CHAPTER I
PRELIMINARY

1.1. Problem Background

The development of sciences and technologies which is rapidly increased demands the qualified human resources who have high competences. One of the competences is competence in mathematics. Mathematics is one of the subject matters that are important and necessary because its concepts, principles, and procedures are always used in solving problems in almost all subject matters in school and even in daily life. Mathematics subject matter is expected to help students to be able to think critically logic, and systematic. By mastering mathematics, students are expected to have a competitive advantage, either in the workplace or for further study to a higher level.

Mathematics has an important role because it has the advantage in advanced of sciences and technologies as follows (Martono, et. al, 2007:vii)

1. The language and rule in mathematics is well designed and consistent.
2. The information network structure of mathematics is very strong by its clear and systematic reasoning pattern.
3. Mathematics is an approach to learn sciences and technologies.
4. Mathematics is a tool in solving problems of other subject matters.
5. By mathematics, a problem can be seen in a compact model.

The importance of mathematics can also be seen from the position and role of mathematics according to Adam and Hamm (Wijaya, 2012:5-6):

1. Mathematics as a way to think

   Mathematics has role in the process of organizing ideas, analyzing information, and drawing conclusions among data.
2. Mathematics as an understanding of pattern and relation

   Connecting a mathematical concept with existing knowledge of students is very important in the study of mathematics so that they realize that the

concept they are learning has similarities and differences with the concepts they have learned.

3. Mathematics as a tool

   We have to view mathematics as a tool that we can use every day. Plenty of mathematical concepts can be found and used in daily life. For instance, the concept of the area of circle is useful to determine the price of circular food that has the same height, i.e. pizzas are often advertised according to their diameter.

4. Mathematics as a language or a tool to communicate

   Symbols in mathematics have the same meaning for certain terms from different languages. Therefore, mathematics is the universal language. For example, when we say "empat dikali tiga sama dengan dua belas", then only Indonesian knows that statement. But if we state that statement as "4 x 3 = 12", then people who have different language knowledge will understand that statement.

Regarding to the role and position of mathematics above, greater understanding of mathematics will be important of today's school-children. They must be able to learn new concepts and skills in order that they can use them in daily life. Student with a poor understanding in mathematics will have fewer opportunities to pursue higher levels of education and to compete a good job (National Research Council (NRC), 2002:3).

The importance of student's conceptual understanding also can be seen from the learning objectives of mathematics according to Content Standard in Kurikulum Tingkat Satuan Pendidikan (Badan Standar Nasional Pendidikan (BSNP), 2006:146), that is mathematics subject matter intended that learners have the following abilities:

1. Memahami konsep matematika, menjelaskan keterkaitan antar konsep dan mengaplikasikan konsep atau logaritma secara luwes, akurat, efisien dan tepat dalam pemecahan masalah.

2. Menggunakan penalaran pada pola dan sifat, melakukan manipulasi matematika dalam membuat generalisasi, menyusun bukti atau menjelaskan gagasan dan pernyataan matematika.
3. Memecahkan masalah yang meliputi kemampuan memahami masalah, merancang model matematika, menyelesaikan model dan menafsirkan solusi yang diperoleh.
4. Mengomunikasikan gagasan dengan simbol, tabel, diagram, atau media lain untuk memperjelas keadaan atau masalah.
5. Memiliki sikap menghargai kegunaan matematika dalam kehidupan, yaitu memiliki rasa ingin tahu, perhatian, dan minat dalam mempelajari matematika, serta sikap ulet dan percaya diri dalam pemecahan masalah."

If we notice the above learning objectives of mathematics, we can see that mathematics education in Indonesia is already noticed the development of mathematical thinking ability. One of those abilities that have to be possessed is mathematical concept ability. Understanding the concepts and theories well is getting emphasis in mathematics (Martono, et. al, 2007:viii). This ability is a fundamental ability to achieve other higher abilities.

Understanding may consist of a variety of other things as well. If the object of understanding is a phenomenon then its understanding may consist in finding an explanation of why the phenomenon occurs. A person may feel she understands an action because she knows how to perform it successfully. Piaget asserts that understanding focuses neither on the goals that the action is expected to attain, nor on the means that can be used to reach them (Sierpinska, 2005:5-6).

