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Application of *the Discovery Learning* Modelto Increase Communication Skills Mathematics of Class X IPA-6 Students

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ABSTRACT

This research aims to improve students' mathematical communication skills through the application of the *Discovery Learning* learning model in Trigonometry material in class X SMA Negeri 11 Medan . This type of research is classroom action research. The subjects of this research were class X IPA-6 students SMA Negeri 11 Medan, totaling 32 people. The object of this research is students' mathematical communication skills by applying the *discovery* learning model to trigonometry material.Based on data analysis, students' mathematical communication abilities in cycle I were obtained 18 students (56.25%) out of 32 students have achieved learning completion (≥ 70). After action II, through administering the Mathematics Communication Skills Test II, 27 students (84.375 %) of the 32 students had achieved learning completion (≥ 70). There was an increase in the percentage of classical completion by 28.125%. Based on the classical completeness criteria, this completeness percentage is fulfilled. The average score of the mathematics communication skills test results in cycle I was 69.88 and in cycle II it increased to 83.16. The increase in average value was 13.28 with a Gain Score of 0.44 which was in the medium category. Based on the descriptions above, it can be concluded that students' mathematical communication improves by applying the *discovery learning* model to Trigonometry material in class X IPA-6 at SMA Negeri 11 Medan.

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INTRODUCTION

Mathematics is one of the most important subjects to be taught at every level of education because it is the basis for the development of other sciences. Apart from that, according to Minister of National Education Regulation No. 22 of 2006, Mathematics lessons need to be given to all students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically and creatively, as well as the ability to work together. These abilities are really needed by all students so that they are able to survive in conditions that are always changing, uncertain and competitive. (Ministry of National Education, 2006)

Cockroft (Abdurrahman, 2009) also expressed his opinion that:Mathematics needs to be taught to students because (1) it is always used in all aspects of life; (2) all fields of study require appropriate mathematical skills; (3) is a strong, concise and clear means of communication; (4) can be used to present information in a variety of ways; (5) improve logical thinking skills, accuracy and spatial awareness; and (6) provide satisfaction with efforts to solve challenging problems.

The objectives of mathematics learning in the Education Unit Level Curriculum state that mathematics subjects aim for students to have the following abilities:

1. Understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms, flexibly, accurately, efficiently and precisely in solving problems.
2. Using reasoning on patterns and properties, carrying out mathematical manipulations to make generalizations, constructing evidence, or explaining mathematical ideas and statements.
3. Solving problems includes the ability to understand problems, design mathematical models, complete models and interpret the solutions obtained.
4. Communicate ideas with symbols, tables, diagrams, or other media to clarify situations or problems.
5. Have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention and interest in studying mathematics, as well as a tenacious and confident attitude in solving problems.

From the objectives that have been explained, several abilities that want to be developed include understanding concepts, reasoning, problem solving and understanding concepts. One of the abilities that students must have in learning mathematics is mathematical communication skills.

Indonesia is a country with low mathematics skills compared to other countries. This can be seen from the results of an international survey conducted by *the Program for International StudentsAssessment* (PISA) in 2015. The mathematics ability of students in Indonesia was ranked 63rd out of 71 countries with the maximum score obtained by Singapore, namely 564 and the minimum score obtained by the Dominican Republic, namely 328, while Indonesia obtained a score of 386 (OECD, 2016). The results of a survey conducted by PISA indicate that the mathematical abilities of students in Indonesia are still very low. One of the mathematical abilities that is still low is students' mathematical communication abilities.

The mathematical communication skills of students at X IPA-6 SMA Negeri 11 Medan are also still relatively low. Based on the results of interviews with teachers in the field of mathematics, there is a tendency for teachers to still use lecture-based learning methods which place more emphasis on students remembering or memorizing and do not train students enough to convey and express their ideas in appropriate mathematical language. Many students still experience difficulties in describing and expressing solutions to problems using pictures, have difficulty explaining ideas, solutions and mathematical relationships in writing, using mathematical language and symbols correctly. This causes the mathematical communication skills of X IPA-6 students at SMA Negeri 11 Medan to remain low.

