IMPROVING YEAR 7 STUDENTS' MATHEMATICS COMMUNICATION SKILLS BY THE DISCOVERY LEARNING MODEL

Ulima Dani[1], Tuti Zubaidah[1]*

[1]Program Studi Pendidikan Matematika, Universitas Syiah kuala, Banda Aceh, Indonesia

*Email: tuti.zubaidah@fkip.unsyiah.ac.id

Abstrak: Salah satu cara untuk meningkatkan keterampilan komunikasi siswa adalah dengan menerapkan model Discovery Learning. Hal ini dapat meningkatkan keterampilan komunikasi siswa dengan memungkinkan siswa mengekspresikan ide-ide temuannya. Keterampilan komunikasi dapat secara lisan atau tulisan, dan guru perlu memotivasi siswa untuk berkomunikasi secara aktif. Penelitian ini bertujuan untuk mengetahui kemampuan komunikasi matematika siswa kelas 7 dengan model Discovery Learning dalam pembelajaran matematika. Jenis penelitian ini adalah kuantitatif dengan rancangan pra eksperimental dengan one group pretest-posttest. Populasi penelitian ini adalah seluruh siswa kelas 7 di sekolah yang diteliti, dan sampelnya adalah satu kelas yang dipilih secara acak. Instrumen penelitian berupa pre-test dan post-test untuk menggali keterampilan komunikasi siswa. Hasil penelitian menunjukkan bahwa model Discovery Learning dapat meningkatkan keterampilan komunikasi matematika siswa kelas 7. Diharapkan penelitian ini dapat memberikan informasi kepada guru dan pendidik tentang penerapan model pembelajaran yang tepat untuk meningkatkan kemampuan komunikasi siswa

Kata kunci : *keterampilan komunikasi, discovery learning*

Abstract: One way to improve students' communication skills is by applying the Discovery Learning model. It can improve students' communication skills by enabling students to express ideas of their findings. Communication skills can be orally or in writing, and teachers need to motivate students to communicate actively. This study aims to determine Year 7 students' mathematics communication skills by the Discovery Learning model in mathematics learning. This was a quantitative research using a pre-experimental design with a one-group pretest-posttest. This research population was all Year 7 students in the school studied, and the sample was one class that was selected randomly. The research instruments were pre-test and post-test to explore students' communication skills. The results indicated that the Discovery Learning model could improve Year 7 students' mathematics communication skills. It is expected that this research may inform teachers and educators concerning the application of appropriate learning model for enhancing students' communication skills.

Keywords : *communication skills, discovery learning*

INTRODUCTION

Mathematics is one of the subjects studied at all educational levels, from elementary to high school. It is a pivotal subject for facing an ever-changing life. National Council of Teachers of Mathematics (2000) stated five mathematical abilities in mathematics learning: problem-solving, reasoning, communication, connection, and representation abilities. Mathematical communication skill is one of the mathematical abilities that teachers need to develop in mathematics learning. BSNP (2010) also stated that one of the goals of learning mathematics is to communicate mathematical ideas clearly and effectively. Students are expected to be able to master their abilities in mathematics.

Students nowadays are not trained to express their ideas, especially in the square and triangle topics. In the square and triangle topics, students are required to understand the mathematical symbols and sketch the given problem, which will be solved systematically and conclude the solution. Meanwhile, the teachers often provide an example of questions related to calculations, not testing students' mathematical communication skills This condition leads to the low of students' ability in mathematical communication (Kristiwan, 2012). Trends in International Mathematics and Science Study (TIMSS) also mentioned that only a few countries emphasize mathematical communication in learning. The implementation is more about mastering necessary abilities. Based on the PISA survey in 2012, Indonesian students' average mathematical ability is 375, with a benchmark score of 494 (OECD, 2014). It can be seen that Indonesian students are ranked 64th out of 65 countries. The PISA survey in 2015 (OECD, 2018) also reported that the average mathematical ability of Indonesian students is 386, with the benchmark score being 490. Although the average score of student's mathematical ability in 2015 was higher than their ability in 2012, this score is still below the PISA standard. Therefore, to improve Indonesia's quality of education, it is necessary to develop new methods that can be applied in the learning process.