Learning mathematics with understanding is essential and makes subsequent learning easier. Knowledge learned with understanding provides a foundation for remembering or reconstructing mathematical facts and methods, for solving new and unfamiliar problems, and for generating new knowledge (NRC, 2002:11). Mathematics makes more sense and is easier to remember and to apply when students connect new language to existing knowledge in meaningful ways. To attain the meaningful understanding, then mathematics learning should

be aimed at developing mathematical connection ability among ideas, how ideas interconnected to each other so that will be built the understanding thoroughly, and use mathematics in context out of mathematics (NCTM, 2000:20). Getting students to see connections between the mathematics they are learning and what they already know also aids them in conceptual understanding. According to Ansari (2009:28), mathematical understanding is the level of student's knowledge about concepts, principles, algorithm, and skillfulness of students in using solving strategy to the presented problems. Therefore, all students should be expected to understand and be able to apply procedures, concepts, and processes mathematics (NCTM, 2000:20). Mathematical understanding can be gained by experience about the owned characteristics and not possessed of a set of objects (abstraction). By doing observation of examples and non-examples, students could gain the meaning of a concept (Suherman, 2001:55). So that, when students understand mathematically, they are able to classify the objects based on its concept by their own words, give example and non-example, and use the concepts in solving routine exercises.

To know the ability of student's understanding of mathematical concept in the field, researcher should do the preliminary study. Arikunto (2007:26) asserts that preliminary study is the activity of researcher to conduct the temporary data collection for the certainty of the next step in research. Regarding to Arikunto's opinion, we can say that preliminary study is useful for researcher to collect the data and information and also to know how to analyze the data (Sahayu, 2012).

In the preliminary study that has been done by researcher, researcher conducted the preliminary test. The preliminary test is compiled by researcher based on three indicators of understanding of mathematical concept, they are, be able to classify the object according to its concept, be able to give example and non-example, and to use the concept in the routine exercises. Preliminary test that conducted to 28 students of class VIII Bil-2 at SMP Negeri 1 Lubuk Pakam indicates that conceptual understanding ability of certain students is still low. This is one of the reasons for selecting school of SMP Negeri 1 Lubuk Pakam and

junior high school students as the population, that is, the students' understanding of mathematical concept is not sufficient. In addition, since stage of junior high school students' cognitive development has reached the stage of formal operations, which is asserted by Piaget's theory (Trianto, 2011:30) that the level of formal operation development of students at the age of 11-15 old years. In this step, students begin to think concept that is out of their knowledge and try to connect it with their own knowledge so that it is possible to implement the RME approach. Besides that, it is few studies conducted in the schools, especially in the field of mathematics education research.

This case also can be seen from several student's answers when this following problem was given: "A ship sailed from point A to the east as far as 3 km. After that, the ship turned to the north as far as 4 km then arrived at point B. From point B, the sailing ship continued its journey to the east as far as 6 km and turn toward the north as far as 8 km. Finally, the ship arrived at the point C. Define the distance from point A to C through point B."

Example of student's answer for the above problem is

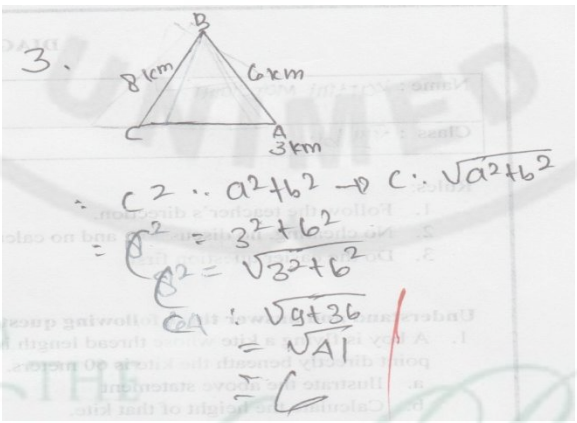

Fig. 1.1. Example 1 of student's answer

From the student's answer above, we can say that the ability of student in understanding the problem given and using Pythagorean Theorem is low.