The lecture method still has many shortcomings. This is in line with Sanjaya's opinion (2009:145), namely:"The lecture method is carried out by conveying lesson material orally, usually the lesson material delivered is ready-made lesson material, such as data or facts, certain concepts that must be memorized so that it does not require students to think again and not be able to express ideas using his own language."

From the diagnostic tests given by researchers, of the 32 students who took the test there were 8 out of 32 students or 25% of students who were in the medium category, 6 out of 32 students or 18.75% of students who were in the low category and 18 out of 32 students or 56 .25% of students are in the very low category.

Based on the data obtained, there are still many students whose mathematical communication skills are classified as very low. However, it is realized that the importance of mathematical communication competence really needs to be improved. The importance of mathematical communication skills is stated in *the National Council of Teachers of Mathematics* (NCTM) (2000) that communication is an important part of mathematics and mathematics education. It is a way to share ideas and classify understanding.

This statement is in line with Anggraini and Hia (2016) who state that by not ignoring other abilities that are useful for students' lives now and in the future, it is appropriate that students' mathematical communication skills should be a factor in the emotional intelligence students need to receive. very special attention in learning mathematics. Because if these weaknesses are not anticipated and corrected, they will always occur

and will hinder the achievement of learning objectives as a whole. More specifically, Broody (Ansari, 2016) stated that there are at least two important reasons why mathematical communication needs to be developed among students, namely:"First, *mathematics as language* , meaning that mathematics is not just a tool *to aid thinking* , a tool to find patterns, solve problems or draw conclusions, but mathematics is also a valuable tool for communicating various ideas clearly, precise and thorough. Second, *mathematics learning as social activity* , meaning as a social activity in learning mathematics. Mathematics is also a vehicle for interaction between students and also communication between teachers and students. This is the most important part of accelerating students' mathematical understanding."

Based on the description of the problem above, there needs to be an improvement in the learning process to overcome this problem. The learning carried out must of course be appropriate by changing the habit of teacher-centered learning activities to situations that make students the center of attention. The teacher is the facilitator and guide, while the students are the ones being guided, not just copying and following examples without understanding the mathematical concepts. In other words , the learning carried out must be designed in such a way as to improve students' mathematical communication skills.

One learning alternative that could possibly improve students' mathematical communication skills is *Discovery Learning* .*Discovery learning* is a learning model designed so that students can discover concepts through their own mental processes. In this learning model, students are actively involved in the learning process. This learning model can facilitate students in developing their mathematical communication skills. In the learning stages of the *discovery learning model* , there is space for students to practice their mathematical communication skills.

Discovery learning is a learning process that is not given in its entirety but instead involves students to organize, develop knowledge and skills for problem solving. So, by implementing the *discovery learning model* , it can increase individual discovery abilities, in addition to making learning conditions that were initially passive become more active and creative. So teachers can change learning that was initially *teacher oriented* to *student oriented* . (Yuliana, 2018: 22)

Based on the explanation above, the researcher is interested in conducting research with the title: Application of the *Discovery Learning Model* to Improve the Mathematical Communication Skills of Class X Science-6 Students**.**

RESEARCH METHOD

This research was conducted at SMA Negeri 11 Medan which is located on Jalan Pertiwi No.93 Medan . The subjects of this research were 32 students in class X Science-6 of SMA Negeri 11 Medan.The object of this research is the application of the *Discovery Learning model* in improving students' mathematical communication skills on the subject of Trigonometry

In accordance with this type of research, namely classroom action research, this research has several stages which constitute a cycle. Each cycle is carried out in accordance with the changes to be achieved. In this research, if the cycle is not successful, namely the teaching and learning process has not improved the students' mathematical communication skills as seen from the mathematical communication skills test, then a further cycle will be held until the students' mathematical communication skills improve.