The preliminary observations conducted on the Year 7 mathematics teacher at one of the private Islamic junior high school, namely: MTs Darul Ihsan Aceh Besar, Indonesia, revealed that teachers did not concern about improving students' mathematical communication skills. Students' mathematical communication skills are not taken into consideration by teachers in creating questions or teaching. As a result, students' mathematical communication in the school lacks, especially in determining the area and perimeter of squares and triangles. Other factors contributing to students' low mathematical communication skills are students have not been accustomed to training their mathematical communication skills, especially in solving HOTS (High Order Thinking Skill) problems; (BSNP, 2010). At the beginning of the lesson, the teachers immediately deliver the definition of the sub-topic of learning, before providing a formula and several sample questions followed by some questions that are

almost similar to the given sample questions. This is strategies caused students to only memorise the formulas without knowing the concepts. Also, teachers have not applied an appropriate model in learning, so students are not given many opportunities to present their mathematical ideas since learning tends to be teacher-centred. Moreover, teachers never use teaching media so that students find it challenging to understand learning. It causes students' mathematical communication skills to develop less optimally because students are less actively involved in the learning process. Therefore, a learning model that is suitable for the topic is the right solution to improve students' mathematical communication skills.

Based on the problems found, the researchers argue that the learning process needs to be improved by using the right learning model. Learning Model is an effort to achieve learning objectives. The better the application of the learning model, the more successful it is in achieving learning objectives. Rusman (2014) stated that teachers are required to provide an appropriate learning model to create a sense of willingness and enthusiasm to be actively engaged in learning and discover the mathematical concepts by themselves. In the discovering process, students are given a problem and solve it, then conclude according to the results.

One of the learning innovations is the Discovery Learning model. Discovery Learning is a model of teaching that applies guided discovery in learning. In the learning process, students are guided at a gradual stage so that at each stage, the teacher can ask children to express their ideas orally or in writing. In the Discovery Learning model, the teacher can also provide a problem to solve together by students in various ways so that it can improve students' mathematical communication skills.

Bell (in Qodariyah, 2015) proposed other advantages of the Discovery Learning model include the following. First, it allows students to actively learn because they think and use their abilities to find concepts. Second, it helps students develop effective collaborative ways of working, sharing information, and listening to and using other people's ideas. Through the Discovery Learning model discussion, students are expected to be able to state, explain, listen to, ask questions and work together so that learning is no longer monotonous. It can also train students to convey the results of their thinking both orally and in writing, communicate their mathematical ideas by providing explanations and reasons in an appropriate language, and writing down the results of their thoughts and conclusions.

Studies related to communication skills has been conducted by previous researchers (Disty et al., 2020; Klochkova et al., 2016; Kostos & Shin, 2010; Safitri et al., 2020). However, limited research has investigated the application of discovery learning model to enhance the students' communication skills. Hence, this study will examine the use of discovery learning for promoting communication skills.

1. *Mathematical Communication Skills*

As stated by Koellner et al., (2005), mathematical communication has a pivotal role in mathematics learning. This condition is because communication can act as:

a. media to show mathematical ideas and help the relevance of mathematical topics to be able to recognise students' abilities,

b. media of recognising or reflecting on students' mathematics understanding and being a measure of development in understanding mathematics,

c. media to organise students' mathematical thinking,

d. media to improve mathematical abilities, problem-solving, reasoning, self-confidence, and social abilities.

Mathematical communication can be interpreted as students' ability to show their mathematical thinking ideas in writing, speaking, diagrams, pictures, or certain mathematical symbols (Dahlan, 2011). Good communication skills will make it easier for students to understand mathematical concepts to solve problems.

Mathematical communication indicators, according to Sumarmo (2012) are: (1) Connecting pictures, diagrams, and real objects into mathematical ideas; (2) Explaining ideas and mathematical relations in writing or orally with real objects, pictures, graphics, and algebra; (3) Expressing daily-life problems in mathematical language or symbols; (4) Listening, compromising, writing mathematics, and delivering mathematics presentations; (5) Making conjectures, compiling arguments, formulating definitions, and explaining or asking questions related to mathematics; (6) Explaining and asking questions related to mathematics that have been studied.

Meanwhile, National Council of Teachers of Mathematics (2000) also suggested indicators of mathematical communication, namely: (1) the ability to express mathematical ideas in writing, orally, and describe them visually, (2) the ability to understand, define, and evaluate mathematical ideas orally, in writing, and into other visuals, (3) the ability to use terms, mathematical notations and structures to convey ideas and describe relations with situation models.

2. *Discovery Learning Model*

Discovery Learning is a teaching model that applies to learn by discovery. Knowledge can be obtained through the discovery process, not directly informed. Sund (in Roestiyah, 2008) stated that Discovery Learning requires students to integrate the principles or concepts by themselves. Concepts or principles are seeing and observing, understanding, grouping, designing, explaining, concluding, etc.