Then, from the other problem: "The following figure is a kite frame which is composed by two bamboos. The lengths of each bamboo are 60 cm and 50 cm.

The longest bamboo is made into a perpendicular frame. If the end of each bamboo is connected with ropes, then calculate the required ropes (winding ropes are ignored).”

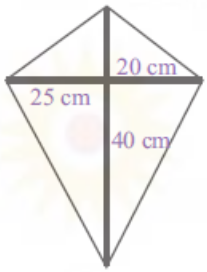

Fig. 1.2. A kite frame

Example of student’s answer for the above problem is

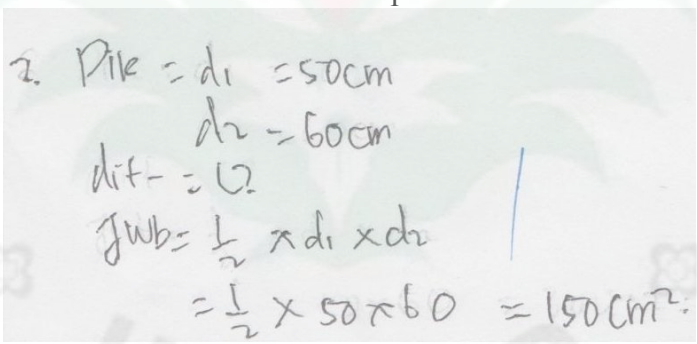

Fig. 1.3. Example 2 of student’s answer

From the student’s answer above, we can say that the ability of student in using the Pythagorean Theorem in problem is low.

For another example:

Write down the triangle’s sizes that is triple of Pythagoras or not triple Pythagoras, then classify what type of triangle is that (minimal 3).

Example of student’s answer for the above problem is:

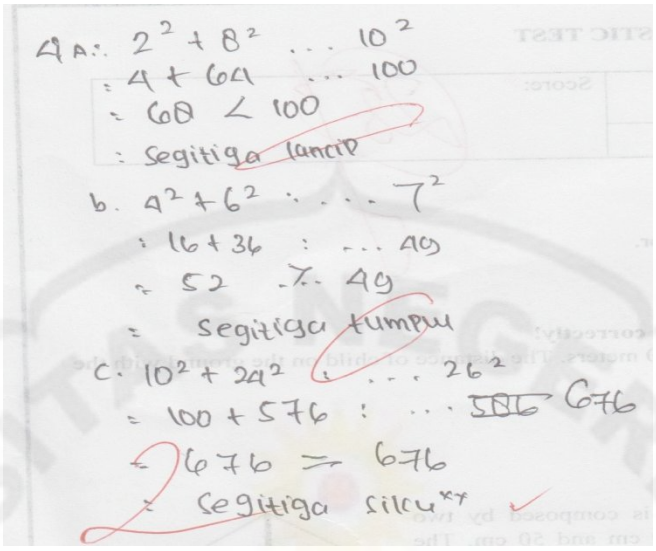

Fig. 1.4. Example 3 of student's answer

From the above answer, we can say that the ability of student to classify the object according to its concept is low.

The decline of mathematical understanding ability of students in class are because the teacher often exemplifies to students how to solve problems, students learn by listening and watching the teacher do the mathematics, then teacher tries to solve it by his/himself, and when teaching mathematics, the teacher explains the topics that will be directly studied, followed by giving examples, and problems for practice. Brooks and Brooks call the above learning is as conventional, because the most activities in learning activities are still dominated by teacher (Ansari, 2009:2). Learning activities like those can not fulfill the students' needs for developing their ability in mathematical understanding. The teacher explains the material is only targeting on learning outcomes rather than on learning process (Arifin, 2009:85). One of the reasons of this happens because the density of the material which is explained and completed based on the applicable curriculum. It is realized by researcher at the time of the Program Pengalaman Lapangan Terpadu (PPLT). This conventional or mechanistic learning emphasizes on exercise or drill by repeating the procedure and more using a formula or a more specific algorithm (Ansari, 2009:2). When learning mathematics emphasizes on rules and procedures, it can give the impression that math is to memorize.

