Preliminary Research Development of Mathematics Learning Device Based on Cognitive Conflict to Improve Critical Thinking Ability of 1st Grade Senior High School Students

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Abstract – This research discusses about the development of mathematics learning device based on cognitive conflict to improve critical thinking skills of class X students. Learning device was developed in the form of Learning Implementation Plans (in the form of RPP) and Student Worksheets (SW). The model of development research that has been used in this study is the Plomp model (Preliminary Research, Prototyping Phase, and Assessment Phase). However, this research only reached to the preliminary research stage. The subject of this study was the 1st grade students of SMAN 3 Painan. Based on the results of interviews to several teachers of SMAN 2 Painan and SMAN 3 Painan concluded that the learning device used by teachers have not been able to stimulate students to think critically optimally.

1. Introduction

To achieve critical thinking in learning, it is not only students who are required to think at a high level, but teachers must also have it. In the field studies, there are still teachers and teaching teams who have not been able to apply critical thinking when learning takes place. Based on research by [2] stated that teacher training is very important, the ability to think and all levels of thinking ability are at the secondary level and this ability is influenced by various factors. Likewise in journal [3-10] Series the results of his research showed that the critical thinking ability of grade X students was low. Sanjaya [11] revealed one of the weaknesses of teachers in teaching is that teachers do not try to get students to think. The PISA results (2015) state that Indonesia, which is a developing country, is under the average OECD. This reflects that the skills of Indonesian students in answering questions that refer to critical skills are still low, [12] Research conducted in Indonesia shows the results that critical thinking skills of secondary school students are low and need further training.

In line with the results of the above study, the low ability to think critically is also evident from the results of tests conducted by researchers at SMAN 3 Painan and SMAN 2 Painan.
Table 1. Percentage of Achievement of Critical Thinking Ability Indicators for Students in Class X MIPA SMAN 3 Painan and SMAN 2 Painan grade 2018/2019

| Indicators | School    | Percentage of learners earning a score (%) |
|------------|-----------|-------------------------------------------|
|            | SMA 3     | 17,15 | 28,57 | 31,43 | 8,57 | 14.28 |
| 1          | SMA 2     | 31,43 | 31,43 | 20,00 | 11,43 | 5,71  |
|            | SMA 3     | 0,00  | 2,86  | 40,00 | 45,71 | 11,43 |
| 2          | SMA 2     | 0,00  | 8,57  | 54,29 | 28,57 | 8,57  |
|            | SMA 3     | 0,00  | 8,57  | 40,00 | 42,80 | 8,57  |
| 3          | SMA 2     | 0,00  | 8,57  | 74,29 | 14,28 | 2,86  |
|            | SMA 3     | 11,43 | 88,57 | 0,00  | 0,00  | 0,00  |
| 4          | SMA 2     | 42,86 | 57,14 | 0,00  | 0,00  | 0,00  |

Based on Table 1 it can be seen from the four indicators measured, there is no class that gets a maximum score of 4. The highest percentage for the maximum score on indicator 1 is 14.28%, on indicator 2 is 11.43%, on indicator 3 is 8.57 %, and indicator 4 is 0.00%. Based on the explanation above it can be said that the ability to think critically mathematics students in class X MIPA Painan High School is still low.

Based on the results of observations and interviews conducted in the X grade of Mathematics and Natural Sciences in SMA Negeri 3 Painan, it appears that the teacher has sought optimal learning. Like starting learning by providing motivation related to learning material, providing teaching materials, and lesson plans. However, this has not been able to improve students' Critical Thinking Ability in mathematics. One proof is the teacher has never designed the RPP and LKPD which aims to develop students' critical thinking skills, even though the school has implemented a 2013 curriculum teachers still often teach using conventional way. Meanwhile, observations and interviews by researchers at SMAN 2 Painan found that teachers do not teach according to the lesson plans that have been made. There are still some devices made by teachers that do not fit the steps of critical thinking. So that the device has not optimized the cognitive potential of students. From the observations at these two schools it is also known that the learning resources used by teachers in the school do not yet support students to think critically. [13] The role of a teacher in designing or compiling teaching materials is very determining the success of the learning process and learning through a teaching material.

