



## THE IMPROVEMENT OF STUDENTS MATHEMATICAL PROBLEM SOLVING ABILITY BY IMPLEMENTING COOPERATIVE LEARNING MODEL IN SMP TUNAS PELITA BINJAI

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### ABSTRACT

This research is a quasi-experimental research with a pretest-posttest control group design. The purpose of this study was to determine the improvement of students' mathematical problem solving abilities using the STAD type cooperative learning model in class VIII of Tunas Pelita Binjai private Junior High School on algebraic operation material. The population in this study were the whole students of class VIII SMP Tunas Pelita Binjai and the sample was randomly selected, namely class VIII-1 (experimental class) and class VIII-2 (control class). The instrument used was a mathematical problem solving ability test instrument. The tests were carried out twice, namely at the beginning of learning (pretest) before receiving treatment and after receiving treatment at the end of learning (posttest). The instrument was confirmed to have fulfilled the validation and reliability requirements. The data analysis was performed using t-test. The finding of this study indicate that there is an improvement in students' mathematical problem-solving abilities using the STAD type cooperative learning model on the subject of algebraic operations significantly. The improvement was seen from the results of the gain score analysis, it was known that the average gain of the experimental class was in the moderate category (0.692) and the average gain of the control class was in the moderate category somehow lower than the experimental class (0.609). The aforementioned findings indicate that there was an improvement in the mathematical problem solving ability of the experimental class which was higher than the improvement in problem solving ability in the control class.

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### INTRODUCTION

Mathematics is one of the most important branches of science and plays a very vital role in the development of the education world. Moreover, mathematics is a universal science and has an important role in developing human thinking. Known as basic science, learning mathematics trains critical, logical, analytical and systematic thinking skills, therefore mathematics needs to be introduced from an early age to children to equip them with the ability to think logically, analytically, systematically, critically and creatively, as well as the ability to work together. Mathematics education has developed rapidly in line with the development of science and technology. Likewise, mathematics learning has undergone various innovations and reforms which are expected to suit current and future needs. Consequently, efforts should be taken so that mathematics learning can be more effortlessly accepted by students and they can achieve more optimal results.

According to the Regulation of the Minister of National Education (Permendiknas) Number 22 of 2006 concerning Standard Content in Mathematics for all levels of primary and secondary education it is stated that the objectives of mathematics in schools are: (1) Understanding mathematical concepts, explaining the relationship between concepts and applying concepts or

logarithms be flexible, accurate, efficient and precise, in solving problems; (2) Using reasoning on patterns and characteristics, performing mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements; (3) Solving problems which include the ability to understand problems, designing mathematical models, solving models and interpreting the solutions obtained; (4) Communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem; (5) Having an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in studying mathematics, as well as being resilient and confident in problem solving [1]. One of those objectives is the ability to solve problems where problem solving is a process to overcome the difficulties faced to achieve the expected goals. According to Sumarmo [2] problem solving is a process to overcome difficulties encountered to achieve a desired goal. In addition, Nasution [3] said that problem solving can be considered as a process of students discovering combinations of previously learned rules that are used to solve new problems.

Meanwhile, the ability to solve mathematical problems is an ability that students must have to solve math problems in every aspect of solving mathematical problems. Kesumawati [4] argues that mathematical problem solving ability is the ability to identify elements that are known, asked and the adequacy of the elements needed, able to create or compile mathematical models, be able to select and develop solving strategies, be able to explain and examine the correctness of the answers obtained. Branca argues that problem solving skills are very essential for every student since (a) problem solving is the general objective of teaching mathematics; (b) problem solving which includes methods, procedures and strategies is a core and major process in the mathematics curriculum; and (c) problem solving is a basic skill in learning mathematics [2]. In addition, Ruseffendi said that problem-solving skills are very crucial in mathematics, not only for those who in the future will explore or study mathematics, but also for those who will apply it in other fields of study and in daily life [2]. From several opinions aforementioned, it can be concluded that mathematical problem solving skills is vital to learn because students will be faced with problems related to concepts of mathematical problems in their daily life.

