CHAPTER I
INTRODUCTION

1.1. Background of Study

Education is a means of educating the nation's people and developing human potential. Education is essential for the development of a nation because the high or low quality of education in a country determines its progress or decline. Mathematics is a branch of science that plays an important role in improving educational quality. As the BSNP (Sepriani, 2021) states, mathematics is a universal science that is crucial in developing modern technology, where its application covers various fields of science and increases the power of human thought.

Realizing the important role of mathematics in life, thus it has become a subject that is studied by all students in all grades of schools and must be mastered well by students. According to Article 37 of Law Number 20 of 2003 concerning the National Education System, mathematics is one of the compulsory subjects in the primary and secondary education Curriculum. A good knowledge of mathematics must be in accordance with the purpose of learning mathematics. This is because the level of achievement mathematics learning can be seen through the achievement of learning goals. According to NCTM (2000), the purposes of learning mathematics are that students must have five standards of mathematical ability, namely problem solving, reasoning, communication, connection, and representation.

Mastering mathematics can be a powerful tool for learning other subjects (Heryan, 2018). Communication is the most crucial component in learning mathematics, as are speech and writing. Firmansyah et al. (2020) stated that the characteristics of mathematics which are abstract, full of terms and symbols, have caused most students to simply swallow all the material without understanding the

information contained in it. Students can think and reason to optimize their understanding of a mathematical concept and then communicate their ideas.

NCTM (2000) states that mathematical communication is a way of sharing ideas and clarifying students' understanding. Thus, when students communicate ideas, they also learn to explain and convince. Yulianti et al. (2021) stated that mathematical communication ability is the ability to express, understand, read situations into mathematical language, express ideas with tables, diagrams, symbols, or other media to clarify the state of the situation, and express mathematical ideas appropriately using mathematical language.

Mathematical communication ability is an ability that can support other mathematical abilities, such as problem-solving ability (Elmujahidah et al., 2018). Students who have good communication ability can more easily solve a mathematical problem, meaning that if students cannot communicate well in terms of interpreting mathematical concepts and problems, students cannot solve the problem properly. As stated by Safitri & Effendi (2022) that good mathematical communication ability helps students easily understand and solve mathematical problems related to the concepts they learn.

Students' mathematical communication ability can be assessed through indicators of mathematical communication ability. According to (Heryan, 2018), three indicators of mathematical communication ability should be developed in mathematics learning, which are, students can: (1) write explanations of answers of problems mathematically, reasonably, and systematically (writing); (2) express problems in the form of pictures, diagrams, and tables with completely (drawing); (3) create mathematical models of existing mathematical problems, do calculations so that the correct and complete solution is obtained (mathematics expression).

Although mathematical communication is an important ability and must be possessed by students, the current reality is that students' mathematical communication ability is still low. Based on the Programme for International Student Assessment (PISA) results in 2018, Indonesia only ranked 73 of 79 countries with an average score of 379, and the score is still far below the average international score determined by PISA, which is 489 (OECD, 2019). In addition,

the national examination results of junior high school students in Indonesia are also relatively low, especially in junior high schools in Langkat district, North Sumatra Province. Puspendik Kemendikbud (2019) explained that the average score of national examination results at the junior high school level in Langkat district is ranked 521 of 548 with an average score of 42,90, and the score is still far from the average score of national examination results at junior high school level in Indonesia which is 53,18. Furthermore, it is known that the results of the national examination at the junior high school level in mathematics have the lowest average score compared to other subjects, with average coverage of calculus (29,64), algebra (43,80), statistics (49,14), geometry and trigonometry (34,31). It will certainly affect the low abilities of students in mathematics, one of which is the ability of mathematical communication. This is because mathematical communication ability is the ability that can support other mathematical abilities (Elmujahidah et al., 2018).

SMP N 1 Selesai is a junior high school located in Langkat Regency. Based on interviews conducted with a mathematics teacher at SMP N 1 Selesai, it is known that during the mathematics learning process, students have difficulty in communicating their mathematical ideas both verbal and written, so it also impacts on the low students' mathematical communication ability. The low mathematical communication ability in verbal can be seen in the process of learning mathematics, most students are just silent and reluctant to ask about things that have not been understood. It is also shown in the research of Risdianti et al. (2019) and Deswita et al. (2018) which explain that students have not been able to express a situation or problem in mathematical expressions and when the teacher asks students, they have not been able to communicate their ideas so most students are only silent and unwilling to ask about materials that are not understood. In addition, when the teacher instructs students to read the information in their book and then asks them to convey what they read, students tend to only read what is written in the book. So, it can be said that students are not able to communicate the information in their own language.

