

Senior high school mathematics learning device development based on guided discovery to improve students' reasoning ability (preliminary research)

A Faizasari, Yerizon* and D Permana

Department of Mathematics, Faculty of Mathematics and Natural Sciences,
Universitas Negeri Padang, Jalan Prof Hamka, Padang 25131 Indonesia.

*yerizon@yahoo.com

Abstract. Students' mathematical reasoning ability that can be found in the field has optimal yet, this can be seen from school learning, and teacher has yet got the students to get used to solve the mathematical reasoning questions. The purpose of this research is to produce mathematics learning device based on guided discovery to improve students' reasoning ability. This is a development research. The development model in this research is plomp model which consists of three phases, namely, preliminary research, development or prototyping phase, and assessment phase. The researchers hinge only on preliminary research. The result of the data analysis on this first phase revealed that: 1) the students' reasoning ability is not yet optimal. 2) Some students' still think mathematics is a difficult subject to learn. 3) The development of student worksheet is of vital importance in order to be able to comprehend the learning material. 4) Students expect that student worksheet will discuss problems related with mathematics knowledge in daily life as well as problem related with their individual activity.

1. Introduction

Mathematics and mathematical reasoning are two things that cannot be separated. It is due to mathematics material can be comprehend through reasoning, as for reasoning itself can be trained by using mathematics. Therefore, mathematics reasoning ability is of vital importance for the students. This mathematical reasoning will facilitate the students to absorb mathematics learning at school. Mathematics is the pillar of every knowledge and technology, therefore it is very important to develop mathematics [1]. In line with that, government also keep trying to develop mathematics learning system at school to be a better one, so that students will be well prepared in facing the fast advancement of science and technology development.

To overcome the above problem one of the government policy is to regulate Permendikbud (the regulation of cultural and educational ministry) No. 58 Year 2014, which mentions that one of the mathematics learning purpose is to use reasoning on pattern and characteristics, conducting mathematics manipulation in making generalization, arranging prove and mathematics statement. Based on the purpose of Permendikbud, one of the ability that has to be possessed by students are mathematical reasoning, Brodie [2] stated that "Mathematical reasoning is reasoning about and with the object of mathematics." Meanwhile, Lithner revealed that reasoning is the adopted idea to produce statement and



to draw conclusion on problem solving which is not always based on formal logic and not limited to proof.

In fact, students' ability in mathematical reasoning has optimal yet. This can be seen from the result of previous research. Based on the conducted research [4], the of students' low ability in comprehending and reasoning mathematics caused by the inability of the students to work on the question given. This research used guided discovery model to deal with the students' mathematical reasoning improvisation and the method employed by teacher on teaching. Other research conducted by [5], Aan Putra (2017), Izzatul Ulya (2017), [8], Habriah Ahmad (2015) and international level research [4], [6], Doris Jeannotte (2017), Izwita Dewi (2016), Rohana (2015), [7] revealed that students' mathematical reasoning ability is still low.

The same thing also encountered by researchers when conducting preliminary research in Public Senior High School (SMA N) 1 Rambatan. When given questions of mathematical reasoning, only some of them can provide answer. When given the question about proof, only very few students that can answer the question correctly, take that as an example. The students' low ability in reasoning also has impact the learning result. The researchers also notify that the students are lack of enthusiasm in the learning process, even though teacher has provide chances for them to ask whenever they need to related with the learning material. The interview with teacher reveals that students are experiencing difficulty to work on reasoning question type.

The observation revealed that, students feel confused in comprehending the question given to them. The questionnaire distributed to them signified that the students prefer to work in group than work individually. The reason to this is in group they can ask one another when facing problem in solving problem given by the teacher. The less effective learning process also caused by the less optimal of learning device arrangement, lesson plan and student worksheet.

One of the solutions to improve students' mathematical reasoning ability is by developing learning device based on guided discovery. Through guided discovery, students are trained to find their own concept of the material learned as well as assisted by teacher guidance. This guided discovery model is one way to deliver mathematics topic in such a way so that students can figure out themselves the pattern or the structure of mathematics through the past time learning experience and still under teacher surveillance and guidance[10]. Learning mathematics through guided discovery model can improve students' mathematical ability. Through this guided discovery learning model, students can develop concept based on direct experience and engaged actively in building the knowledge. Ekhasemomhe in [11] stated that discovery learning puts teacher as the surveyor and facilitator in learning, as well as mediator for the students and as a learning material.

Some previous research also has employed this guided discovery model, such as Izzatul Ulya (2017), Habriah Ahmad (2015), Yerizon (2018), Olorode (2016). This guided discovery research model has many advantages, namely, students can remember the learned material concept in a longer time, can implement it in the daily life, grow exciting feeling toward mathematics learning, and can develop students reasoning ability. The steps in this guided discovery are stimulation, problem statement data processing, verification, generalization.