The condition in the field is one of the reasons why researchers need to develop cognitive conflict-based learning tools. The solution offered is in the form of research into the development of learning devices that are expected to be able to overcome the problem of low critical thinking skills of high school students. The cognitive conflict based learning model is designed to develop from the problem based learning model proposed by Ronis [14] as a basic model, and combined with the cognitive conflict strategy by Baser [15] The combination of cognitive conflict based learning models is expected to overcome the real critical thinking problems experienced by students, by involving deep thought processes or higher-order thinking. Sadia [16] states that the cognitive conflict model is a learning model for changing students' misconceptions into scientific concepts by presenting conflicts to the minds of students who experience misconceptions. Conflict presentation will shake the students' initial conception, and there is a modification in the cognitive structure to rebuild a new concept that is scientific.

Cognitive conflict has a general pattern, namely: exposing alternative frameworks (expressing initial conceptions), creating conceptual cognition (creating conceptual conflict), encouraging cognitive accommodation (seeking cognitive accommodation). Whereas critical thinking is thinking that involves testing, connecting and evaluating all aspects of a situation or problem. This includes
collecting, organizing, remembering and analyzing information. Thinking is also the ability to read with understanding and identify the materials needed. In addition, it is the ability to draw conclusions from a set of data [17] Critical thinking involves the ability of students to practice prior knowledge, give mathematical reasons, perform cognitive strategies. Students will develop strategies to solve problems based on familiar mathematical experiences. This research is expected to produce a cognitive conflict based LKPD in class X high school to improve students' critical thinking skills in mathematics

2. Materials and Methods
Research carried out in this research is development research. Borg and Gall [18-19] state that development research is a research method used to develop or validate products used in education and learning. The research model used in this study is the development model of Plomp. Plomp [20] states that the Plomp model consists of three stages, namely the initial investigation phase (preliminary research), the phase of development or prototype making (development or prototyping stage), and the assessment stage. In the initial investigation phase (preliminary research) there are several activities carried out namely analyzing needs, curriculum analysis, analysis of concepts and analysis of students and teachers to collect data, analyze and identify problems that occur in learning as a basis for determining alternative solutions and product specifications needed according to the problem found.

3. Result and Discussions
The need analysis was conducted at SMAN 3 Painan in class X by observing and interviews to several mathematics teachers and students. In the observation activities on learning devices designed by teachers in the form of RPP and LKPD. Based on observations and interviews, the teaching materials and RPP teachers have not been able to improve students' math critical thinking skills. It is evident that teachers have not designed the RPP and LKPD which aims to develop students' critical thinking skills. Not only that teachers also teach conventionally. Activities in conventional learning usually begin with the teacher explaining the concept informally, giving examples of questions and ending with the training of questions. As a result students are more directed to the memorization process than in understanding the concept so that the learner's thinking skills such as critical thinking skills become less developed. In mathematics learning activities, learners are still many who are not serious about learning. This can be seen from the activities of learners who do not care about the learning activities, learners who speak to their next friend, go out at the time of the lesson, and many still do not work on the task given by the teacher. It can not be allowed to occur continuously without any resolution. Interviews are also done to some X-grade learners to know their views on mathematical subjects. From the results of interviews, information that generally students do not like learning mathematics. This is because learners think that mathematics is too difficult to learn. With the dislike of learners to learn mathematics, the learners do not have the motivation to learn. Among the many learners who do not like mathematics, there are still some learners who are happy and like math. But at the age of the learners have difficulty in understand the application problems relating to application in daily life.