The term of Discovery Learning model was initially expressed by J. Bruner (in Johar, 2016), which prioritises one's learning process rather than learning outcomes, such as finding

concepts/formulas/principles through the help of teachers with syntax rules. According to Hosnan (in Susanto, 2016), there are several learning characteristics in constructivism theory, namely;

    a.   Focus on the learning process rather than the teaching process.

    b.   Emphasise the student's mind for independent study.

    c.   View students as ideas and achievement creators.

    d.   View learning not at results but through processes.

    e.   Invite students to do trial and error.

    f.   Value critical knowledge in learning.

    g.   Encourage high curiosity in students.

    h.   Evaluate the learning process based on the students' effort and understanding.

3. *Stages in the Discovery Learning Model*

According to Syah (2009), the syntax or stages of the Discovery Learning model is described in Table 1.

Table 1. Syntax of discovery learning model

Phase	Activities
Phase 1 Stimulation	Students are faced with confusion, so they have a curiosity for themselves. After that, the teacher guides students to ask questions, recommend reading the book and instruct students to prepare for problem-solving.
Phase 2 Problem Statement	Students are asked to identify as many problems as possible per the learning topic, and then they prepare a temporary solution to the questions.
Phase 3 Data Collection	Responding to problems or demonstrating the correctness of the hypothesis. Students are expected to be able to combine relevant materials/data, read the literature, and conduct the test and so on. Consequently, students are required to learn actively, creatively, and innovatively to solve the given problems. It automatically associates students to connect the problems with their prior knowledge.
Phase 4 Data Processing	Students' information is processed, estimated and calculated, if it is necessary, at a certain level of trustworthiness.
Phase 5 Verification	The hypothesis is examined more carefully to see whether the hypothesis is proven or not.
Phase 6 Generalisation	The results are concluded so that they can be used as guidelines for other similar problems.

Based on these stages, it is hoped that students will be able to apply them to the learning steps. It is expected that the learning process will match the expectations, as well as the learning activities, which can be increased and developed so that all students can participate in learning. The advantages of the Discovery Learning model were stated by Bell (in Qodariyah, 2015), including:

a. Allow students to engage in learning because they think and use their abilities to find concepts.

b. Help students form effective collaborative ways of working, sharing information, and listening to and using other people's ideas. Through the Discovery Learning discussion, students are expected to be able to express, explain, listen, ask questions and work together.

c. Learning is no longer monotonous and can train students in conveying their thoughts both orally and in writing, can communicate their mathematical ideas by providing explanations and reasons in the appropriate language, and can write down the results of their thoughts and conclusions.

Meanwhile, according to Mutmainna (2015), the drawbacks of the Discovery Learning model are:

a. Students must be physically and psychologically prepared before learning, be courageous, and hope to acquire the knowledge around them.

b. If the study space is enormous, then the methods are less effective.

c. The learning process of the Discovery Learning model is longer than the conventional one.

METHOD

This research used a quantitative approach. This study aims to identify the increase in students' mathematical communication skills with the Discovery Learning model. The type of this research is pre-experimental design (non-design) with one-group pre-test and post-test type. Using this method, the sampling technique provides equal opportunities for each member of the population to become the research sample. The sampling techniques used random sampling. Based on the random sampling technique, one Year 7 class consisting of 23 students was selected to be the sample at MTsS Darul Ihsan Aceh Besar, Indonesia.

The research instruments used for this study were pre-test and post-test. The pre-test aimed to determine students' initial mathematical communication skills related to the concept to be taught before the learning. While the post-test aimed to measure students' mathematical communication skills towards the learning concept that has been taught, and it was held at the end of the lesson. The test questions were adjusted to the applied learning indicators and mathematics communication skills indicators. The test was an essay which consisted of 5 questions with a time of 2x40 minutes and a maximum score of 100.

Students' mathematical communication skills can be measured through assigning tasks; one of them is mathematical problem-solving. The assignment must pay attention to several indicators or aspects of mathematical communication. Table 2 presents the scores in the assessment of students' mathematical communication skills.

