Implementation of Numbered Heads Together (NHT) type of cooperative learning to improve mathematical communication skills of eighth grade students of YKWI Pekanbaru MTs based on mathematical communication capability indicators

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Abstract. This study aims to improve students' mathematical communication skills through the Implementation of Numbered Heads Together (NHT) Cooperative Learning. This research was a classroom action research with the subject of 20 eighth grade students. Data collection techniques in this study are using observation sheets and mathematical communication test questions. The results of this study indicate that there is an increase in students' mathematical communication skills from the baseline score to Cycle I, from cycle I to cycle II. The percentage of students' mathematical communication ability on the baseline score was 36.87%, at cycle I was 47.5% and at cycle II was 72.81%. Based on the results of this study, it can be concluded that the application of Numbered Heads Together (NHT) cooperative learning can improve the mathematical communication skills of the eighth grade students.

1. Introduction

One of the mathematical abilities that must be mastered by students today is mathematical communication skills. Mathematical communication skills are deemed necessary to be further developed, because by understanding mathematical communication skills students can complete non-routine mathematical tasks. Mathematical communication ability is an ability needed in learning mathematics and is very necessary in dealing with problems in students’ lives. But in reality most of the students' mathematical communication skills are still low. [4] Once the importance of mathematical communication ability in mathematics, but the facts encountered with the field shows that the still low ability of students ' mathematical communication. This can be seen from the results of the PISA (Program for International Student Assessment) test held in 2009 aimed to measure the level of mathematical communication ability of students also showed the same thing. Of the 65 countries that participated in Indonesia are ranked 61, while Thailand (50), Australia (15), Kazakhstan (53), Japan (9), Singapore (2) and Shanghai-China (1). This data shows that the new Indonesian State can occupy the top 10 lowest of 65 countries. These results reflect how mathematical communication ability of students in Indonesia today. The low level of students' mathematical communication skills is due to the lack of teachers in providing non-routine questions. What's more, there are still many students who think that mathematics is a difficult and rigid lesson. So that mathematics becomes a subject that students don't like. Especially if the presentation of the teacher in conveying the subject matter does not attract students' attention. This will increase students' difficulties in learning mathematics.
Learning difficulties in mathematics are generally related to children's inability to read, imagination, integrate knowledge and experience, especially in understanding story problems. Children sometimes find it difficult to digest a phenomenon that is still abstract, so that something abstract must be visualized or made concrete so that it can be understood. [8] Suggested that curriculum standards, mathematics as a means of communication (mathematics as communication) for grade 5-8 (SMP) is able to: (1) modeling the situation, either orally, in writing, the real, images, graphics, and algebra strategies; (2) reflect and clarify their own thinking about mathematical ideas and their relationship; (3) develop an understanding with his mathematical ideas into rules and definitions; (4) use the ability to read, listen to interpret and evaluate mathematical ideas; (5) discuss mathematical ideas, make conjectures and convincing arguments; (6) to appreciate the value, mathematical notation, and its role in the development of mathematical ideas.

Based on the results of observations and interviews that researchers did in class VIII MTs YKWI Pekanbaru, stated that the activities Mathematics learning is still dominated by the activities of teachers, and teachers are lacking in providing questions related to mathematical communication to students. This can be seen when the teacher gives questions related to mathematical communication questions. From the tests given, it was found that only 28.5% of students were able to answer mathematical communication questions. This shows that students' mathematical communication is still lacking. Lack of students' understanding of the concepts contained in mathematics and the difficulty of students communicating mathematically. This is because teachers at the time of teaching have not used learning methods that can encourage students to think and engage students actively. There are still many teachers in teaching using conventional learning methods, namely a teacher-centered learning method.