In this research, students' mathematical communication skills are said to have increased if the gain index is included in the medium category, there is an increase in the average value and an increase in the presentation of many students who are able to communicate problems. After implementing the *Discovery Learning* learningmodel , students will be given a mathematical communication skills test to see whether

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there is any improvement in the students. Schematically, the action research model (classroom action research) is presented as Figure 1 below. (adapted from Kemmis, in Setyosari, 2012)

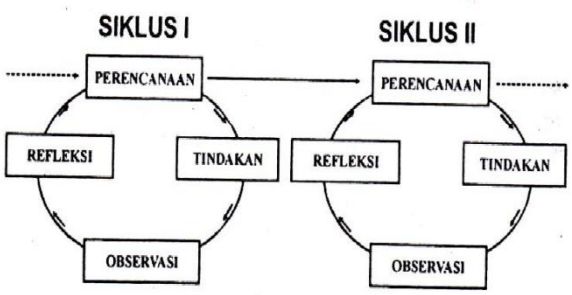

Figure 1. Classroom Action Research Cycle

RESULTS AND DISCUSSION

Was carried out in class four hours of lessons with a time allocation of 90 minutes at each meeting and there is a post-test at the end of the cycle. The teaching and learning process was carried out by the researcher as a teacher, and involved two colleagues as observers, while the teacher acted as a guide during teaching and learning activities and during reflection activities.

The application of learning in this research was carried out in two cycles, namely cycle I and cycle II, each consisting of two meetings. Before learning activities are carried out, the researcher acting as a teacher prepares a number of tools needed, including lesson plans, teaching materials, evaluation questions, practice questions, group activity sheets, questionnaire sheets, and student observation sheets. The researcher also involved one observer who was tasked with observing all student activities during the learning process, while the teacher acted as a guide to the learning process.

1. Increase in the average score obtained by students.

The class average score in the first cycle communication skills test was 69.88 and increased to 83.16 in the second cycle, resulting in an average increase in students' mathematical communication skills of 13.28. More details can be seen in the following table.

Table 1.Description of Students' Mathematical Communication Ability Levels for Each Cycle.

Value Interval	Level of Student Communication Skills	Cycle I	Cycle II
90 ≤ TKKM ≤ 100	Very high	0	9
80 ≤ TKKM < 90	Tall	4	15
70 ≤ TKKM < 80	Enough	14	3
60 ≤ TKKM < 70	Low	10	3
0 ≤ TKKM < 60	Very low	4	2
∑		32	32
Class Average		69.88	83.16

These results can be presented with the following graph.

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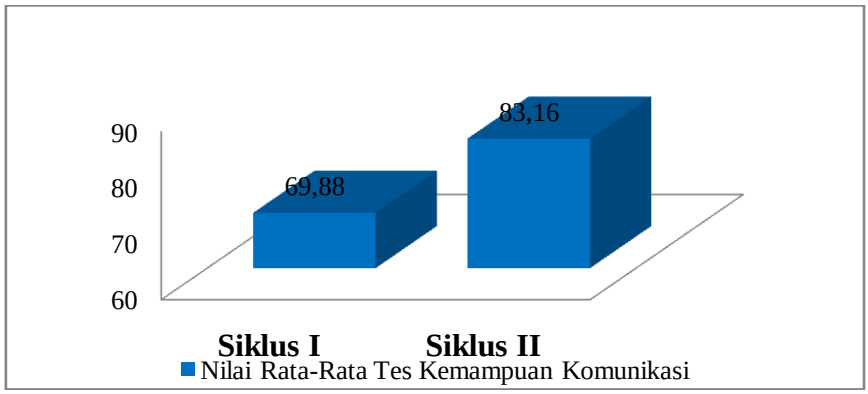

Figure 2. Graph of the Average Score of Students' Mathematical Communication Ability Test in Each Cycle

The increase in the average score obtained by students seen from each indicator of mathematical communication from cycle I to cycle II was obtained as follows:

a. Mathematical writing ability in cycle I obtained an average value of 67.45 and in cycle II it was 83.85 so the increase in average value was 16.4.
b. The ability to draw mathematically in cycle I obtained an average value of 69.01 and in cycle II it was 79.95 so the increase in average value was 10.24.
c. Mathematical expression ability in cycle I obtained an average value of 73.18 and in cycle II it was 85.68 so the increase in average value was 12.5.