2. Research Method

In this research, development model is adapted from plomp model. This model has many advantages particularly in testing the practicality of a product by one to one step, small group, and field test [9]. This model consists of three phases. One of them is preliminary research phase. In this phase, there are steps such as needs analysis, student analysis, curriculum analysis, and concept analysis. Needs analysis is conducted by interviewing teacher and distribute the questionnaire to the students. The instrument given in interview with teacher of SMA N 1 Rambatan and the questionnaire distributed to the students have been validated by some mathematics experts and Indonesian language experts. The information obtained in the interview is related with learning process in the classroom, the use of teaching material in improving students' reasoning. Meanwhile, the information obtained from the questionnaire distributed to the students indicated that some students still think that mathematics is a difficult subject

to learn and they also find it difficult to comprehend both the question and the learning material given by teacher.

In this research, the development that will be conducted is the process of innovation toward the existed product. The product that will be developed on mathematics learning device is in the form of RPP and LKPD based on guided discovery in order to improve students' reasoning ability. The devices that will be developed need to be valid, practical, and effective.

3. Results and Discussion

On preliminary research, there are many analyses that will be conducted to identify the problems in mathematics learning as the basic in determining alternative solution and product specification required, and identifying the appropriate learning material in implementing guided discovery method. This research which was conducted in class X SMA is in preliminary research phase which consists of three activities as follow:

3.1. Needs Analysis

It is to obtain information about problem at school encountered by both teacher and students. The information collection is implemented by interviewing teacher, distributing questionnaire to the students, and introduction test sheet. Interview with teacher reveals that students' comprehension toward learning material has satisfied yet. This is due to the level of students' enthusiasm toward mathematics learning is still low, and some students are busy doing their individual activity rather than paying attention to their teacher during learning process.

Learning resources used by teacher are textbook and LKPD (student worksheet). The student worksheet employed by teacher arranged by the teacher individually. However, the LKPD has not yet facilitate students in developing their reasoning ability. This is caused by students tend to be enthusiast at the beginning in using LKPD provided by teacher, however starting from the third meeting onward, their interest and enthusiast start to decline. The questions on LKPD also lack of mathematical reasoning questions type. The daily test result of the students shows that the result is less satisfying particularly on reasoning question type. Therefore, teacher expect that LKPD should be interesting for the students in terms of the font, pictures on cover and question and clear and brief language instruction, so that the students find it interesting to work on question in LKPD (student worksheet).

In the making of lesson plan, teacher works together with mathematics teacher team in Senior High School, however, in fact, the implementation is not in line yet with the lesson plan. It can be seen when teacher explain the learning material in the front of the classroom. The teaching methods used by teacher at school are lecturing, discussion, and question-answer session. In fact, most of the students fail to comprehend the learning material and are hesitated to ask their teacher whenever they experiencing difficulty in comprehending learning.

During learning process, teacher divided students into groups to work on the question in LKPD. During the group activity, only part of the students are working and discussing seriously. The observation conducted by the researcher revealed that only some students are actively engage in learning, most of them are busy doing their individual activity and pay less attention to teacher explanation.

The questionnaire distributed to the students revealed that some students dislike mathematics. They think that mathematics is a very difficult subject to learn. However, numbers of students love to learn mathematics since it has advantages in their daily life.

3.2. Student Analysis

The analysis is to reveal the students' characteristics. The interview with the students reveals that students tend to ask their peer during learning process than ask their teacher whenever they find it difficult to understand learning material. Students are also different in learning style. Some students would like to learn again at home after school, some are never learn again after school and so they find it hard to recall their memory when teacher ask for it again at school.

The living environment of the students also influences them. Some students help to run the small business family or just to hang out with their peer. The questionnaire distributed to the students reveals that some students find it hard to answer mathematics learning delivered by the teacher. Meanwhile, other students find it easy to comprehend mathematics learning delivered by the teacher.

Students love colorful LKPD. Most of them love blue, attractive picture LKPD and regular size LKPD. Students prefer to work in group rather than individually since they can express their feeling and discuss the mathematics problem solving together.

3.3. Curriculum Analysis

Curriculum analysis is conducted on equation and in equation of absolute value. This curriculum analysis shows no change on basic competence (KD) and achievement indicator employed by school.

3.4. Concept Analysis

After conducting concept analysis based on curriculum 2013 on learning material of class X in the odd semester which consists of 4 chapters, namely, equation and in equation of linear absolute value of one variable, linear equation system of three variables, function, and linear equation system of two variables. Based on the result of analysis concept, equation and in equation of linear absolute value of one variable is chose as the mathematics learning material that will be developed. The material given will be in line with the indicator and aimed to facilitate the students to comprehend the learning material.

Based on the problem found in the field, students need learning device to improve their mathematical reasoning ability. The learning device that will be designed is referring to the result of need analysis, student analysis, curriculum analysis, and concept analysis. The learning device is designed based on the characteristics of guided discovery.

4. Conclusion

Based on the result of discussion and research, it can be concluded that:

- 1) Students' reasoning ability has optimal yet
- 2) Some students still think that mathematics is difficult subject to learn
- 3) LKPD development is of vital importance to help students to comprehend the learning material
- 4) Students are expecting that the questions in LKPD will be much closely related with the use of mathematics knowledge in daily life and problems related with their personal activity.
- 5) Students prefer to work in group rather than work individually since they can discuss and ask their peer whenever they find it difficult to comprehend the learning material.

It is expected that the development of this learning device based on guided discovery may improve students' ability on mathematical reasoning.

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