THE ANALYSIS OF STUDENT THINKING IN MATHEMATICAL UNDERSTANDING OF 7TH GRADE OF BOPKRI I JUNIOR HIGH SCHOOL ON ANGLE

Wike Ellissi[1, a] and Auxilia Maria Aroran [2, b]

[1,2] *Department of Mathematics Education, Faculty of Teacher Training and Education, Sanata Dharma University, Mrican, Tromol Pos 29, Yogyakarta 55002, INDONESIA*

[a] wike.elis@gmail.com
[b] auxiliamariaaroran@gmail.com

Abstract

This research aimed to describe the student thinking in mathematical understanding of students from 7th grade of BOPKRI I Yogyakarta related to the line and angle topic. The method used in this research was qualitative descriptive. Data were obtained by using worksheet based on Hypothetical Learning Trajectory. There were 4 test subjects, 1 subject with advanced mathematical skill, 2 subjects with intermediate mathematical skill, and 1 subject with beginner mathematical skill. These choosen subjects were interviewed to know their thinking process.

The result shows that there are two kinds of mathematical understanding regarding subjects' understanding, which are relational understanding and instrumental understanding. 4 steps of student thinking were used by the subjects, includes problem understanding, using mathematical model, mathematical manipulation, and decision making.

Keywords: mathematical understanding, thinking process, hypothetical learning trajectory.

Introduction

Indonesian government, on Permendiknas No.22 2006 (Depdiknas, 2006:346) states that on of the goals of mathematics on secondary education is that learners have the ability to understand the concepts of mathematics, explaining the interconnection between concepts, and applying concepts or algorithms flexibly, accurately, efficiently and appropriately in troubleshooting. Understanding the concept needs to be instilled to learners from an early age, since the learner is in elementary school as well as for students of junior high school. They are required to understand about the concept, have a good grip of problem solving, and the operation of mathematics acurately, because it will be a provision in learning mathematics at higher levels of education.

The understanding of mathematical concepts is important for meaningful learning of mathematics. In the process of learning mathematics, understanding the concept is a very important foundation for thinking in solving mathematical problems and daily problems. Teachers of course expect that students' understanding will not be limited to connecting only. This is the most important part of mathematics learning as Zulkardi (2010) states that "the mathematics lesson emphasizes the understanding of concepts". This means that in learning mathematics students must understand the concept of mathematics in advance, in order to solve the problems, apply the theories in the real world (Herawati, 2010), and to be able to develop other capabilities that became the goal of mathematics learning. Similarly, Mohd Sholeh Abu states that if the understanding of concepts in learning mathematics is not achieved, it will reduce the interest of students in the learning of mathematics itself and students will consider it difficult math (Yahaya, 2010).

Mathematical understanding is important for learning mathematics in a meaningful way, where students can interwine between knowledge possessed and other circumstances of theirs, so that they can learn by understanding. However, how to optimize the learning outcomes of mathematics is certainly the task of a teacher. Therefore, we need a new paradigm in developing teaching strategies in class. Teachers are required to think critically in preparing a learning device that will support the activities of teachers as educators and support the achievement of the desired learning objectives. In preparing learning tools, it is important to consider the conjecture and anticipation of what might happen to the students who will be thaught about angles. In this study, the learning device is HLT. Hypothetical learning trajectory (HLT) is a hypothesis or prediction of how students' thinking and understanding develop in a learning activity (Prahmana, 2017: 11). Based on the above statement, then in this study will be analyzed students'

mathematical understanding ability in the subject about the relationship between angles with the help of learning devices in the form of HLT.

Theory

A. Mathematical Understanding

Bloom (Sagala, 2009: 157) states that understanding (comprehension) refers to the ability to understand something after it was known or remembered and interpret the learning subject. In general, indicators of understanding of mathematics include: recognize, understand and apply concepts, procedures, principles and mathematical ideas. According to skemp (Herdian, 2010) based on his level of thinking, understanding of mathematics is classified in the following stages:

1. Instrumental understanding, which is to memorize something separately or can apply something to a simple/routine calculation, doing something algorithmically only.

2. Relational understanding, which can link something with other things correctly and aware of the process undertaken.

Instrumental understanding is defined as the understanding of mutually exclusive concepts and only memorize formulas in simple calculations. In this case one understands only the order of workmanship or algorithms. Whereas relational understanding contains schemes or structures that can be used in the explanation of the wider problem and its usage properties are more meaningful. Indicators of students 'mathematical understanding of mathematical concepts according to NCTM (2000) can be seen from the students' ability in:

