

CHAPTER 1 INTRODUCTION

1.1. Background

Mathematics is one of the subjects studied at each school level both at the primary, secondary and higher education. Mathematical objects have an abstract and deductive thinking patterns and consistent (Depdikbud, 1996). In addition, functions of mathematics is to develop the ability of students' to communicate using numbers and symbols as well as the sharpness of reasoning that can help clarify and resolve problems in daily life.

Mathematics in school is not just for the purposes of the calculation, but more than that, mathematics already being used to help the development of a variety of science and technology. The importance of mathematics to study because so many potential uses include the study of mathematics, we are able to do other calculations, the calculation becomes more simple and practical, and to learn mathematics is expected that students' were able to become a man who thinks logically, critically, diligent, responsible and capable of resolving the problems (Ruseffendi, 1991: 70)

The world we live where change is accelerating and where the need for mathematics as way of representing, communicating and predicating events is improving. In the century the important requirement is what we learn must be utilized in daily life to cope with dynamic competition. To face the situation we (teachers) want to produce critical thinking capabilities among the learners. Through there are many methods to teach mathematics in the world the only method being adopted by mathematics teacher is lecture method (instruction). Poor learning outcome is due to poor instructional strategy. This is an important problem in teaching mathematics among the learners. This way supported by Ogunbiyi (2004) in his study it has been quoted "in most part of the world it has been discovered that lecture method or traditional expository method is being used by mathematics teachers.

Antonoplos (1985) and Stevenson (1987) in their studies showed the understanding the importance of mathematics, superiority of Japanese students' in mathematics when compared with their counterparts from Sweden, Australia, England and the United states. Stevenson also explained that the Japanese teachers are enthusiastic in their classroom practices. They engage the attention of the pupils in discussion and debate on mathematics. The children were encouraged to make meanings and connections through discussion and giving various meanings on the same idea or cocept to be leant (Stigler, lee and Stevenson, 1987: Antomoplos 1985). The length of hour put into mathematics teaching and learning was highest when compared with those other countries. The commitment has also justified their cultural believe in hard work for success in mathematics rather than innate ability (Abimbade,2012)

To engage the attention of the learners our teachers must adopt some different method to teach mathematics which provide plaform to learners to think, active, brainstorm and learning have come to the fore in discussions of classroom or transferable learning and gives motivation. The only economical method which provides all the above said is problem based learning (PBL) method. This article first describes different philosophy and methods of teaching mathematics and problem based learning (PBL) and goal of PBL and the adcantages, secondly it provide evidence that PBL is effective for teaching mathematics by conducting experiment.

Problem solving is a basic human activity in life because in order to survive and develop human beings are always dealing with the problem. education is expected to help students' have good problem solving abilities in order to resolve issues and questions relating to the subjects, especially mathematics. In fact, according to most students as mathematics is a science and a mere abstract formula. The students' perceptions makes the subjects of mathematics instruction are not well liked by the students so the effect on students' ability to master and have an impact on the ability of mathematical problem solving. Mathematics is part of the science that has great contribution in the development of science and technology (Sopiah,S.,dkk, 2009). The rapid development of science and

technology have a positive impact of improving the welfare of society but unconsciously also had a negative impact on the development of science and technology one of which is the pollution of the river were not immediately stopped eating will reduce water quality and increase the chances of flooding.

Improving the chances of flooding can not be separated from human actions. One cause is the lack of public awareness on the environment as a result of a lack of public understanding about it - whatever it can cause flooding. Therefore, the duty of a teacher to prepare young people to better understand the causes of flooding and other natural disasters, through the study of disaster (Rusilowati,A.,dkk,2012)