Most learners are only able to memorize the concepts (rote learning) and using the formula without knowing why they are using that formula and even they do not know the benefits of his knowledge into daily life. Excessive emphasis on

rote learning can be caused students feel difficult to transfer knowledge into other situations. In addition, the learning process is still dominated by the role of the teacher while the students tend to be passive (teacher-centered). Passive role of students in the learning process can make students quickly forgot the knowledge they have just been receiving. And also most of students consider mathematics is the most difficult lesson, bored, even their biggest enemy.

Actually, these are the crucial problems since the up-to-date curriculum or curriculum of 2013 demands learning system that was teacher-centered becomes students-centered, students become more interactive, active, and observant in the learning process, students may get the knowledge from whoever and wherever they get, and passive learning system becomes critical one (Kementrian Pendidikan dan Kebudayaan (Kemendikbud), 2013:68). Therefore, to increase students' understanding of mathematical concepts and achieve one of the learning objectives in Indonesia, it is necessary to change the less effective methods to be more effective, making the role of students in learning activities that were passive to be active, and more using the experiences of students and contextual problems in learning mathematics so that learning mathematics can be more meaningful for students.

Problem that is faced by students is difficult to relate the knowledge they already had with the material they are learning in school. Knowledge they already had can take the form of contextual problems and their experiences in daily life. And they are also difficult to relate the mathematical material in classroom with the real situation out of classroom. Using real situations can strengthen their ability to see those relationships and generate informal mathematical knowledge. Connecting the real situation with the actual experience of students can make learning more effective (Muijs, 2008:343).

Learning strategies that begin learning by using examples and realistic situations, then change the realistic situation into a mathematical model, direct that model to the mathematics solution and then re-interpret as a realistic solution that would be useful in relating knowledge and application of mathematics and the real world (Muijs, 2008:342).

One approach that is appropriate with the above strategy is the Realistic Mathematics Education (RME) approach. The approach which is introduced and developed by the Freudenthal Institute in the Netherlands emphasizes how to learn real mathematics, beginning with simple problems that exist in real life so that students can be more understood the concepts that are being taught.

Freudenthal's view that the basis in the development of RME approach is *mathematics is a human activity*. Based on his view, mathematics is a form of activity or process. Students are given the opportunity to construct or re-invent a mathematical concept in their own way. In other words, students are not given a ready-made product that is ready to use, but rather construct their own knowledge of mathematics. This is caused students become more active in the learning process.

The word realistic in the RME approach is not only referring to the real-world. But it also refers to the real problems experienced by students and can be imagined. The problems are presented based on the experience and knowledge that is already had by students made learning becomes more meaningful. The differences in the level of experience of each student are useful so that each student complement their knowledge based on the experience of the individual.

Realistic Mathematics Education approach has five characteristics in learning. The first characteristic is using contextual problems. The use of contextual problems gives students an experienced and motivating way so that students can build or re-invent mathematical concepts. Contextual problems here are not always a real world problem, but could be other situations that can still be imagined by students. By using contextual problem in the beginning of learning, it intends to stimulate students to construct or invent the defenitions, concepts, operations, and the way of solving problems. So they could be more understood concepts of the topic they are learning.

The second characteristic is the use of models for progressive mathematization. Since students have understood the concepts by using contextual problems, students are expected to make their own model in solving problem.

The third characteristic is the use of student's own production and contribution. Student-centered learning aims to stimulate students in generating ideas, variation of answer, and variation of informal problem solving.

The fourth characteristic is the interactive. By interactivity in learning process, that is interaction between student and teacher, among students, and students and their environment, causes students have active roles in sharing their own knowledge so that the learning process becomes meaningful.

The fifth characteristic is the intertwinement. Concepts, topics, procedures in mathematics have intertwinement (Suryanto, et. al, 2010:45). The intertwinement made integration among the concepts, even between mathematics and other subjects. By this integration, learning time becomes more efficient and easier for students to solve problems.

Besides having five characteristics above, RME approach also has three principles; they are guided reinvention and progressive mathematization, didactical phenomenology, and self-developed model.