Table 2. Mathematics communication skills assessment rubric (adapted from Sumarmo, 2016)

Score	Criteria
4	The response given is complete and precise; the explanation or description given is not ambiguous, including in making pictures and providing substantial and complete arguments
3	The response given is complete; The explanation or description provided is also quite reasonable, including using images that are also quite complete and provides supporting arguments but contains some minor flaws.
2	The responses given show some accuracy, but the explanations or descriptions given seem ambiguous, vague, and difficult to interpret, including using images that are also unclear, and providing incomplete arguments or based on illogical reasons.
1	Some of the responses given are rather precise but failed to complete, or there are some parts of the problem that fail to be expressed, including the pictures given that are incorrect and difficult to interpret. The explanation is interrupted or challenging to continue.
0	None of the responses given is correct, including the problem situation is not entirely described, and the words given do not reflect the problem.

The category of students' mathematical communication skill level is determined as in Table 3.

Table 3. The category of mathematics communication skills (adapted from Arikunto, 2010).

Category	Percentage
Very good	80 – 100
Good	66 – 79
Adequate	56 – 65
Inadequate	40 – 55
Highly inadequate	≤ 39

RESULTS AND DISCUSSIONS

Before the research was undertaken, the researchers gave a pre-test to the sample class. This test aimed to determine the students' initial mathematical communication skills. In this study, the researcher conducted three meetings in the sample class. After implementing the Discovery Learning model, the researchers gave a test to the students to examine the students' mathematical communication skills.

Students were still not familiar with the Discovery Learning model at the first meeting, so the researchers encountered a few obstacles in its implementation. Some of these obstacles included: (1) Students found it difficult to manage information and work on students' worksheet; (2) When working on students' worksheets, only a few students discussed with their group mates. This condition happened because the students were not familiar with the learning process using the Discovery Learning model

At the second and third meetings, students have begun to understand the learning procedures, so that they have sat in groups before starting the learning. This learning preparation can minimise the time consumption so that the learning time can be optimally used. Then during the teaching and learning process, the students already understood the steps to complete the students' worksheet. Besides the

students' worksheet, some learning media were also provided for students, so the students were able to organise the results of their knowledge, and their mathematical communication skills could develop optimally. Also, students have discussed with their group mates in managing information. Then each group presented their learning results in front of the class. The exciting thing that researchers discovered during the learning was that students became active since they were given the learning media to arose their curiosity. This fact described that students could develop their mathematical communication skills.

Mathematical communication skills of students taught through the Discovery Learning model are better than students taught through the conventional one at MTsS Darul Ihsan Banda Aceh. It can be caused by the differences in students' roles in learning. In the Discovery Learning model, each student works with fellow group members and has the opportunity to discover, manage information, improve communication skills, and build comprehensive interactions. The teacher's role is only to monitor the learning and become a facilitator when students face difficulties.

This finding is in line with the statement of Hayati (2018) who said that this learning model is designed to provide stimulation, thinking, and an invitation to think critically, systematically, and analytically to solve the given problems so that students can develop their ability to express mathematical ideas. The fact indicates a positive relationship between the Discovery Learning model and mathematical communication skills.

Discovery Learning differs from conventional learning. Conventional learning only focuses on teachers who dominate the teaching and learning process so that students obtain learning content from the teacher and do the exercises that are distributed. This theory is in line with Hibattulloh & Deddy (2014). They stated that the activity in the conventional learning model is that the teacher explains the material then provides examples of questions. The communication process is in one way, students only gain knowledge from what is conveyed by the teacher and are not allowed to manage the information.

Based on the test results, students' mathematical communication skills before using the Discovery Learning model was categorized as adequate, according to the table of Students' Mathematical Communication skills Category (Source: Adapted from Arikunto, 2010). However, if it is seen from the table of post-test and pre-test score differences, students' mathematical communication skills improved from the previous learning. So, it can be said that the model of Discovery Learning can improve the Year 7 students' mathematical communication skills at MTsS Darul Ihsan Aceh Besar, Aceh, Indonesia. The problem in the learning is that the students are still not used to receiving HOTS (Higher Order Thinking Abilities) problems according to the demands of the 2013 curriculum. In addition, the students think that the learning content is difficult for them since they have only memorized the formula without knowing the concept of how to obtain the formula.

Therefore, teachers need to apply the appropriate learning model according to the learning content. Students can be better trained in discovering a learning concept and can solve the HOTS problems. The student can also improve their mathematical communication skills so that the learning objectives can be achieved.

CONCLUSIONS

Based on the research results, it can be concluded that the application of Discovery Learning model can improve Year 7 students' mathematical communication skills at MTsS Darul Ihsan Aceh Besar in the 2019/2020 academic year. The finding implies that teachers should consider to use Discovery Learning model for enhancing student's mathematics communication skills. It is also recommended for future researchers to examine the effectiveness of the model in other mathematics topics or difference level of schooling.

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