Alternative learning model that can condition students' to be more active and can enhance the understanding of disaster is a model of *Problem Based Learning* Visionary SETS (Environment Science Technology and Society). PBL is a learning model centered on the learner that empower learners to experiment / lab work, integrate theory and practice and apply their knowledge and abilities to develop a viable solution to the problem as defined (Savery,J.R., 2006). In learning activities with a model PBL students' will be faced with the problems that exist in their environment or problems in real life. As a result, students can improve solving abilities and allows the student to understand the concept (Trianto,2011: 67). PBL learning model provides a positive influence to improve problem solving abilities, critical and creative thinking (Selcuk, 2013)

SETS element integrated in the subjects of mathematics in the learning activities will facilitate students' in understanding the events - natural disasters with mathematical concepts. SETS is the integration between science (*Science*), the environment (*Environment*), technology (*Technology*) and communities (*Society*) (RusilowatiA.,dkk, 2012). SETS element in mathematics learning activities will provide an overview or a real example of the relation of science (*mathematics*) with objects or events that occur in the life of an environmental day - day. Consequently SETS can enhance students' understanding of disaster.

Curriculum of mathematics has been approved to change the system of mathematics education with the development of Indonesian society. Mathematical

knowledge will be obtained by students through the learning process. Learning will be more successful if it had known the objectives to be achieved. On curriculum Education Unit (KTSP) described awarded mathematics learning objectives are:

- (1) Understanding the mathematical concept, explain the link between concepts and apply concepts or algorithms in a flexible, accurate, efficient, and precise in problem solving,
- (2) Using the reasoning in the patterns and nature, perform mathematical manipulation in making generalizations, compile evidence or explain mathematical ideas and questions,
- (3) Solve problems that include the ability to understand the problem, devised a mathematical model, complete the mathematical model and interpret the obtained solution,
- (4) Communicate ideas with symbols, tables, diagrams or other media to clarify the situation or problem,
- (5) Having respect for the usefulness of mathematics in life is curiosity, concern and interest in studying mathematics, as well as the resilient nature and confidence in problem solving (BSNP, 2006).

In accordance with the common goal of learning mathematics formulated NCTM (*National Council of Teachers of Mathematics*) is a problem solving ability, communication abilities, ability to teconnect, reasoning ability, and representation. The purpose of learning mathematics not only divert the mathematical knowledge to students, but also develop the potential of the students' and has the knowledge allowing the occurrence of a change in the mindset of the students'.

The mathematical problem solving and mathematical communication is ability of students' in mathematics to be possessed by students Junior High School in the achievement of the curriculum, (BSNP 2006) suggested that mathematics learning objectives, among others:

- (1) Solve problems that include the ability to understand the problem, devised a mathematical model, finish models and interpret the obtained solution,

(2) To communicate ideas with symbols, tables, diagrams, or other media to clarify the circumstances or problem.

Both of these are very necessary for a students' to develop the abilities of mathematical, as disclosed Sumarmo (in Somakin; 2007) problem solving ability, and mathematical communication is referred to as the power of mathematics (*mathematical power*) or the abilities of mathematical (*doing the math*), so that mathematics can be classified into thinking low level and higher level thinking.

NCTM (2000) argued that solving the problem is the process of applying the knowledge that has been acquired earlier in new and different situations. In addition NCTM also express purpose of teaching problem solving in general is to

- (1) Build knowledge of new mathematics,
- (2) Solve problems that arise in mathematics and in the context of other contexts,
- (3) Implement and customize a variety of appropriate strategies to solve the problem
- (4) Monitor and reflect on the process of mathematical problem solving.

In addition to the ability of mathematical problem solving, mathematical communication ability also need to be developed, as disclosed Baroody (in Ansari; 2009) that there are at least two important reasons why communication in mathematics learning need to be nurtured in school, the first is not just a mathematical thinking tools, tools to find patterns, solve problems or take decisions but mathematics as well as a tool to communicate their ideas clearly, precisely and concisely, the second is as a social activity in learning school mathematics, mathematics as well as a vehicle for interaction between students' and also as a means of communication teachers and students'.

Suherman, (2003: 92) argues that "an issue usually contains a situation that encourages a person to solve it will but do not know firsthand what is to be done to resolve it ". Therefore, if a problem is given to a students', and the students' can know immediately answer correctly to the question is given, then the issue is not said to be a problem.

