CHAPTER I

INTRODUCTION

1.1 Background

Mathematical education plays an important role in the development of education. However, mathematics learning outcomes in Indonesia are still low. This is because mathematics is a frightening specter for the majority of students. This is evidenced by the TIMSS survey data conducted by The International Association for Evaluation and Educational Achievement based in Amsterdam, placing Indonesia in 36th position out of 40 countries in 2011 (Budi Murtiyasa, 2015:1).

Related to the issue of the development of education at the international level, the 2013 curriculum was designed with improvements. The assessment models in the 2013 curriculum adapt standard internasiaonal assessment models that are expected to help students to improve their *Higher Order Thinking Skills*.

Consummation of among others performed on standard content i.e. reduce irrelevant material as well as deepening and expansion of the material that is relevant to learners and enriched with the needs of the learners to think critically and analytically appropriate with the standard international. The other refinements are also carried out on standard assessment, with adapt gradually the standard valuation models international.

But in fact it has not been done properly. On the supervision and monitoring of the construction of the Postgraduate student assessment high school which has been implemented by the Directorate of Coaching high school, mostly high school teacher objectives in drawing up the grain problem tend to just measure the ability to think low level (Low Order Thinking). (Module Compilation Problem, Higher Order Thinking Skills, 2015:1).

Learning outcomes assessment is expected to help students to improve Higher Order Thinking Skills *(HOTS)*, because high-level thinking can encourage students to think broadly and in depth about subject matter (Module of the Higher Order Thinking Skills Problem Maker, 2017:1).

Viewed from the dimensions of knowledge, generally the HOTS problem measures the metacognitive dimension, not just measuring the factual, conceptual, or procedural dimensions. Metacognitive dimensions describe the ability to connect several different concepts, interpret, solve problems (problem solving), choose problem solving strategies, find (discovery) new methods, argue (reasoning), and make the right decisions.

Student learning outcomes are influenced by five factors, namely (1) learning talent, (2) time available for learning, (3) individual abilities, (4) quality of teaching, (5) environment (Caroll in R. Angkowo and A. Kosasih (2007: 51)). While Bloom (1976: 201-207) divides learning outcomes into regions, namely cognitive, affective, psychomotor. The cognitive area is related to memory or intellectual knowledge and abilities as well as skills. Affective regions describe attitudes, interests and values as well as the development of understanding or knowledge and adaptation and adequacy. The psychomotor region is the ability to activate and coordinate motion, improve the quality and quality of each individual. Mathematics lessons are also useful to improve human thought, because by learning mathematics students can develop the ability to think, reason, communicate ideas and can develop creative activities and problem solving.

The dimensions of the thinking process in Bloom's Taxonomy as refined by Anderson & Krathwohl (2011), consist of abilities: knowing (knowing-C1), understanding (understanding-C2), applying (aplying-C3), analyzing (analyzing-C4), evaluating (evaluating-C5), and creating (creating-C6). HOTS questions generally measure ability in the field of analyzing (analuzing-C4), evaluating (evaluating-C5),

and creating (creating-C6) (Module on the Formulation of Higher Order Thinking Skills Questions, 2017: 3).

As a science of patterns, mathematical concepts are arranged hierarchically. A mathematical concept cannot be learned as general knowledge. In general, mathematical concepts must be studied sequentially and sustainably. A mathematical concept cannot be learned properly if the material that requires the material has not been mastered thoroughly (mastery learning). A student is said to complete learning if at least has reached a certain minimum value called the minimum completeness criteria.

The minimum completeness criteria value is prepared by subject teachers in each education unit by considering the intake, carrying capacity, and material complexity. The better the existing intake, the higher the minimum completeness criteria value. The more complete the carrying capacity, the higher the minimum completeness criteria value. But, the more complex the material is, the lower the minimum completeness criteria value is determined. The completeness of mathematics learning obtained by students allows these students to be able to perform cognitive processes well to master the next various mathematical material. That is, cognitive processes will occur if students master the initial knowledge about what is learned. Thus, every learner of mathematics must master the initial knowledge of mathematics needed to learn an advanced mathematical material. The results of the (Hailikari, 2009) study concluded that procedural knowledge (early knowledge of mathematics) that requires high level cognitive skills (higher order cognitive skills) predicts final achievement well and is also closely related to the success of previous studies. According to (Rittle-Johnson, 1999), conceptual understanding is an understanding of the principles that affect domains and procedural knowledge is the ability to carry out a sequence of actions to solve problems correctly (Fyfe, 2012). Previously in depth, procedural knowledge, also reached a higher level of advanced material targets.The results of this study indicate that the success of students in the

learning process of an advanced mathematical material is largely determined by the success of students in mastering the previous material that requires further mathematical material Therefore, initial knowledge and its influence on learning and performance has been the focus of research in recent years (Hailikari, 2009).