In learning mathematics, it is also known that students more often memorize and remember the formula of mathematics. Thus, most students have

difficulty when solving a mathematics problem that is different from the example given by the teacher. This is because students have not been able to understand, explain, and describe problems in mathematics by communicating ideas using their own language, symbols, pictures, tables, and diagrams. In addition, when presented with mathematical problems in the form of narratives or pictures, students have not been able to fully understand the information contained in them so that the information interpreted is incomplete and the answers obtained are wrong. This certainly has an impact on the low mathematical communication ability of students in writing.

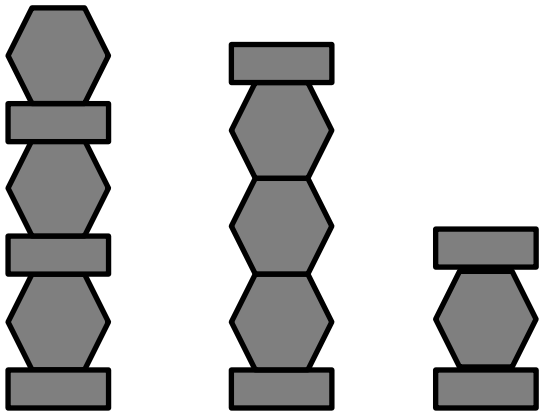
The low mathematical communication ability of students' writing is also evidenced by the results of initial tests in the form of mathematical communication ability tests that have been given to class VIII students consisting of 32 people are still far from expectations. The questions given consisted of 3 questions, each of which was in accordance with the indicators of mathematical communication ability. Question number 1 contains mathematical writing indicator, question number 2 contains mathematical drawing indicator, and question number 3 contains mathematical expression indicator. The following are the questions that researcher gave to students:

1. Perhatikan sistem persamaan linear dua variabel berikut ini:

   a) $2x - y = 6$ b) $x + y = 6$

   $6x - 3y = 9$ $2x + y = 9$

   Diantara SPLDV (a) dan SPLDV (b) di atas, manakah sistem persamaan linear dua variabel yang tidak memiliki penyelesaian dan memiliki penyelesaian? Berikan alasannya!
2. Sinta dan Tina bekerja di sebuah perusahaan sepatu, Sinta dapat membuat 3 pasang sepatu setiap jamnya, dan Tina dapat membuat 4 pasang sepatu setiap jamnya. Jumlah jam bekerja mereka setiap hari adalah 14 jam dengan banyak sandal yang dapat dibuat 50 pasang sandal. Jika lama jam bekerja mereka tidak sama, tentukan lama jam bekerja mereka masing-masing dengan menggunakan metode grafik!

3. 

(1) (2) (3)

Di sebuah kota dibangun 3 buah menara dengan ketinggian yang berbeda-beda yang terususun dari dua bentuk yaitu bentuk segi-enam dan persegi panjang seperti pada gambar di atas. Menara pertama memiliki ketinggian 21 m dan menara kedua memiliki ketinggian 19 m. Tentukan tinggi menara yang ketiga dengan menggunakan SPLDV!