Problem solving is a process involving a task that the solution method is not known before, to find solution students' should map out their knowledge, and

through this process they often develop new knowledge about mathematics, thus solving the problem is an integral part in all parts of mathematics, and also should not be taught in isolation from mathematics (Turmudi, 2008).

Branca (Krulik and Reys, 1980) suggests that solving the problem of having three interpretations, that is: problem solving (1) as the main purpose; (2) as a process, and (3) as a basic skill. Thirdly it has implications in mathematics. *First*, if problem solving is an objective he regardless of the issues or a specific procedure, also regardless of the material of mathematics, the most important is how to solve the problem until it succeeds. In this case the problem solving as the main reason for learning mathematics. *Second*, if problem solving as a process point of view, the emphasis is not solely on the results, but rather how the methods, procedures, strategies and measures were developed through reasoning and communication to solve the problem. *Third*, problem solving as basic abilities or life abilities (*life skills*), because every human being should be able to solve its own problems. So problem solving is the basic abilities should be owned by every students'.

Mathematics teachers must teach students not only to solve problem but also to learn about mathematics through problem solving. While “many students’ may develop procedural fluency...”. they often lack the deep conceptual understanding necessary to solve new problems or make connections between mathematical ideas. This presents a challenge for teachers: problem based learning (PBL) provides oppurtunities for teachers to meet this challenge.

PBL exists a teaching method grounded in the ideals of constructivism and students’ centered learning. When using PBL, teachers help students’ to focus on solving problems within a real life context, encouraging them to consider the situation in which the problem exists whrn trying to find solutions. The majority of research examining PBL focuses on its use in medical schools, wih the key features being (a) the use of collaborative small group work, (b) a student centered approach, (c) the teacher as facilitator and (d) the use of real – life problems as the organizing focus.

In the medical arena, groups of students' are given a set of realistic patient symptoms and expected to research possible diagnoses and courses of treatment; groups work independently, developing and answering their own questions. If, during this diagnostic phase, a group is unsuccessful in addressing key issues, the instructor notes this on their assessment but does not provide the solution. In the classroom setting, it is this aspect of PBL which presents the most significant challenge, requiring teachers to shift from direct instruction to supporting students' organize their own learning

To measure the ability of solving mathematical problems required several indicators. The indicator according Sumarmo (2012) as the following:

(1) identify the elements that are known, asked, and the adequacy of the elements,(2) create a mathematical model, (3) implement a strategy to solve the problem within / outside of mathematics, (4) to explain / interpret the results, (5) complete the mathematical model and real problems, (6) use math significantly. According to George Polya explained in *How to Solve It* outlines put forward four main steps in solving the problem, namely: *Understanding the problem, Devising a Plan, Carrying out the Plan, and Looking Back* (Motte, 2010).

In this research, problem solving capabilities will be measured through students ability to solve a problem by using the steps in solving problems by Polya, namely: (1) *understand the problem*, (2) *plan the solution*, (3) *execute a plan settlement issues*, and (4) *lookings back*, arguing that strategy commonly used.

Mathematical communication abilities and problem solving is important to be mastered by students'. This is because people need intellectuals who are able to solve the problem in a systematic and able to interpret into spoken or written language that is easy dipaham. College as a place of formal education is expected to facilitate the development of mathematical communication abilities and problem solving students'.

Problem Based Learning (PBL) as one of the learning model has a characteristic that always begins and focused on the issue. In the PBL students can work in groups - small groups and have to identify what they know and what they

do not know and have to learn fatherly solve a problem. The main role of the faculty to facilitate the group process and learn, not to provide a direct answer.

Several studies of PBL in mathematics / statistics obtained positive results (Warigan 2007; Dina, 2008). But research at the same time see the mathematical communication abilities and problem solving through PBL on statistics has not been done. Hand, the research related to communication abilities are mathematically still unsatisfactory results (Firdaus, 2005).