2. Increase in the number of students who achieve learning mastery in solving mathematical communication ability test questions

In cycle I, 18 students or 56.25% of students had achieved learning completeness, while in cycle II, 27 students or 84.375% of students had achieved learning completeness. The increase in the number of students who achieved learning completion was 9 students or 28.125%.

More details can be seen in the following image.

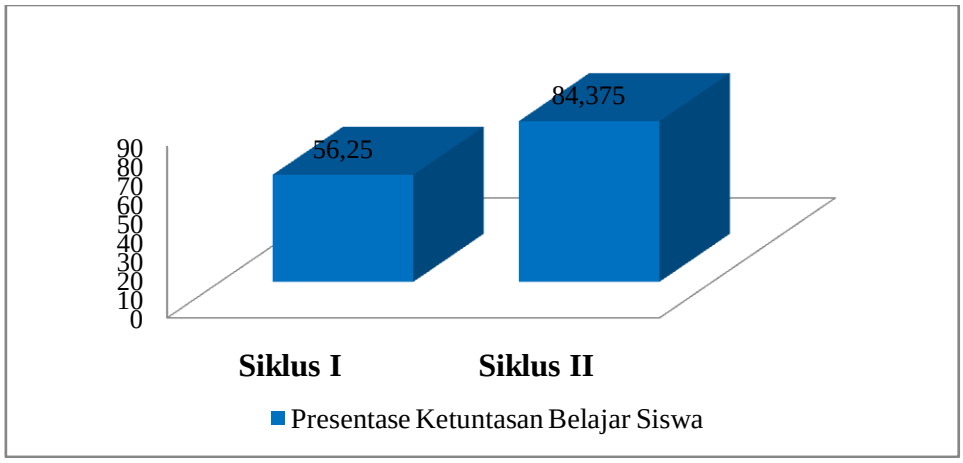

Figure 3 . Graph of Student Learning Completion Percentage

The increase in the number of students who achieved learning mastery seen from each indicator of mathematical communication skills from cycle I to cycle II was obtained as follows:

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a. Mathematical writing ability in cycle I was obtained by 16 students or 50% achieving learning completeness, while in cycle II 28 students or 87.5% achieved learning completeness. The increase in the number of students who achieved learning completeness was 12 students.
b. Mathematical expression abilities in cycle I were obtained by 28 students or 87.5% achieving learning completeness, while in cycle II 28 students or 87.5% achieved learning completeness. The number of students who achieve learning completion is constant.
c. The ability to draw mathematically in cycle I was obtained by 17 students or 53.125% achieving learning completeness, while in cycle II 26 students or 81.25% achieved learning completeness. The increase in the number of students who achieved learning completion was 9 students.

3. Increasing the level of students' mathematical communication skills

In cycle II students' mathematical communication skills increased from cycle I, of the 32 students there were 9 students who got scores between 90 ≤ TKKM ≤ 100 which were categorized as students with very high abilities, 15 students who got scores between 80 ≤ TKKM < 90 were categorized as students with high ability, 3 students got scores between 70 ≤ TKKM < 80 which were categorized as students with medium ability, 3 students got scores between 60 ≤ TKKM < 70 which were categorized as students with low ability levels, and 2 students got scores between 0 ≤ TKKM < 60 are categorized as students with very low ability. More details can be seen in the following image.