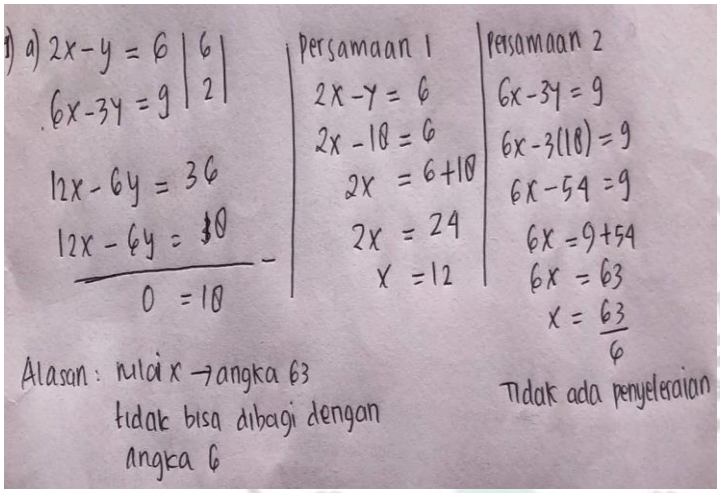
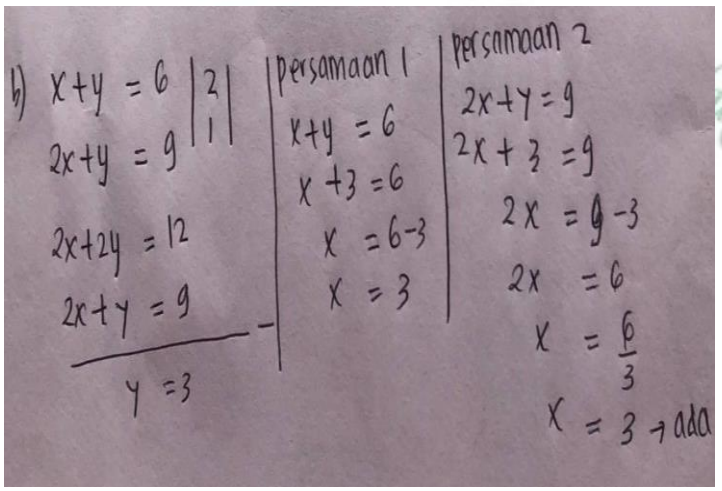
From the results of student work in answering the test, it can be analyzed, which is seen by calculating the score obtained by students for each question so that the level of students' communication ability can be categorized according to Kabeakan et al. (2018) as Table 1.1.

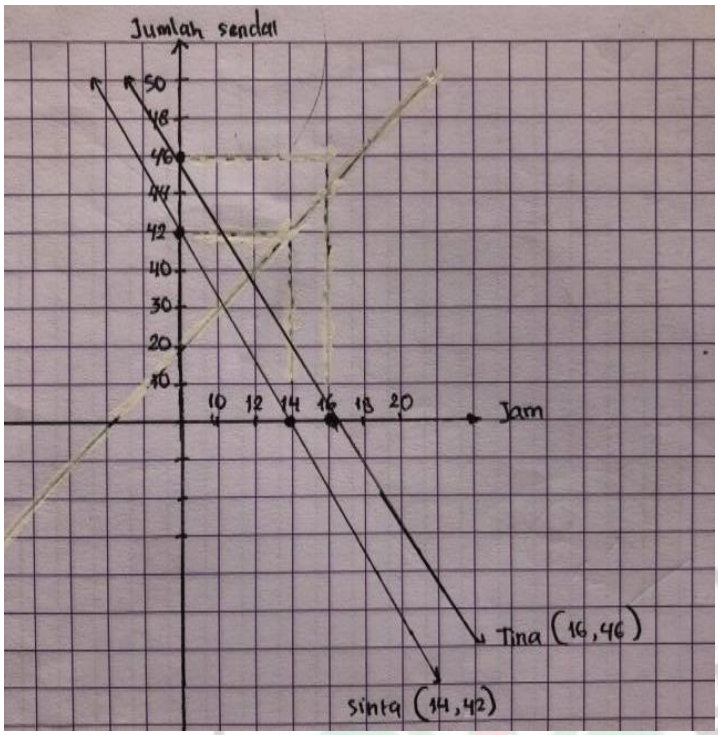
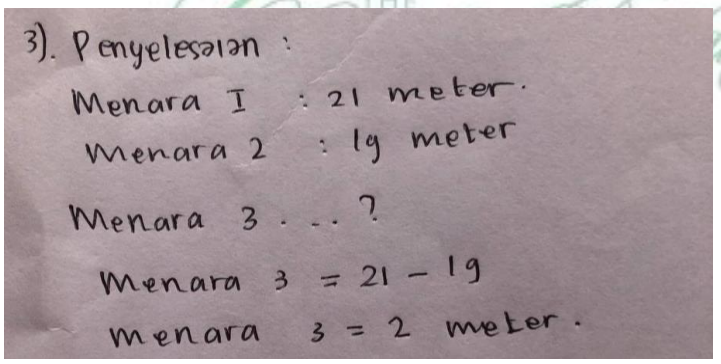
Table 1.1. Category of students' mathematics communication ability level

Score	Category	Number of Students	Percentage
75 – 100	High	0	0%
50 – 74,99	Medium	0	0%
25 – 49,99	Low	5	15,62%
0 – 24,99	Very Low	27	84,37%

Based on Table 1.1. It was found that from 32 students who had the test, there were no students who had mathematical communication ability in the high and medium categories (0%), 5 students (15,62%) who had low mathematical communication ability, and 27 students (84,37%) who had very low mathematical communication ability. Following the sample of students' answer sheet in Table 1.2.