Based on initial observation are PGRI Sumbar STKIP student who took the course, Elementary Statistics is found that underprivileged students in solving mathematical problems related to the real world and are not accustomed to pour thoughts orally or in writing. Their difficulty in determining the problem, steps that must be selected to find a solution and to determine patterns that can be used. Students' prefer that the matter be given in the form of symbols and numbers that instantly know what to search without having to interpret the matter beforehand. Questions about the "why" the most difficult to answer. Students' are groundless, "know the answer but hard for phrased".

Besides the ability to problem solving, mathematical communication ability are also required in the learning of mathematics. According to The Intended Learning Outcomes (Armiati 2009), mathematical communication is a essential abilities in mathematics, namely the ability to express mathematical ideas coherently to friends, teachers and others through the spoken and written language. Through this mathematical communication abilities students' can develop an understanding of mathematics when using correct mathematical language to write about mathematics, clarify ideas and learn to make the argument and represents the mathematical ideas verbally, images and symbols.

Baroody (Chap Sam and Cheng Meng, 2007) suggests that there is two reasons to focus on the first mathematical communication, mathematics is a language which is essential for mathematics itself. Mathematics is not just as thinking tools that help students' to develop a pattern, solve problems and provide conclusions, but also as a means to communicate thoughts, varying ideas in a clear, precise and concise. Second, learning and teaching mathematics is a social

activity that involves at least two parties, namely the teachers and students'. Communicating with friends is an important activity to develop abilities communication, so that students can learn as a mathematician and able to solve the problem successfully.

To measure the students mathematical communication abilities required some of the indicators proposed by Sumarmo (2012), among others is

- (1) Connect real objects, pictures and diagrams into mathematical ideas,
- (2) Explain ideas, situations and relationships math orally or in writing with real objects, pictures, graphics or algebraic form,
- (3) States the events of everyday language or math symbol,
- (4) Listening, discussing and writing about the mathematics,
- (5) Reading and writing mathematics presentation prepare questions that are relevant,
- (6) To make a conjecture, make the argument, formulate definitions and generalizations.

Meanwhile, according to NCTM (2000) indicators mathematical communication can seen from:

- (1) The ability to express mathematical ideas through word of mouth, writing, and demonstrate and describe it visually,
- (2) The ability to understand and evaluate mathematical ideas, either orally, in writing, or in other visual forms,
- (3) The ability to use terms, notations of mathematics and structure of the structure to present ideas, describe relationships with models of the situation.

Indicators of mathematical communication ability that will be used in this study were

- (1) Explain the idea and the situation in writing,
- (2) Certify the picture or diagram into mathematical ideas,
- (3) Certify the situation into mathematical models / drawings.

The above description shows that a high level of ability in mathematics such as problem solving and mathematical communication is still much to be desired in the curriculum of KTSP 2006. Based on observations of researchers in

SMP Negeri 30 Medan obtained information that mathematics learning in school do not fully develop High level capabilities such as the ability of students' mathematical problem solving and mathematical communication. Learning mathematics is generally still traditionally takes place with the characteristics centered on the teacher, using an approach that is expository so the teacher to dominate the process of learning activities in the classroom while students passively, in addition to training provided more questions that are routine, so less trained power of reason in problem solving and thinking abilities students' only at low levels.

Conditions in schools, math teacher pay less attention to the improved activity of students' in learning. This was disclosed Wahyuddin (in Rahman, 2012) that most students' looked closely following any explanation or information from the teacher. Students' very rarely ask questions to the teacher so the teacher engrossed himself explained what he had prepared, and the students' receives course delivered by teachers. Learning so inclined in one direction, learning activities more teachers than the interaction between students'. That is, learning tends to be centered on the teacher (teacher centered).