The low mathematical communication skills cannot be separated from the process of learning mathematics. The improvement of students' communication skills can be done by designing a learning that familiarizes students to construct their own knowledge, so that students better understand the concepts being taught and are able to communicate their thoughts both with the teacher, friends and the mathematics material itself and able to solve mathematical problems. Communicating skills is the ability of the students to express their ideas, describe, and discuss mathematical concepts coherently and clearly. It is the students’ capability to explain and justify action in procedure and process both orally and in writing. Pointed out that all that effect in learning can be promoted through interactions and communications. Challenging students to communicate both orally and in writing in mathematics class can help deepen their conceptual understanding. When students are encouraged to interact with others, they are able to construct individual understanding and concept formation [6].

Mathematical communication skills can be interpreted as a student's ability to convey something he knows through dialogue or mutual relations events that occur in the classroom environment, where there is a message transfer. The message that is transferred contains about the mathematics material that students learn, for example in the form of concepts, formulas, or strategies for solving a problem. Representation in mathematical communication can help the process of perfecting the understanding of mathematical ideas and help students build the meaning of an idea. When students are challenged to think and reason about mathematics and communicate their ideas verbally and in writing, then with the help of representation can get an increasingly clear and definite understanding [7]. That way mathematical communication can help students to understand and build their own knowledge so that the knowledge gained will last long in the minds of students. The parties involved in communication events in the classroom are teachers and students. The way to transfer messages can be oral or written. Mathematical communication is an important skill in mathematics, according to The Intended Learning Outcomes [9], mathematical communication, namely the ability to express mathematical ideas coherently to friends, teachers, and others through spoken language. This means that with mathematical communication the teacher can better understand the students' ability to interpret and express their understanding of the concepts they are learning.

In this study, the indicators used to assess mathematical communication skills are (a) presenting mathematical statements in writing and pictures; (b) linking images to mathematical ideas. (c) explain ideas in writing with pictures; (d) State everyday events in a language or mathematical symbol.
The effort to incorporate thoughts into words helps students to compile and clarify their reasons. Talking about mathematics communicates concepts to others but also helps communicate these concepts to each individual. However, students do not have to communicate verbally to get the benefits of individual communication. Writing about mathematics also produces benefits for understanding [5]. Therefore, to help students to be able to communicate a learning model that activates students is needed. One learning model that is expected to develop students' mathematical communication skills is the cooperative learning model. With cooperative learning students can communicate with their friends and help each other to solve common problems. The cooperative learning model consists of various models. However, the learning that will be used in this research is Numbered Heads Together (NHT) type of cooperative learning model. This is in line with the opinion of [3] that Numbered Heads Together was developed by Spencer Kagen (1993) to involve more students in studying the material covered in a lesson and checking their understanding of the content of the lesson. Where the structure of the Numbered Heads Together (NHT) type cooperative learning model designs a group learning by organizing students in study groups. In the Numbered Heads Together (NHT) type cooperative learning model the teacher conveys information then students are grouped into groups of 3-5 people and each group member is numbered between 1 and 5. This type requires students to have good communication skills and group process skills and can train students to foster independent thinking skills. This model is an effective way to develop students 'skills in order to improve students' ability in applying mathematical concepts.

2. Method
The form of this research is Classroom Action Research (CAR). Classroom Action Research (CAR) has a very important and strategic role to improve the quality of learning if implemented properly and correctly [1]. In the implementation of this class action research was conducted in two cycles. One cycles consists of three met. According to [1], this class action research consists of a series of four activities carried out in repeated cycles. Four main activities exist in each cycle, namely (a) planning, (b) implementation, (c) observation and (d) reflection.

This Classroom Action Research was conducted in class VIII MTS YKWI Pekanbaru from October 4 2016 to October 27, 2016 with Subjects in the eighth grade MTS YKWI Pekanbaru in the odd semester totaling 20 students.