Regarding to the importance of problem-solving abilities, the National Council of Teachers of Mathematics (NCTM) said that in implementing mathematics learning in schools, teachers must pay attention to five mathematical abilities, namely: connections, reasoning, communications, problem solving, and representations [5]. Therefore the teacher has a very significant role in fostering the ability to solve mathematical problems in students both in the form of the methods used, and in the evaluation of making supporting questions. However, in reality, students' mathematical problem solving ability is still low. This is proven by the results of an interview conducted by the researcher with one of the mathematics teachers at Tunas Pelita Binjai Private Junior High School who stated that "Students experience difficulty in solving problems that require problem solving skills in algebraic operation material. When the questions given vary slightly, students have difficulty solving it". The researcher also conducted an interview with one of the students at the same school and she stated that "Mathematical problems are difficult to solve especially in problem solving form. I find it difficult to identify what information are provided and what must be solved and how to solve it, especially in algebraic operation material." This is due to the students' lack of understanding to the concept of problem solving given and the lack of interest in learning mathematics.

Besides, the learning process that had been taking place was still using conventional learning method where it only focuses on the lecture learning model. The monotony conventional learning caused the learning atmosphere seemed inflexible. The learning process carried out by mathematics

teachers tends to achieve the target curriculum material, more concerned on how to make the students memorize the concepts, not how to make the understand. This could be seen from the learning activities in the classroom which were always dominated by teachers. In delivering material, the teacher usually applied the lecture method where students just sit, take notes, and listen to what are stated and there was little opportunity for students to ask questions. Thus, the learning atmosphere was not conducive which lead students' passiveness. The same learning continuously happens at almost every meeting which makes students feel bored easily. This feeling of boredom makes students less interested in learning mathematics. The aforementioned elaborations were strengthened by the provision of mathematical problem solving ability test questions to 20 students of class VIII-1 of Tunas Pelita Binjai Private Junior High School which were related to solving problems in the form of description questions. However, the results showed that the students' mathematical problem solving ability was still low, even though one of the objectives of learning mathematics currently includes the ability to understand problems, plan problems, solve problems according to plan and check the correctness of the answers obtained.

In order to improve students' problem-solving abilities, the teacher should try to train and accustom students to problem-solving forms in their learning activities, such as providing students opportunities to hold scientific conversations to gather opinions, conclusions or develop alternative problem solving. Therefore, teachers require to choose the suitable learning model to encourage students to learn to solve mathematical problems. The learning model must be a student-centered learning model. Students are no longer just listeners but become an active part of the learning process. One of the learning models that is appropriate and considered suitable for solving problems in mathematics is the STAD (Students Teams Achievement Divisions) type of cooperative learning model.

Cooperative learning is a learning model that places students learning in small groups who have various levels of ability [6]. Cooperative learning will train students to share knowledge, experiences, assignments, and responsibilities. Students will also learn to recognize the strengths and weaknesses of others. Cooperative learning will change norms related to learning outcomes, cooperative learning can provide benefits to both lower and upper groups who work together to complete academic tasks [7]. STAD type of cooperative learning is one of the types of cooperative learning which emphasizes the cooperation of students in groups in solving a problem to achieve learning goals. Slavin states that at STAD students are placed in a learning team consisting of 4-5 people which is a mixture according to level of achievement, gender, and ethnicity [8].

In addition to the theory overhead, this is also reinforced by previous research, including the results of Astuti's research which stated that the STAD type of cooperative learning model is very appropriate for problem solving [3]. Mathematical problem-based student worksheets (LKS) are used to support learning. STAD learning enables students to help each other solve problems faced, be motivated to learn, can improve social skills and provide opportunities for students to participate more in learning. Besides, the average percentage of mastery of mathematical problem solving abilities also increases as well. In the first cycle, the average value was 73.82 and the percentage reaching the passing grade was 40.91%. Meanwhile, in the second cycle it was 80.73 and the percentage of students who reached the passing grade was 77.28%. In cooperative learning type STAD critical thinking skills are developed and cooperation, positive relationships between persons from different backgrounds, apply peer-to-peer guidance, and create a constructive environment mathematical problem solving abilities in students. This shows how important cooperative learning is in improving problem solving skills

Moreover, there is also research conducted by Winarsih in 2015 which obtained good results as follows; Winarsih argues that STAD learning in mathematics learning has changed the atmosphere of students, students who are less able become able to understand learning material, while students who have low abilities can increase their comprehension in understanding a particular problem or problem so that it can trigger an increase in the achievement learning outcomes [9]. With the implementation of STAD type learning model, the resulting learning atmosphere will be more enjoyable since students learn and exchange ideas with their own friends. In addition, students can think creatively through interaction with friends so that they can solve problems systematically.