Table 1. 2. Sample of student answer sheet

Answer Sheet	Problem Detection
 	**Case 1.** Most of students have not been able to provide written explanations of the answers to problem given. One of the students' answer sheets can be seen in the figure beside. In part a, the written explanation of the answer to problem given by the student is still wrong. The explanation of the answer to problem that should be given by student is that SPLDV has no solution because using the elimination method results in the wrong equation, which is 0 = 18. In part b, student only write the answer to the problem, which is the value of x and y without explaining that the SPLDV has a solution. The correct answer is that SPLDV has a solution because by using the elimination-substitution method, the value of x = 3 and y = 3 is obtained.

	**Case 2.** Most of students have not been able to express the problem in the question into a graphic form. One of the students' answer sheets can be seen in the figure beside. The graph drawn by student is still wrong so that the answers obtained are also wrong. Representation of the x-axis and y-axis that student draw is still wrong, the x-axis should represent Sinta's duration of working hours and the y-axis should represent Tina's duration of working.
	**Case 3.** Most of students have not been able to represent the picture in the problem in the form of a mathematical model. One of the students' answer sheets can be seen in the figure beside. The answer obtained by student is wrong. Students cannot transform the problem into mathematical symbols as x and y. Suppose the rectangular tower is represented in the x symbol and the y symbol for the hexagon tower so that mathematical models can be made from the problem.

Based on the initial test conducted, it can be seen that there are no students who are able to answer the questions given correctly and completely and there are still many students who have very low mathematical communication ability. Based on the results of interviews with students, it is known that students' errors in solving the problems given are caused by students' difficulties in converting mathematical problems presented in the form of narrative problems or pictures into the form of mathematical equations to obtain solutions. In addition, it is also known that students do not understand the meaning of the problems given so that students' answers do not match what is asked in the problem. Students think that the answer is finished when in fact it is not finished.

According to Andini et al. (2018), the cause of students' low mathematical communication ability is caused by the teacher-centered learning process and tends to be a memorization process without understanding the theory. This is in accordance with the researcher's observation found when the teacher teaches in class. It was found that the teacher generally uses conventional methods in learning mathematics, where learning processes that are carried out emphasize more teacher activities. As a result, many students are still less active during learning. From this explanation, it can be concluded that the learning model is one factor that affects mathematical communication ability. So, it is necessary to change the learning model that can improve students' mathematical communication ability, one of which is problem-based learning (PBL).

The problem-based learning model is student-centered because it is a form of transformation from the teaching paradigm to the learning paradigm. According to Hafidloh et al. (2020), problem-based learning is a learning model based on contextual problems then students are required to solve the problems individually or in groups with teacher guidance so that there is an exchange of information and ideas. This problem-based learning model challenges students' abilities, provides satisfaction for discovering new knowledge, and can help students to develop their new knowledge and take responsibility for their learning (Daulay et al., 2020). In the implementation of the problem-based learning model, there are five syntaxes: (1) orienting students to the problem; (2) organizing students to learn; (3) guiding

individual or group investigations; (4) presenting work; and (5) evaluating (Hafely et al., 2018).

There are several connections between the syntax of the problem-based learning model and indicators of mathematical communication ability, including can be seen in the phase of guiding individual and group investigations and the phase of developing and presenting work. In the phase of guiding individual and group investigations, the teacher guides students in collecting the information needed, where in collecting information, students' drawing and mathematical expression ability is used to get information (Firmansyah et al., 2020). Therefore, it can be said that PBL is a learning model that can improve and hone students' mathematical communication ability.

Research conducted by Hafidloh et al. (2020) also stated that the mathematical communication ability of students who use the PBL model is better than students who learn with the conventional learning model because in the process of learning in groups, students are seen asking each other to students who have more understanding of the problems given, it means that there is good communication between students and students can be more independent in solving a problem. The same statement was also stated by the research of Layliyyah et al. (2022) that the students' mathematical communication ability in the experiment class (PBL model) was higher than the students' mathematical communication ability in the control class (conventional)..