Data about the activities of teachers and students during the learning process are collected using observation sheets, and students' mathematical communication skills data are collected using tests of mathematics learning outcomes. Tests are given for daily tests I and daily tests II. The data analysis technique used is descriptive statistical analysis. This descriptive statistical analysis aims to describe data about the activities of students and teachers during the learning process, data about students' mathematical communication

2.1. Analysis of observation results
Observations obtained by observers and researchers from the observation sheet were analyzed descriptively or in a description that aimed to describe data about the activities of teachers and students. Observations are useful to see the suitability between planning and implementation of actions. When there were discrepancies in the implementation, a revision was done for the next cycle.

2.2. Analysis of student mathematical communication achievement
Students' mathematical communication skills were measured by using a set of questions given in the form of mathematical communication ability questions after Cycle 1 (three meetings) and Cycle 2 (three meetings). The students' answers were scored by using students' mathematical communication skills score criteria such as the following table:

| Table 1: Mathematical Communication Ability Rubric. |
|-----------------------------------------------|
| Indicator | 0 | 1 | 2 | 3 | 4 |


Prasetya’s [10] qualification percentage of students’ modified mathematical communication was used to calculate the percentage of students’ mathematical communication (see Table 2).

\[
\text{answer score} = \frac{\text{score the correct answer}}{\text{Maximum score}} \times 100\%
\]

| No | Percentage | Criteria |
|----|------------|----------|
| 1  | 80% ≤ P ≤ 100% | Very high |
| 2  | 60% ≤ P < 80%  | High     |
| 3  | 40% ≤ P < 60%  | Enough   |
| 4  | 20% ≤ P < 40%  | Low      |
| 5  | P < 20%       | Very Low |

3. Results and Discussion

3.1 Qualitative Data Analysis

Analysis of the results of observations of teacher activities and student activities on the application of this NHT type cooperative learning model shows progress - progress for each meeting. This can be seen from Table 3 about the analysis of the results of actions of teacher activities and student activities in each cycle during the learning process.
Table 3: Qualitative Analysis of Teachers and Students Before Action, Cycle I and Cycle II.

| Before action | After action |
|---------------|--------------|
| **Cycle 1**   | **Cycle 2**  |
| Students are still reluctant to ask the teacher or other students even though they cannot solve the problem given | At the first meeting, there were only a few who were actively involved in group discussions. The rest work individually. Students are also still reluctant to ask the teacher and other students in working on the given LKS. This shows that there are only a small portion of students who want to discuss with friends or groups. At the second meeting each group member had begun to work together. But when there were those who did not understand how to do the assignments, they were still reluctant to ask the teacher. So the teacher is the one who asks each group more about the problems found. At the third meeting the students had begun to dare to ask the teacher and his friends who understood how to solve the problems encountered. |
| In solving mathematical problems, students rarely reveal or explain verbally or in writing why they got the answer | At the first meeting, when students were told to present the results of the discussion in front of the class, they felt insecure. So the teacher needs to encourage the student. When the teacher asks other students to comment on what their friends presented, none of the students commented. Similar to the first meeting, the second meeting of these students was the same as presenting the results of the group's work. Because other students don't want to. But this student only reads what is written on the LKS. At the third meeting students must still be given motivation so that not only one student is dominant in learning, because all students have the opportunity. One student advanced to present the results of the discussion, but still impressed to read what was written in the answer paper. |
| At the fifth meeting the students were still shy to present the results of the discussion. The teacher sees that students who are presentation are not confident and shy. So the teacher tries to motivate the student to dare to present in front of the class. At the sixth meeting students have begun to dare to presentations, students scramble to present the results of their group discussions, as well as the seventh meeting. |

From table 3 it can be seen that the activity of teachers and students in the NHT type cooperative learning model of each meeting in the second cycle has increased from each meeting in the second cycle.
has increased from each meeting in the first cycle, where in the second cycle the activities of teachers and students have been carried out very well and in accordance with planning.