Based on the above RME characteristics and principles, RME fulfills the criteria of scientific approach in curriculum of 2013 (Kemendikbud, 2013:182), such as, 1) subject matter is based on the facts and explainable phenomena by logic and certain reasoning; 2) encourage and inspire students to think critically, annalistically, and exactly in identifying, understanding, solving problems, and applying the subject matter; 3) encourage and inspire students to be able to understand, apply, and develop rational and objective thinking system in responding subject matter, etc. Besides that, in 2013 curriculum, teacher-centered becomes student-centered, students more interactive (teacher-student-people-environment), students is active in learning process, self-study system becomes group-study, students may get the knowledge from whoever and wherever they get, etc. It is appropriate with the characteristics of RME in the learning process.

By implementing learning syntax which is based on the characteristics and principles of RME, they are understanding the contextual problems, solving contextual problems, comparing or discussing the answers, and concluding (Yuhasriati, 2012), then learning process becomes student-centered, so that

learning activity can be more fun because student is actively participated in learning activities. The activeness of each student can be seen when they state his/her knowledge based on his/her experience to teacher and his/her classmates. Those activities could be made students able to classify the object based on its concepts, give examples and non-examples, and use the concepts in solving routine exercises. And also reinvention the concept by themselves is better than recitation since students could apply the concept directly.

Based on the above explanation of problem background, researcher attracts to conduct a research entitled **"The Difference of Student's Mathematical Understanding in Realistic Mathematics Education and Conventional Classroom of Grade VIII at SMP Negeri 1 Lubuk Pakam"**

1.2. Problem Identification

Based on the background above, the matters that considered as problem identification are:

a. Students considered that mathematics is a difficult subject.
b. Students are rarely involved in the learning process.
c. The student's understanding of mathematical concept is low, so that they feel hard to solve mathematics problem by their own way.
d. Most learners are only able to memorize the concepts and using the formula without knowing why they are using that formula and even they do not know the benefits of his knowledge into daily life.
e. Teacher often exemplifies to students how to solve problems.
f. Teacher explains the material is only targeting on learning outcomes rather than on learning process.
g. The most activities in learning activities are still dominated by teacher.
h. Conventional learning model that is usually used by teacher cannot fulfill the students' needs for developing their ability in mathematical understanding.

1.3. Problem Limitation

Based on the above background and identification of problem, the research problem is limited only to know the difference of student's understanding of mathematical concept in RME and in conventional classroom at SMP Negeri 1 Lubuk Pakam in the topic of cube and cuboid.

1.4. Problem Formulation

Based on the above identification and limitation of problem, then the problem formulation is: is student's understanding of mathematical concept in RME better than student's understanding of mathematical concept in conventional classroom at SMP Negeri 1 Lubuk Pakam?

1.5. Objective of Research

Based on problem formulation above, then the problem objective is: to know whether student's understanding of mathematical concept in RME classroom is better than student's understanding of mathematical concept in conventional classroom at SMP Negeri 1 Lubuk Pakam.

1.6. Research Benefit

This research is expected to be useful for all people, including:

1. For students. Helping students of SMP Negeri 1 Lubuk Pakam for increasing their conceptual understanding in mathematics.
2. For teacher. As consideration for teacher in implementing the Realistic Mathematics Education Approach to increase student's understanding of mathematical concept in learning mathematics.
3. For researcher. The results of research can be used as reference in developing the appropriate learning approach in learning process.

1.7. Operational Defenition

1. Understanding of mathematical concept is students' ability to classify the objects based on its concept, give example and non-example, and use the concepts in solving routine exercises.
2. The syntaxes of realistic mathematics education are:
   - Step 1: Understanding the contextual problem
     Teacher gives contextual problems to students.
   - Step 2: Solving the contextual problem
     Teacher assists and enhances the results of the students by asking the questions to lead students to construct their knowledge about the possibility of appropriate *model of*.
   - Step 3: Comparing or discussing the answer
     Teacher asks one of students to present *model of* and its solution in front of the class, give opportunity to other students to present different *model of*, and let students to respond and choose the appropriate *model of*.
   - Step 4: Summarizing
     Teacher helps students to make a summary and conclusion.
3. Conventional learning model is a common learning which is done by most teachers in school is marked by lecturing, explanation, and giving examples and tasks.