners in the third quiz are not the same as the second quiz team results and there are 2 teams that won the super team award. This shows that the STAD type cooperative learning model activates student learning. The results of the third quiz become a base score to be used in the next improvement.

To see the next improvement the fourth quiz results were used, there were 1 student each getting a score of 41 and 42. Obtaining a score of more than 85 there were 20 people. This shows that there has been a good improvement from previous quizzes. There are as many as 4 teams that won the super team award. The score of the fourth quiz results as the initial score to be used in the next improvement. The results of the fifth quiz turned out to be a striking change, namely the student's lowest score of 70. This shows that there was a big jump in the ability to understand students' mathematical concepts. But on average it is not much different from the acquisition of student scores on the fourth quiz. It can be stated that in the results of this fifth quiz the students can be stated to have an almost even understanding of the concept. The results of the team's progress award were obtained by 4 super teams. The sixth quiz results a decrease in the acquisition of individual student scores and on average. There are 1 students who score 60 and 2 students who score 65 and the scores of other students vary. As a result of the team's progress award, there is no team that gets it as a super team. A decline in value on average occurs because the teaching material on the sixth quiz is algebraic fractions that contain algebraic fraction questions with their facts.

The ability to understand mathematical concepts of students who use indicators understanding the concepts of learning with the STAD type cooperative model results in increased understanding of students' mathematical concepts. This is caused by, among others, active student learning, demanding students work together and take responsibility in teams [6]. The stages of the STAD type cooperative learning model that can affect indicators of understanding students' mathematical concepts are the presentation of material (stage 1), team learning (stage 2) and doing quizzes (stage 3). At the presentation stage of the indicator material understanding of the mathematical concepts achieved is to restate the concept and provide examples and counter examples relating to the concept. At the learning stage in a team that trains students to learn to work together in groups helps foster an attitude of responsibility in themselves and can improve students' understanding of mathematical concepts. When learning students are facilitated with student worksheets that support in developing students' understanding of mathematical concepts. Student worksheets contain instructions to help students build their own knowledge in understanding mathematical concepts to be achieved. Students not only work on student worksheets in small groups but must present them in classical discussions in front of the class. This is used to check the truth of the answers from the group discussion.
The STAD type cooperative learning process makes students really learn and work together in groups because at the next stage there is a quiz. The stages of working on the quiz are the stages that make students motivated to learn because the results of individual and team quiz scores will influence the recognition stage that spurs students to win group awards. The results of the STAD cooperative learning model show that there has been an increase in students' understanding of mathematical concepts.

4. Conclusion
Based on the results of research conducted on students of class VIII 3 of SMP Negeri 18 Padang, it can be concluded that there has been a development in understanding students' mathematical concepts by using cooperative learning models that are facilitated by student learning worksheets. This can be seen from the results of the quiz given to students as many as 6 times there was a significant increase in student acquisition scores.

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