3.2 Quantitative Data Analysis
The improvement of mathematical communication skills can be seen from the analysis of mathematical communication skills for each indicator and the number of students for each category, namely the indicators of mathematical communication skills and the number of students for each category in the basic score, cycle I and cycle II. The analysis of students' mathematical communication skills from basic scores, UH I and UH II are as follows:

| Table 4: Analysis of Students' Mathematical Ability on Basic scores, Cycle I and Cycle II. |
|---|---|---|
| Value | basic score | Cycle 1 | Cycle 2 |
| Percentage of Indicator 1 | 40 | 48,75 | 73,75 |
| Percentage of Indicator 2 | 33,75 | 46,25 | 75 |
| Percentage of Indicator 3 | 37,5 | 51,25 | 72,5 |
| Percentage of Indicator 4 | 36,26 | 43,75 | 70 |
| Average Percentage of KKM | 36,87 | 47,5 | 72,81 |
| Category | Low | Enough | High |

Based on Table 4, it can be seen that for all indicators there is an increase in the percentage of mathematical communication skills. From the baseline score increased by 10.63% to Cycle I, whereas from Cycle I to Cycle II increased by 25.31%.

The following is an example of an answer from one student who cannot solve mathematical communication questions with indicators explaining mathematical ideas in mathematical writing. from the student's answers can be seen students are not able to determine the upper and lower limits of a function, then the student also cannot substitute a point to function.

Figure 1. An example of student’s incorrect response.

| Table 5: Number of students for each category in the basic score, UH 1 and UH II. |
|---|---|---|---|
| Percentage | Category | Basic score | UH 1 | UH 2 |
| P ≥ 80 % | Very High | 0 | 1 | 8 |
| 60 % ≤ P < 80 % | High | 0 | 4 | 10 |
| 40 % ≤ P < 60 % | Enough | 7 | 8 | 2 |
| 20 % ≤ P < 40 % | Low | 10 | 7 | 0 |
| P < 20 % | Very Low | 3 | 0 | 0 |
| Amount | 20 | 20 | 20 |

P = Average Percentage of Students' Mathematical Communication Ability
Based on Table 5 above it can be seen that for the very low category in the basic score there are 3 students, in UH I and UH II there are no students who have very low abilities. In the basic score there were no students in the high category. At UH I there were 4 students and at UH II there were 10 students. For the very high category in the basic score there were no students in this category, at UH I there was 1 student and at UH II there were 8 students.

3.3 Discussion of Research Results
By referring to qualitative data, the observation sheet of teacher and student activities is an increase in teacher and student activities in each cycle. This is indicated by the improvements made by the teacher at each meeting. When the learning process takes place the teacher always gives the opportunity to all groups to discuss the concept of finding and working on all the commands that are in the student worksheet. Then when there are students who experience difficulties the teacher tries to provide guidance and direction in providing solutions to the problems experienced by students.

When viewed from the attitude of students have seen a good motivation in learning, each student tries to be able to play an active role in every learning activity and when conducting discussions in groups. Students have carried out their respective duties well so that when the presentation of the work of the group the students look enthusiastic and compete so that they can become the representatives of their groups in presenting the results of their discussions.

Meanwhile, with the quantitative data analysis both through the analysis of the success of the action it can be seen that there is an increase in students' mathematical communication skills. This can be seen by comparing scores before action and after action. The percentage in the base score is 36.51% and an increase in the first daily test of 56.25% then also increased in the second daily test to 61.67%.

With the improvements that occur from teacher and student activities as well as improving students' mathematical communication skills, it can be said that NHT type cooperative learning is an alternative to create a conducive learning environment by building good communication between teachers and students so that they can improve student mathematical communication.

Based on the discussion of the results of the research above, it can be concluded that the application of NHT type cooperative learning can improve the learning process and improve students' mathematical communication. So, this analysis supports the proposed action hypothesis, namely the application of NHT type cooperative learning can improve the learning process and improve mathematical communication of eighth grade students of MTs YKWI Pekanbaru.

4. Conclusion
Based on the research and discussion that has been stated, the conclusion of this study is the application of NHT type cooperative learning can improve the learning process, improve the mathematical communication skills of VIII Mts YKWI Pekanbaru students.

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