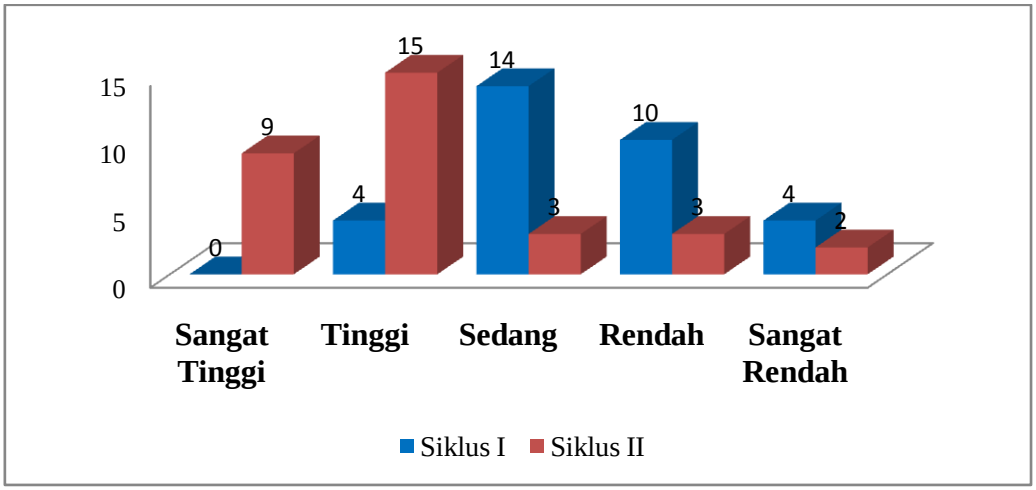

Figure 4. Graph of Students' Mathematical Communication Ability Levels

Based on the results of research conducted using Gain Score, an increase in students' mathematical communication skills from cycle I to cycle II was obtained as follows.

$$\text{Gain Index} = \frac{\text{Skor akhir} - \text{skor awal}}{\text{skor maksimum ideal} - \text{skor awal}}$$

$$= \frac{83{,}16 - 69{,}88}{100 - 69{,}88} = \frac{13{,}28}{30{,}12} = 0.44$$

Increasing students' mathematical communication skills based on a score gain of 0.44 , namely in the medium category.

Based on the research results, it was found that the *discovery learning approach* could improve mathematical communication skills in class X IPA-6 students at SMA Negeri 11 Medan on Trigonometry material. The increase in students' mathematical communication skills can be seen from the increase in average scores, increase in students' mastery (mathematics communication skills) in the percentage of

individual learning completeness and classical learning completeness. Thus, the *discovery learning approach* is one of the efforts that can be made to improve students' mathematical communication skills. In line with the research results of Lisda et al (2015) which stated that *discovery learning* was successful in developing students' mathematical communication and disposition. Based on this explanation, *discovery learning* is able to help students solve problems, especially mathematical communication problems.

By implementing the *discovery learning model* , it emphasizes students' active involvement in learning activities, so that they are able to use their mental processes to discover the concept or theory being studied. The discoveries made by students are something new to themselves even though they are already known to others. These new things can be in the form of concepts, theorems, formulas, patterns, rules and the like. With the process of finding and investigating, the results obtained will be faithful and long-lasting in the memory, and will not be easily forgotten by students. Bruner considers that discovery learning corresponds to the active search for knowledge by humans, and by itself gives the best results. Trying to find solutions to problems and the knowledge that accompanies them produces knowledge that is truly meaningful. Using PowerPoint media also makes students look more enthusiastic about learning. By looking at the observations and results of students' mathematical communication tests obtained in cycle II, a hypothesis can be achieved so that there is no need to carry out the next cycle.

Thus, based on the discussion that has been presented, learning is done by applying the *discovery learning model*succeeded in improving the learning process by increasing students' mathematical communication skills, especially the subject of Trigonometry in class X IPA-6 at SMA Negeri 11 Medan

CONCLUSION

Based on the results of the research and discussion, the following conclusions were obtained:

1. There are 84.375% of students who have a moderate level of mathematical communication skills.
2. The increase in students' mathematical communication skills based on the gain index is in the medium category, namely 0.44.
3. The teacher's ability to manage learning is in the good category.

The data above shows that the learning process in cycle II went better than cycle I. There were no obstacles that had a big influence on the learning process or the students. Apart from that, learning by applying the *discovery learning model* can increase students' achievement of learning mastery. So it can be seen that the application of the discovery learning model can improve the mathematical communication skills of Trigonometry material in class X SMA Negeri 11 Medan

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