Early of mathematical prior knowledge is defined as the mathematical knowledge students have n becomes a prerequisite for a mathematical material to be learned. This initial knowledge is also known as basic knowledge of mathematics even though it has differences. The difference is that basic of mathematical pror knowledge is more directed at all knowledge that becomes basic mathematics. For example, in school mathematics is divided into knowledge about decimals, fractions, integers, percentages, operations, algebra, geometry, measurements, coordinate geometry, data analysis, and sets. Whereas the initial knowledge of mathematics is the students' initial knowledge of the mathematical material they will learn or which they have learned to support their mastery of the next mathematical material. This opinion is in line with the opinion of Dochy, Moerkerke & Segers (1999) which states that initial knowledge can be defined as knowledge that: (1) includes declarative and procedural knowledge; (2) presented before the implementation of a specific learning material; (3) obtained or can be *recalled* or reconstructed *(reconstructed)(reconstructed)*; (4) organized into *structured schemata*; (5) the degree of trust that other learning materials can be transferred or applied; or (6) dynamics in nature (Hailikari, 2009). This opinion implies the importance of initial knowledge and its relation to various other knowledge when students carry out the learning process.

In school mathematics, this initial knowledge or basic mathematics is very important position to bring students to successfully carry out the learning process. In line with that, according to NCERT (2006), in school mathematics, it emphasizes clearly the need for providing factual knowledge *(factual knowledge)*, *procedural fluency*, and understanding concepts *(conceptual understanding)*. New knowledge is

constructed from initial experience and knowledge using conceptual elements. This opinion implies that mastery of the initial knowledge of mathematics needs to be sought by every educator when carrying out the learning process. This effort can be done by linking the initial knowledge of mathematics with various other knowledge and always making feedback so that the learning process can make students able to perform cognitive processes smoothly. According to Mayer (1996), effective learning and construction of knowledge contain a cognitive process for selecting, organizing, and integrating information. That is, if the learning process goes well, students will be able to show cognitive processes selectively, organize, and integrate all information.

The cognitive process can run smoothly if students can understand and connect all the information they have learned. The learning process can take place well if the knowledge that supports all the learning activities has been owned by students well. This is where the importance of students' initial mathematical knowledge is used to be selected, organized, and integrated with other mathematical material so that new knowledge emerges as a result of cognitive processes.

The use of context and the adequacy of the initial knowledge of mathematics that students already have will make students able to learn mathematics effectively. According to Ormrod (1996), the reason why students do not study effectively is because students do not have enough initial knowledge of the material they are learning to determine what information is important or what questions they will ask about the material. This opinion implies that students 'mathematical thinking creativity is influenced by the adequacy of the students' initial mathematical knowledge of a mathematical concept and the quality of the mathematics learning process that they follow.

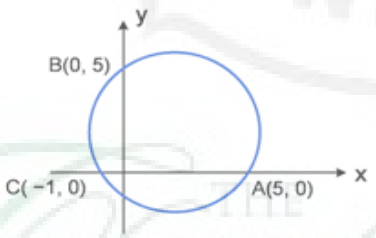
In this study researchers needed students who had initial knowledge above the average student in general. The researcher chose SMA N 2 KISARAN as a place of research, because before the researchers had experience in SMA 2 N KISARAN.

Based on the results of interviews with one of the teachers, SMA N 2 Kisaran is one of the best high schools in the city of Kisaran. Besides that it was supported by the high passing grade of SMA N 2 Kisaran which resulted in the students who were accepted by the SMA N 2 Kisaran were the best students.

Based on the observations and experience of the researcher on the sosal previously given by the teacher at SMA N 2 Kisaran, only a few questions measure the ability of analysis and evaluation, but there are no questions that measure the ability to create. Whereas in the mathematics book class XII which is used as a learning resource students who apply the 2013 curriculum dominating questions are questions that invite students to think analysis, evaluation and creating. And here also the researcher gives questions to students.

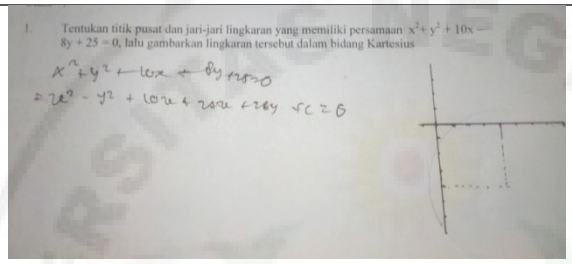
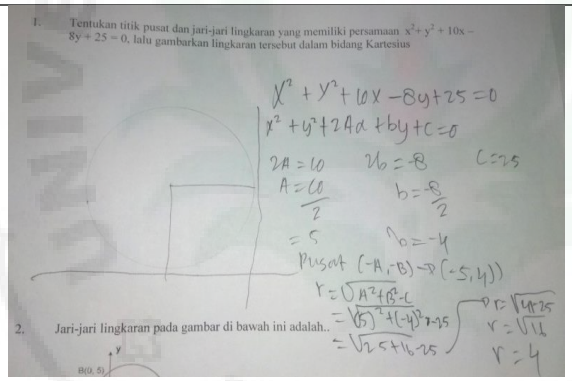
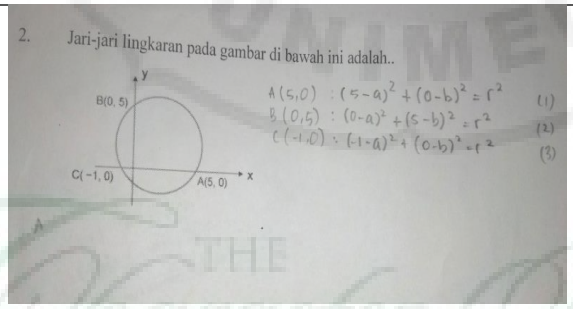
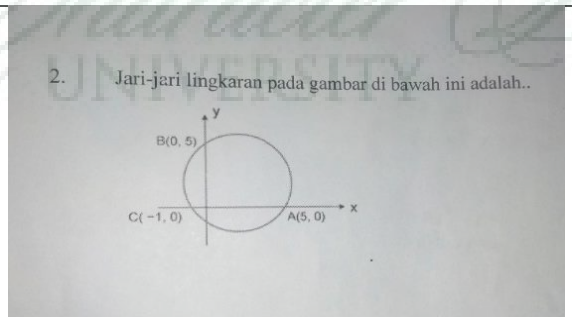
Here are the questions given by the researcher:

1. Determine the center and radius of the circle which has the equation $x^2 + y^2 + 10x - 8y + 25 = 0$, then draw the circle in the Cartesian field
2. The radius of the circle in the image below are ...



Here are the results of working on a number of students who made mistakes in solving the description questions above, seen in the following table:

Table 1.1 The Results of Solve on The Question of Some Students

No	work results	Analysis of errors
A		Students are not able to plan problem solving.
B		Students are able to understand the problem in writing what is known and what is asked about the problem but cannot describe it into the cartesius field
C		Students are not able to solve problems, where students only write is known.
D		Students are not able to understand the problem in writing what is known and what is asked on the question ..

From the table above it can be seen that some students still have difficulty in solving problems related to the equation of the circle. This could be because they have not fully understood because they have just started the material study of the circle equation. The results of these tests indicate that students' thinking abilities are classified as low, medium and high. Some students still have difficulty understanding the meaning of the questions given, identifying the elements that are known and the elements asked from the questions, planning the problem solving that is not directed and the calculation process that causes the solution or the answers made by students is incorrect.

Based on the background that I have described above, the researcher was interested in conducting a study entitled **"Analysis of Student's Ability in Solving HIGHER ORDER THINKING SKILLS (HOTS) Test on The Circle Topic Based on Mathematical Prior Knowledge Students of Class XII MIA 2 in SMA 2 KISARAN A.Y 2019/2020 "**.

1.2 Problem Identification

Based on the background of the problem described above, several problems can be identified as follows:

1. In teaching and learning activities, only a few questions measure analysis and evaluation skills, while in the 2013 curriculum mathematics books dominating questions are questions which invites students to think analysis, evaluation and creating.
2. There is still a lack of mathematical prior knowledge students in solving on high-level thinking questions.
3. The ability of high-level thinking students in mathematics learning is still low.

1.3 Problem Limitation

Based on the background and identification of the problems that have been described, the need for problem solving is so that researchers are more focused and directed at solving on their research. The limitation of the problem in this study is in the analysis of mathematical prior knowledge students in solving on questions *HOTS* in class XII of SMA 2 KISARAN.

1.4 Problem Formulation

Based on the limitations of the above problems, the formulation of the problem in this study is

1. How the ability of students to solve onproblems is *HOTS* reviewed from the initial mathematical knowledge ability.
2. How is the difference of students mathematical prior knowledge in solving on HOTS questions in terms of solve Questions, Observations, Questionnaires and Interviews.
3. Whether there are factors that affect the students in doing reserved *HOTS*?

1.5 Research Objective

The objectives of this study are:

1. To find out, whether this mathematical prior knowledge affects aspects of the problem *HOTS*.
2. Proving, that students mathematical prior knowledge can do the problem well enough *HOTS*.
3. To find out what factors cause the student cannot solve on problems *HOTS*.

1.6 Research Benefit

After conducting research, the benefits can be expected as follows:

1. For students, by conducting research students can improve their mathematical prior knowledge in solving on questions *HOTS*.

2. For teachers, as a consideration and input for teachers in expanding knowledge pengeatahuan in helping students to improve students mathematical prior knowledge in solving on problems *HOTS*.
3. For researchers, as information material and materials for researchers to solve on teaching assignments as prospective teachers.
4. For the school, as a consideration for the school to fix the mathematics teaching program at the school.

1.7 Operational Definitions

The operational definitions in this study are:

a. Student prior knowledge is a determining factor in success in mathematics learning. Every individual has different knowledge. The initial knowledge of students is the ability that has been possessed by students before he participates in the learning process activities.

b. *Higher Order Thinking Skills (HOTS)* is the ability to think that is not just a remembrance, reiterate, and also sulk without doing processing, but the ability to think to examine information critically, creatively, creatively and able to solve problems, because high-level thinking can encourage students to think broadly and deeply about the subject matter.