Low ability mathematical problem solving and communication students' also happened in SMP Negeri 30 Medan. Based on observations and interviews with teachers of mathematics courses on Wednesday, February 10th 2016 at the school, there was information that the students often have difficulty expressing problem situation into a mathematical model, especially if the matter is done in need of an image in its completion. This suggests that the ability of the students' described the situation problem and stated solution to the problem using pictures, charts, tables, or algebraically still low.

Low ability mathematical problem solving and communication students' can be seen from one of the examples of the tested sample questions to the students of SMP Negeri 30 Medan in class VIII-6.

Problems example 1 :

1. Budi buy 20 candies in the shop which is near his home. When he was at home, his brothers and sister (Iwan, Wayan, and Wati) asking for candy and

then, Budi candies remaining 11 seeds. How much candy requested by the third brother Budi?

Handwritten student solution for Figure 1.1:

$$\textcircled{1} \quad 20 - x = 1120$$

$$\quad \quad \times 11$$

$$\quad \quad 20 - x = 11$$

$$\quad \quad \quad \quad x = 9$$

Figure 1.1 Sample of Students' Answer Sheet Number 1

Based on Figure 1.1 students do not write what is known on the matter, in which communication and problem solving abilities are indispensable in writing what is known and what is asked in the question to resolve the problem.

Problem example 2 :

2. Every day Fitri set aside allowance for savings at home. After a 11days Fitri money get to Rp 154,000.00. How much money, Fitri aside her money every day?

Handwritten student solution for Figure 1.2:

$$\textcircled{2} \quad 11 \times y = 154$$

$$\quad \quad 11 \times y = 154.000$$

$$\quad \quad \quad \quad y = 14000$$

Figure 1.2 Sample of Students' Answer Sheet Number 2

Based on Figure 1.2 students also did not write what is known and what is asked the question, where this is necessary in solving problems and also students do not write completely the formula used in solving the problem.

Problem example 3 :

3. Knowing, the price pairs of shoes twice the price of a pair of slippers. A trader bought four pairs of shoes and three pairs of slippers. The traders must paying Rp 275,000.00.

- a. Make a mathematical model of the description above.
- b. Solve the mathematical model. Then, specify the price of 3 pairs of shoes and 5 pairs of slippers.

$$\begin{aligned} \text{Sepatu} &= x \\ \text{sandal} &= y \\ x &= 2y \quad 4x \\ 4x + 2y &= 275.000 \\ 4(2y) + 2y &= 275.000 \\ 8y + 2y &= 275.000 \end{aligned}$$

Figure 1.3 Sample of Students' Answer Sheet Number 3

Problem example 4

4. A farmer has a rectangular shaped piece of land. The land width of 6 m shorter than the length. If the ground around 60 m, determine the land area farmers.

$$\begin{aligned} K &= 2(p+l) \\ 60 &= 2(x+4-6) \\ 60 &= \dots \end{aligned}$$

Figure 1.4 Sample of Students Answer Sheet Number 4

Based on the students work on the Figure 1.1, Figure 1.2, Figure 1.3 and Figure 1.4 we can see that the wrong occurred because the students' have not been able to outline what is known and what is asked in the problem so that the students' answers yet precise and students tend to solve problems quickly regardless of the question on the matter properly and carefully, based on the results of diagnostics tests given to students' obtained results that the students' ability in planning to solving the problem, solve the problem, looking back the problems were resolved and communicate what is gained from the issue is still

very low it can be seen from the results of diagnostics tests of students who have been granted before this research begin.

Based on case that have been mentioned above the problem solving and mathematical communication is important to be known by students. Therefore, it should be considered an attempt to enhance the problem solving and mathematical communication, One strategy to enhance the mathematical problem solving and mathematical communication is to provide a guides that can steer students toward problem solving and mathematical communication, which it found in Problem based learning (PBL).

