CHAPTER I

INTRODUCTION

1.1 The Background

Science is a knowledge which consists of three main points, namely as process, product or method and attitude (Carin and Sund, 1989). Science is a mental and physical process in comprehending nature, within thinking process, mental activity, attitude and confidence in solving nature problems. The process is about skills in understanding nature, observing, manipulating, reasoning, using hypothesis, measuring, predicting, defining, and applying experiment. Science product is knowledge from creative process such as facts, concepts, theory, model and others that continuously developed along with the development of the science process alone.

Mathematics as one of the science taught in school attached to the points above. Mathematics in achieving knowledge through a long learning process accompanied with mathematical thinking process, reasoning, creative thinking, proving, communication, and solving problem. Mathematics learning sued to generate students who are active, creative, critics, flexible, and be able to communicate well. In junior high school level, students are expected doing well in recalling, interpreting information, abstracting, solving problem, generalizing, and reasoning. All these demands cannot be achieved when there are still obstacles in learning mathematics.

A preliminary observation held at grade nine of junior high school students on the subject of Pythagorean theorem. This school is located in a downtown which has 30-40 students in each class. The preliminary observation was conducted in an excellent class consists of middle and high achievement students. The Pythagorean theorem had been taught by the former teacher on the second semester in the previous year, with a note that students had been informed about what subject will be tested in the exam. From the preliminary observation results showed there are some visible difficulties from students' answers, namely:

1. Students do not understand the concept of Pythagorean theorem;

This is shown in the students' answers that use the Pythagorean theorem incorrectly. (*can be seen in the attachment 1*).

2. Students is less flexible in manipulating Pythagorean theorem;

   The students could answer the problem regarding the Pythagorean concept but when the problem presented in another context, students could not answer the problem. (*can be seen in the attachment 2*)

The points above show there are problems and obstacles in solving problems. However the problems were not only because the students did not prepare well in advance, but also there were some of them that already memorized the formula, yet they could not do well in the test when it comes to contextual problem, they seemed confused in doing so. Whereas the problems were really identical with the others, but depth understanding is needed to know what is given and how to manipulate what is given to answer the question.

The obstacles in solving the problem given is a product of a learning process, means students could not solve the problem because there are difficulties experienced by students in class. To solve this problem, it is not necessarily solved by giving students more and more problems to be solved, but needs a way to analyzing, why those obstacles happened in the first place. From the result, teacher need to analyze what is required to solve problem.

Learning obstacles in students are different; depend on the factor that cause it; such as physiological, social, emotional, intellectual and pedagogical. Prior knowledge is the instance of intellectual factor, which is greatly affect the success of student learning, because learning occurred in the process of coding and encoding of information in students' mind. For students who have a sufficient prior knowledge will easily accept new information and communicate them in learning experiences and have more confidence in doing so. As for the students who have less prior knowledge, they will have difficulties to accept new information due to the lack of experience of the prior knowledge, so that making students difficult in understanding the concept.

Learning obstacles occur because of mistakes that happened in class, whether that came from teacher or students. One of the mistakes that occur in

class is the same treatment teacher gave to the different characteristic of students. Additionally, another error in class is from students that difficult in connecting their existing knowledge to the new incoming knowledge, and they memorized the formula alone without understanding the concept, so it is difficult for them to applying in different context. They seem uncomfortable with the learning styles that do not suit their characters.

To meet students' needs and to provide sufficient portion for each learning styles, it is required an instructional material that capable to fulfill the needs. Instructional material in question is not mere information transferred from what is in the text book without going through the process of re-contextualization and re-personalization. Re-contextualization is an attempt to put things into another context, so it will be familiar and intertwined and fused by the whole. Re-personalization is making something identifiable as belonging to a particular person. As stated by Suryadi and Turmudi (2011) that preparation of instructional material in general is based only on presentation models that are provided in the text books without going through the process of re-contextualization and re-personalization. In fact, the presentation in the mathematics text books, in the form of concepts description, proving, problem examples, they are the synthesis of a long process that ended in the process of re-contextualization and re-personalization.

This case refers to the need for a renewal of the instructional material prepared by teacher in presenting the material in class. Teacher cannot be a copycat to impose instructional material in the book without looking at the characteristics and obstacles of students who will be taught. As mentioned by the National Council of Educational Research and Training (2006):

> Mathematics education relies very heavily on the preparation that the teacher has, in her own understanding of mathematics, of the nature of mathematics, and in her bag of pedagogical techniques. Textbook-centered pedagogy dulls the teacher's own mathematics activity.

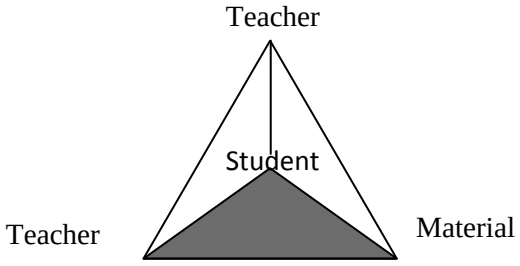
In school, especially in terms of learning, students often make the teacher as a role model for them. Akinsola (2008) stated "Attitudes differ according to how learners perceive what they are taught and whoever is teaching them." So

consciously or not, teachers who daily interact with students in the learning process pass on their attitude they showed indirectly when teaching to students.

In the learning process, Brousseau (1997) defined three types of learning obstacles, namely: ontogenic obstacles, didactical obstacles, and epistemological obstacles. Ontogenic obstacles are obstacles due to differences in the level of knowledge of student's ability with teacher's level of knowledge in teaching. Didactical obstacles are caused by the lack of precise methods or approach that teacher use in teaching. The epistemological obstacles are caused by the mathematical concept.