Based on the background of the problem above, the formulation of the problem in this study is whether there is an increase in students' mathematical problem-solving abilities using the STAD type cooperative learning model in class VIII of Tunas Pelita Binjai Private Junior High School on algebraic operation material?

## **METHODS**

This research is a quasi experimental research because the research setting cannot be fully controlled such as: student preparation before studying at school, additional tutoring outside school hours, student's relationship with parents, student's relationship with their environment and so on. In carrying out this research, it involved two treatments, namely the experimental class which was given STAD learning and the control class which was given conventional learning. This research was conducted at Tunas Pelita Binjai Private Junior High School with a population of all students of class VIII SMP Private Tunas Pelita divided into 2 classes, namely class VIII-1 to class VIII-2 totaling 40 people. The sampling method in this reserach was carried out by applying simple random sampling technique in order to obtain classes VIII-1 (experimental class) and VIII-2 (control class).

The objective of this study was to determine the improvement in students' mathematical problem-solving abilities which measured by administering problem-solving ability test questions. The design in this study was a pretest-posttest control group design. The tests were given twice, namely before the learning process which is called the pretest and after the treatment given which is called posttest. The instrument used in this study was a test of students' mathematical problem-solving abilities.

## **RESULTS AND DISCUSSION**

The results showed that in general the students' mathematical problem solving abilities were still far from what was expected. It can be seen from the pretest average value of students' mathematical problem solving abilities of 28,100 in the experimental class and 26,100 in the control class. After using STAD learning there was an increase of 43,200 in the experimental class and 40,650 in the control class. However, the STAD learning model in the experimental class was significantly more successful in improving students' mathematical problem solving abilities compared to conventional methods in the control class. The increase is seen from the results of the gain score analysis, it is known that the average gain of the experimental class is in the medium category (0.692) and the control class gain average is in the moderate category but lower than the experimental class (0.609). The results above indicate that there is an increase in the mathematical problem solving ability of the experimental class which is higher than the increase in problem solving ability in the control class.

## **Learning Factors**

Observing the research results that have been elaborated above, it illustrates that learning with the STAD cooperative learning model is better in improving students' mathematical problem-solving abilities compared to conventional learning. These findings reinforce the findings of Astuti [3], Winarsih [9] and Suprpto [10] who concluded that the Student Teams Achievement Division (STAD) learning model is better than conventional learning to improve some mathematical skills such as mathematical problem solving, student activity, and on mathematical representation skills.

The learning characteristics of the two approaches indicate that the reasonableness of discrepancies in students' abilities after participating in the learning process. Theoretically, learning with the STAD approach has several advantages when compared to conventional learning, which if these advantages are maximized in classroom implementation, it is very possible for the learning process to be better. These advantages can be seen through differences in views on the characteristics of the two lessons, including the teacher factor.

In the STAD approach, the teacher acts as a learning facilitator. The implication of this view is that it is imperative for teachers to facilitate and encourage students to be actively involved in the learning process. Students are encouraged to construct knowledge for themselves and work together among friends in groups. For this purpose, students need to have flexibility in expressing their way of thinking in solving problems faced with their group friends. To realize such learning situations and conditions, in managing learning, teachers need to encourage students to dare to try possible ways of understanding and solving problems. Students are given the opportunity to construct a problem, solve it and exchange knowledge with their group friends. Teacher management will be very much needed because the teacher will become a facilitator and mediator in the implementation of learning.

On the other hand, in conventional learning, the teacher becomes the center of learning. In this lesson, the teacher emphasizes demonstrating the material, practicing solving problems, asking about formulas, discussing exercises and students are considered successful when completing the exercise with the steps that the teacher has taught. This results in low memorization of concepts or procedures and mathematical communication of students and students are quick to give up if given more complex problems. That is what causes the STAD learning model to be better than conventional methods.