Based on the results of the need analysis, there are several findings gained from the observation and interviews on mathematics teachers and high school students, namely (1) RPP teachers are designed to comply with the provisions of the curriculum 2013, but in Implementation is not well implemented. The RPP is still common. So that mathematics learning becomes monotonous, (2) LKPD used by teachers is still general and obtained from the printing, and has not facilitated the intelligence of learners in learning. Based on findings from the analysis of the need for improvements. One of the improvements that can be made from these findings is to improve on learning and material activities. Context of the problem on the given mathematical material should be associated with problems that are relevant to the real world of students. The problem given aims to motivate students,
arouse students' learning passions, improve student learning activities, learn to focus on problem solving so that students are interested in learning, and find a concept that fits Subject matter. To prevent this, develop a new learning device with cognitive conflict. To develop these devices required information collection. There are four phases in the activity.

First based on the need for analysis, there are several findings gained from the observation and interviews on mathematics teachers and high school students, namely (1) RPP teachers are designed to comply with the provisions of the curriculum 2013, but in implementation is not well implemented. The RPP is still common. So that mathematics learning becomes monotonous, (2) LKPD used by teachers is still general and obtained from the printing, and has not facilitated the intelligence of learners in learning. Based on findings from the analysis of the need for improvements. One of the improvements that can be made from these findings is to improve on learning and material activities. Context of the problem on the given mathematical material should be associated with problems that are relevant to the real world of students. The problem given aims to motivate students, arouse students' learning passions, improve student learning activities, learn to focus on problem solving so that students are interested in learning, and find a concept that fits Subject matter.

The second curriculum analysis was conducted to study the 2013 curriculum on math subjects in high school. This analysis is done to see the conformity of core competencies (KI) of basic Competency (KD), Competency achievement Indicator (GPA) on mathematics subjects.

Third the concept analysis aims to determine the contents and materials of mathematics needed in learning devices. The materials that will be discussed on learning are arranged systematically by associating a concept to another concept so that the material can be sorted. The concept analysis was conducted to determine the mathematical material to be taught in class X SMAN 3 Painan.

Fourth analysis of students and teachers was conducted at SMAN 15 Painan. This analysis is done to see the characteristics of students, the ability of learners in mathematics learning. Aside from that, a review of the teacher's activities is also conducted, which is how teachers make learning devices, how teachers use models and strategies in learning and how LKPD made by teachers.

Based on the information obtained from the initial investigation (preliminary Research), it is done an effort as a solution to solve the problems that have been found. One solution that can cope with these problems is by developing a mathematical learning tool based on cognitive conflict to improve the critical thinking skills of learners.

The device is designed to suit the needs of students, which can increase the competence of students from mathematics science and the critical thinking skills of learners. The RPP developed should be able to increase student motivation, and have a critical, responsible attitude. LKPD is designed to suit the needs of students. Context of the problem presented in the LKPD. The problem presented is a problem that is relevant to the real world students. The problem given aims to motivate students, arouse students' learning passions, improve student learning activities, learn to focus on problem solving so that students are interested in learning, and find concepts that are in accordance with the subject matter. Learners become more active in the learning process and able to connect subject matter with daily life or other knowledge.

4. Conclusion
Cognitive conflict based mathematics learning tools to improve the critical thinking skills of class X students, which were developed in this study only reached the preliminary research stage. The plomp model used in the study consisted of three stages, namely preliminary research, prototyping phase, and the assessment phase was very helpful in developing learning tools for mathematics learning based on cognitive conflict. With the existence of cognitive conflict-based mathematics learning devices, it is expected to be able to increase students' motivation and learning interest in learning mathematics because this device is designed according to the needs of students. The context of the problem presented in the LKPD. The problem presented is a problem that is relevant to the real world of students. Problems given aim to motivate students, arouse student learning, improve student learning activities, focus on problem solving so students are interested in learning, and find concepts that are in accordance with the subject matter. Learners become more active in the learning process and able to connect subject matter with daily life or other knowledge.
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