Besides using the suitable learning model, students' mathematical communication ability is also affected by the presentation of the material and the media used. One of the efforts to visualize mathematical ideas so that mathematics can be truly understood by students, especially in geometry material is needed a media. According to Fauziah et al. (2021), in the learning of geometry in elementary school, many teachers complain about how difficult in giving understanding to students. This is because geometry fits with abstract properties. Students need to imagine or see objects and interpret the images in question.

Patmawati et al. (2022) stated that one of the ICT media that can be used is geogebra. With this media, it can make easier for teachers when teaching. Teachers do not need a long time to use chalk or markers in drawing space object.

Besides, The use of geogebra in mathematics learning can improve students' mathematical communication ability as stated in the research results of Fadilah et al. (2019) shows that the mathematical communication ability of students in junior high school whose learning uses geogebra software are better than students whose learning without using geogebra software.

Based on observations, it is also known in the learning process that ICT-based learning media has never been applied in the mathematics learning process such as the use of geogebra. This is because teachers have not been able to use computers as learning media using mathematics software. Based on an interview with a mathematics teacher, it is also known that the difficulties experienced by teachers in writing mathematical formulas and even drawing mathematical concepts in computer media make teachers more comfortable explaining mathematical concepts with manual media such as cube nets, cube skeletons, or pictures. However, the use of Curriculum 2013 in the schools observed is possible to use media in the learning process. This is also confirmed by Lainufar et al. (2021), which state that Curriculum 2013 is expected to optimally utilize learning media and ICT integration for education in the era of the industrial revolution 4.0.

Based on the background described above, the researcher had conducted a research entitled: **"The Effect of Problem-Based Learning Model Assisted by Geogebra Software on Students' Mathematical Communication Ability in SMP N 1 Selesai".**

1.2. Identification of Problem

Identified problems based on the background of research are :

1. Students' difficulties in communicating mathematical ideas.
2. Students' mathematical communication ability is still low.
3. The learning process used emphasizes teacher activities and minimizes student involvement.
4. The conventional model applied in the mathematics learning process of class VIII SMP N 1 Selesai cannot improve students' mathematical communication ability.

5. Learning hasn't varied like problem based learning never applied in the mathematics learning process of class VIII SMP N 1 Selesai.
6. The mathematics learning process of class VIII SMP Negeri 1 Selesai has not used ICT-based learning media.

1.3. Scope of Study

Based on the identification of the problems described above, the scope needed so that this research is not too broad. The scope of this research is limited to the low mathematical communication ability of students, the lack of use of media in learning, and learning models such as problem based learning models that can support students to improve mathematical communication ability have not been applied.

1.4. Limitation of Problem

The limitation of the problem in this research are:

1. Research focuses on the effect of problem-based learning model assisted by geogebra on students' mathematical communication ability in class VIII SMP N 1 Selesai.
2. Research focuses on problem-based learning model assisted by geogebra on students' mathematical communication ability, which is applied in cube and rectangular prism topics.

1.5. Formulation of Problem

The formulation of the problem in this research are:

1. How is the difference of students' mathematical communication ability taught by problem-based learning model assisted by geogebra and conventional learning model?
2. How is the way of problem-based learning model assited by geogebra can affect students' mathematical communication ability in SMP N 1 Selesai?

1.6. Purpose of Research

The purpose of this research are :

1. Analyzing the difference of students' mathematical communication ability taught by problem-based learning model assisted by geogebra and conventional learning model.
2. Analyzing the way of problem-based learning model assited by geogebra can affect students' mathematical communication ability in SMP N 1 Selesai

1.7. Benefits of Research

This research was conducted with the expectation of providing theoretical benefits and practical benefits as follows:

1. Theoretical Benefit

   This research is hoped to provide contribution in learning mathematics, especially in terms of improving mathematical communication ability with problem-based learning model assisted by geogebra software.
2. Practical Benefits

a. For students

   Students can develop their potential mathematical communication ability through the learning model applied by the teacher.

b. For teachers

   This research is expected to be consideration for teachers to design and manage the learning process, which is to use problem-based learning model that can enhance students' mathematical communication ability.

c. For school

   This research can be used as a consideration in developing and improving mathematics teaching programs in schools.

d. For the researcher

   This research can be used as information material to add insight and knowledge to researchers in choosing the appropriate learning model in carrying out teaching practices for students in the future.