Teachers nowadays are expected to act not only as teachers, but also as researchers. This term is not a mere thing, but the presence of a research is very important in creating a better learning. Teachers do research to obtain information and solutions to solve obstacles experienced in class. After obtaining enough information, teachers can begin to try an innovation in terms of models, media, and approaches, and results were evaluated to see whether the innovation is done to solve the problem. Existing problem may not necessarily be directly solved, or may not even solved at all, for that teachers should continue to conduct researches and development so that what is expected to be achieved.

In learning, there are three important elements, they are teacher, students, and material. The three elements will form a relation, which are students-teacher, teacher-material, material-students. These three relations form a study called Didactical Design Research (DDR).



Picture 1.1. Metapedadidaktik Prism (Suryadi, 2010)

As illustrated, Metapedadidaktik explains the relation between students, teacher, and material. This metapedadidaktik prism is modified from the

Kansanen didactical triangle by Suryadi that added a relation between students-teacher-material, which is called anticipation of didactical and pedagogical.

Didactical is emphasized in learning since the planning stage (Suryadi, 2010). The didactical analysis is conducted before learning, which focuses in relation between teacher, students, and material. The didactical analysis will be the referral to form a learning design.

Learning design is an instructional material design that will be used as a guide in the course of learning. It consists of activity stages to be carried out in learning. This activity is not only involved how teacher teach the material to students, but also how students respond to what is presented by teacher, and the material.

In the design of instructional material, teacher must be able to predict what response will arise, and anticipate what response given after that. This stage mentioned by Suryadi as anticipation of didactical and pedagogical. In this stage, the competence and ability of teacher is needed to build the structure of good instructional material design.

These three relations are not formed by the class itself, but must be designed by the teacher in advance. A design of learning scenario is regulating how the learning will be done. However, there are things that also occur spontaneously or beyond expectations, and teacher must improvise swiftly so that learning objectives still be achieved. In this case the teacher's competence and ability to design a good learning are indispensable. Suryadi named the capability as Metapedadidaktik.

Many methods and models of learning used by teachers from various sources, but the models are not necessarily an instruction that can be applied successfully in all types of students. Some things to note are the school facilities and infrastructure, the social background of students, the school environment, and students' ability to receive learning. NCTM (2000) stated: "Teachers should design the learning of mathematics which aims in a goal-oriented with a focus on the process. Directed learning orientation on competence development 'mathematical thinking' and 'mathematical disposition'". In line with it, Wardani

et al. (2011) stated "Among teaching, students, and school level variables, the biggest role for improving mathematical creativity and disposition was the teaching approach"

In practice, it is difficult to find a suitable model to be applied to all students, especially in class with 40 or more students, too many characters to be met while the time owned is limited. Therefore, it requires an instructional material designed by teacher, so that teacher knows what is needed. Teacher is not stick with a particular model, but flexibly adapted, according to the needs of the diverse of students' characters. Teacher's instructional material design is expected to reduce the obstacles that occur and give comfort to the students in learning. Comfort in learning can be done in various ways.

According to interviews with several teachers in general, teachers prefer to teach high achievement students, because it is easier, that is why teacher tend to communicate with high achievement students more than others. Teachers involve smart students because they capable in doing everything that teacher told. It is not making low achievement students to be motivated, but the opposite, they feel neglected and ignored, so they feel lazy to learn, and only expect all the answers from high achievement students. Then, teachers need to be more considerate in dividing their attention to the students, so every student gets the same opportunity to learn.

Division of the group members are often done at random, which it is actually not a good idea, because it is possible if in one group, all the members are high achievement students, and certainly they can do their task better, and other group, perhaps all the members are low achievement students, and it will be very difficult for them to do the task, besides they do not believe in themselves, they also do not believe their friend, and have no one to ask, in the end, they will not do the task. Division should be a heterogeneous group, comprised the three of students level, the high achievement, the middle achievement, and the low achievement, so the high achievement student can guide other members to do the task. In the end, this way expected each member of the group get the same knowledge, as well as all the members should be able to explain the work they did

by their own words. Also, the number of members in group should not more than four students, it will be better if it consist only three students, so there is no chance for students to let others working alone.

However, in the group study, not only students' roles are expected, but also the role of teacher to facilitate and motivate students in order to form a favorable atmosphere of group study. Teachers are expected not only monitor from the front of the class, but also go around directly to each group to guide students in completing the task. This method will help students in learning and by doing that teacher also be able to recognize better the character of their students.

Based on the above explanation, it requires a depth analysis of learning obstacles in students using didactical design research. From the result of analysis, an effective and efficient instructional material to achieve mathematic learning demands will be designed. This instructional material is not a standard teaching material yet, means it will continue to be evaluated and improved in order to obtain the best result.

1.2 The Problem Identification and The Problem Formulation

This research departed from many errors made by junior high school students in solving Pythagorean theorem problems. These errors can be seen from mistakes they have done in solving the given problem. The students' answers are not as expected, and students' learning outcomes are also far from satisfactory. Because this research is only up to the analysis of learning obstacles and instructional material design, then the didactical design research formulation used only to the extent of the analysis of didactical situation. In the analysis of the didactical situation, there are three important components which are didactical relations, pedagogical relations, and anticipation of didactical and pedagogical.

The problem formulations of this research are:

1. What are learning obstacles experienced by students in the learning of Pythagorean theorem?

2. How is instructional material design which was made based on the didactical design research?

1.3 The Research Objections

1. Analyze the students' learning obstacles in the learning of Pythagorean theorem;
2. Create an instructional material design that is based on the didactical design research;

1.4 The Research Benefits

1. Provide analysis of the students' learning obstacles in the learning of Pythagorean theorem;
2. Provide an instructional material design that are based on the didactical design research;