## **Mathematical Problem Solving Ability**

Problem-solving ability is a method of finding solutions to problems through problem solving stages. In this study, there are four problem solving indicators that must be achieved by students, namely: 1) Being able to understand the problem; (2) Being able to make a solution plan; (3) Being able to solve problems according to plan; (4) Being able to check the correctness of the answers obtained. Based on the research results, there is an increase in each indicator of mathematical problem solving abilities after learning with the STAD model including:

### **a. Understanding the problem**

In the pretest, the percentage of students who understood the problem was 42%. The thing that becomes an obstacle for students at this stage is that they are lazy to write down the information provided on the questions, do not know and understand what information is contained in the questions. After being given worksheets which refer to problem-solving abilities at each meeting, students become accustomed to writing and reviewing the information contained in the questions. The students' ability to understand the problems in the final test increased to 96%. The number of increase that occurred after learning was carried out was 54%.

#### b. Setting the Problem Resolution Plan

Students experienced difficulty converting the information that is at the stage of understanding the problem into equations to ease them to find solutions using the strategies that they have selected. Students think that setting a problem solving plan is a very tough job. Most students never plan to solve problems. In the pretest, the percentage of students who were able to plan the completion correctly was 24%. After being given worksheets that refer to problem-solving abilities at each meeting, they become accustomed and able to make plans for solving the problems. The ability of students in planning problem solving solutions on the final test has increased to 96%. The number of increase that occurred from the pretest and posttest was 72%.

#### c. Solving the Problem According to the Setting Plan

At this stage, students are expected to be able to use mathematical formulas or sentences and consistently apply the chosen solving strategy until they find the solution requested. In the pretest, the percentage of students who completed the questions was 14%. The problem with students at this stage is that students are careless and the formulas they write are much different from the concepts that have been taught. In addition, they often experience errors in calculating the algebraic form.

In the posttest, the students' ability in solving questions got better. The ability of students to solve questions on the final test increased to 80% after being given learning with the STAD model. The amount of increase that occurred from the pretest and posttest was 66%.

#### d. Being able to Check the Correctness of the Answers Obtained

At this stage students are expected to be able to check the correctness of the answers they have obtained by recalculating the completion steps that have been selected. In the pretest the percentage of students who completed the questions was 3%. The problem with students at this stage is that students are not used to checking the results that have been obtained. So that students are confused in conducting re-examination of the correctness of the answer. This causes students to only answer "Yes" or "No", without any reason. In fact, many of the students chose not to write anything down.

After learning using the STAD model, students begin to get used to checking the correctness of the answers obtained where this is one of the steps in the STAD learning model. It's just that, there are still some students who are lazy in recounting, so that the ability of students to check the correctness of the answers obtained in the final test has increased not so significantly, namely 32%. In the final test, the students' ability in solving questions got better. The increase that occurred from the pretest and posttest was 29%.

Based on the description above, it can be concluded that after learning with the Student Teams Achievement Division (STAD) cooperative learning model there is a significant increase in the first, second and third problem solving ability indicators.

## CONCLUSIONS AND SUGGESTIONS

Based on the results of the research, it was concluded that there was an increase in students' mathematical problem solving abilities by using the STAD cooperative learning model on the subject of algebraic operations significantly. The amount of increase is from an average score of 28,100 to 43,200.

Based on the results of research on mathematics learning using the Student Teams Achievement Division (STAD) cooperative learning model to improve students' mathematical problem solving abilities, the researchers provided suggestions for the parties involved, including

the following:

1. For teachers

This research is expected to provide input for teachers to apply the STAD learning model as an alternative learning model, to improve students' mathematical problem solving abilities. Teachers must always accustom students to active learning in the classroom, especially in solving problems.

2. For students

Students are expected to be able to play an active role in learning activities. By being actively involved in learning, it will certainly improve problem-solving skills in addition to cognitive assessment but also affective assessment.

3. For school

The cooperative learning model of the Student Teams Achievement Division (STAD) type in schools is expected to be able to be applied to other subjects besides mathematics. Of course, the school must be able to provide media or teaching aids that can support the success of active learning.

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