Problem based learning is an approach to learning that involves students' actively optimally, allowing students to explore, observation, experimentation, investigation, problem solving abilities and concepts that integrate the basic concepts of the various content areas. These lessons include deduce information about the problem, synthesize and present what has been obtained by the students' to be presented to the other students. Problem based learning (PBL) means that students' make sense of the situation and seek to build and understand the concept of a material in a way involved in solving the problem. In problem based learning teachers are expected to be able to create learning activities that allow students' and mathematical processes and investigate, compile conjecture, explore, plan your moves and then complete the steps to resolve the problem. In this case the teacher acts as a guide, facilitator and motivator, based on Teaching experience program in school (PPL), I discovered that the problem solving and communication abilities students are very low so I was interested to do this research using the Problem based learning model and the first step I did was to measure the level of problem solving abilities and communication abilities of students' in diagnostics tests improved testing diagnostics student must achieve a minimum of 85% of the total students, so it can be said that the problem solving and communication students succeed to improved.

Based on this background, the researchers are interested to do research with title : The Implementation of Problem Based Learning Model to Improve The Students' Mathematical Problem Solving and Mathematical Communication ability of Grade VIII SMP Negeri 30 Medan.

1.2. Problem Identification

Based on the background of the problems that have been mentioned above then becomes identifying the causes of the low ability of mathematical problem solving and communication students' are:

1. Students' mathematical problem solving and communication ability is low.
2. Students' has difficulty to solve mathematical problem solving and mathematical communication.
3. Learning process is dominated by the teacher so the students' only receive without have learning experience.
4. Implementation of Problem Based Learning is an effort to improve students' mathematical problem solving and mathematical communication ability.

1.3 Problem Limitation

Because the extent of the problem and limited ability, time and cost so the researchers need to make a limitation problem in this research. As for the Limitation Problem in this research are:

1. Research subject is the eighth grade students of SMP Negeri 30 Medan in academic year 2016/2017.
2. Model of learning used is Problem Based Learning (PBL).
3. Problem solving and communication ability the eighth grade students' of SMP Negeri 30 Medan in academic year 2016/2017.

1.4. Problem Formulation

Problem Formulation of this research is:

1. Does the implementation of Problem Based Learning model improve students' mathematical problem solving and communication ability in grade VIII at SMP Negeri 30 Medan ?
2. How does Problem Based Learning model improve students' mathematical problem solving and communication ability in grade VIII at SMP Negeri 30 Medan ?
3. Do students' activities improve after the implementation of Problem Based Learning in grade VIII at SMP Negeri 30 Medan ?

1.5. Research Objectives

This research was conducted with the following objectives:

1. Knowing whether students' problem solving and communication ability improve after the implementation of problem based learning model.
2. Improving students' mathematical problem solving and mathematical communication ability through problem based learning in grade VIII at SMP Negeri 30 Medan.
3. Knowing the improving of students' activities after the implementation of Problem Based Learning in grade VIII at SMP Negeri 30 Medan.

1.6. Research Benefits

The results of this study are expected to provide information and to provide the following benefits:

1. For students', in still high order thinking abilities in problem solving and communication.
2. For teachers, it can use problem based learning model for improving students' mathematical problem solving and communication ability in learning activities.

3. For researchers, as information for students' who are conducting research using Problem Based Learning (PBL) to improve students' mathematical problem solving and communication ability in learning activities.

1.7 Operational Definitions

Here are some terms that need to be defined operationally with the intent to avoid the mistakes of interpretation:

1. **Problem based learning model:** a model of learning which refers to five learning basic steps: (1) orientation students' on issues (2) organize the students' to learn (3) guiding the investigation of individual and group (4) develop and presents the results of work (5) analyze and evaluate the problem solving process.
2. **The ability of problem solving** is the students' ability in solving mathematical problems by paying attention to the process of finding answers by step troubleshooting steps: (1) understand the problem, (2) planning processes, (3) execute processes, (4) to re examine the truth of the answers.
3. **The ability mathematics communication** is written communication ability as measured by students' ability to answer the questions test the communication ability shaped mathematical description consisting of (1) states the problem of daily life the day into a symbol or a mathematical language, (2) interpret images into a mathematical model, (3) write down the information on the statement into the language of mathematics.