1. Define concepts verbally and in writing

2. Identify concepts and create example and not example

3. Using models, diagram and symbols to represent a concept

4. Converting a form of representation to another form

5. Know the various meanings and interpretations of concept

6. Identify the properties of a concept and recognize the conditions that define a concept

7. Compare and differentiate concepts.

B. Hypothetical Learning Trajectory (HLT)

HLT is used to predict the conjecture and anticipation of what might happen to students who will get a mathematics learning that reveals the students 'mathematical understanding ability, both the students' thinking processes and the things that will happen in the learning process. Gravemeijer (Charitas Indra Prahmana, 2017: 11) states that Hypothetical Learning Trajectory (HLT) consists of three components: learning objectives, learning activities and tools or media used in the learning process.
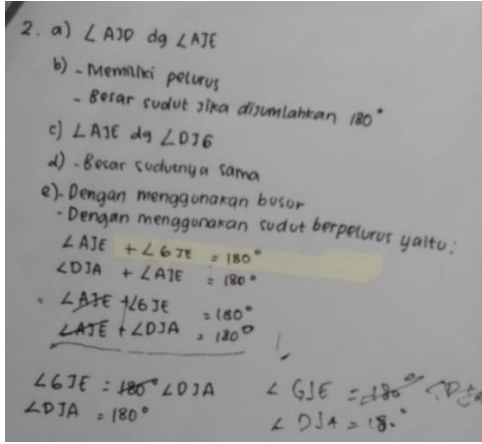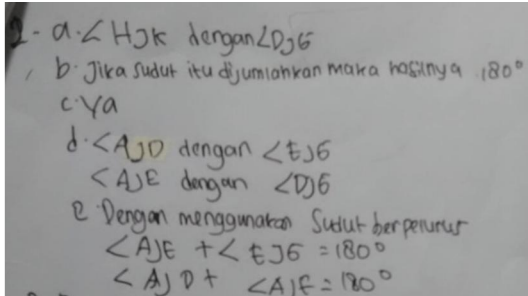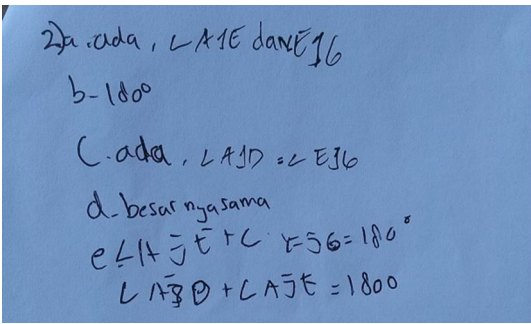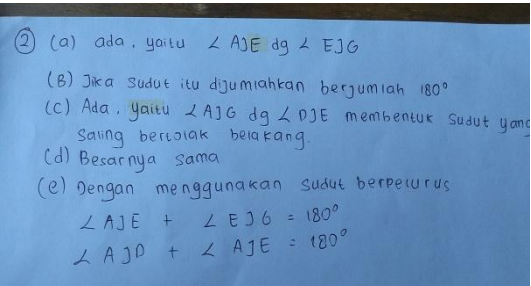
Methodology

The research method in this study is descriptive qualitative. Subject and place of study are students class VIIA of SMP BOPKRI I Yogyakarta in their second semester of academic year 2016/2017. The subjects consist of 4 students and thei research objective is the forms of mathematical understanding. Data collection is done by written test on mathematical problems and interviews about the forms of mathematical understanding used. The instrument used is HLT, while data collection technique is done by written test and unstructured interview. Data analysis technique used in this research is data reduction, data presentation then verification or make a conclusion.

Results and Discussion

The result of this research shows that the level of understanding of most students belongs to the level of instrumental understanding because the students can understand the concept separately and find the relation between one and another but still not able to solve them yet. Students also can understand that the property of supplementary angle can be used for proving the property of opposite angle. The analysis of students' thinking processes can be seen in the following table.

Table 1. Analysis of students' thinking processes

Student's answer	Analysis of students' thinking processes
Student A:	a) This student can understand the problem that is to find the property of supplementary angle and the opposite angle. b) This student can use mathematical models to prove the property of the opposite angle using the property of the supplementary angle. c) This student can use mathematical manipulation so that she can prove the property of the opposite angle using the property of supplementary angel. d) This student can conclude the property of supplementary angle and the property of opposite angle. Conclusion: this student' understanding belongs to the relational understanding because she understands each concepts and then find the connection between concepts and solves the problem correctly.
Student B:	a) This student can understand the problem that is to find the property of supplementary angle and the opposite angle. b) This student can use mathematical models to prove the property of the opposite angle using the property of the supplementary angle. c) This student can't use mathematical manipulation so she can not prove the property of the opposite angle using the property of supplementary angel. d) This student can conclude the property of supplementary angle and the property of opposite angle. Conclusion: this student' understanding belongs to the instrumental understanding because she

Student's answer	Analysis of students' thinking processes
	understands each concepts and then find the connection between concepts but can not solve the problem correctly.
Student C: 2a. ada, ∠A1E dan E16 b-180° c. ada, ∠AJD = ∠EJ6 d. besar nyasama e ∠1AJE+C Y=56=180° ∠AJB + ∠AJE =180o	a) This student can understand the problem that is to find the property of supplementary angle and the opposite angle. b) This student can't use mathematical models properly to prove the property of the opposite angle using the property of the supplementary angle. c) This student can't use mathematical manipulation so he can not prove the property of the opposite angle using the property of supplementary angel. d) This student can't conclude what is the property of supplementary angle and the property of opposite angle. Conclusion: this student' understanding belongs to the instrumental understanding because he understands each concepts and then find the connection between concepts but can not solve the problem correctly.
Student D: ② (a) ada, yaitu ∠AJE dg ∠EJ6 (B) Jika sudut itu dijumlahkan berjumlah 180° (c) Ada, yaitu ∠AJ6 dg ∠DJE membentuk sudut yang saling bertolak belakang. (d) Besarnya sama (e) Dengan menggunakan sudut berpelurus ∠AJE + ∠EJ6 = 180° ∠AJD + ∠AJE = 180°	a) This student can understand the problem that is to find the property of supplementary angle and the opposite angle. b) This student can use mathematical models to prove the property of the opposite angle using the property of the supplementary angle. c) This student can't use mathematical manipulation so she can not prove the property of the opposite angle using the property of supplementary angel. d) This student can conclude the property of supplementary angle and the property of opposite angle. Conclusion: this student' understanding belongs to the instrumental understanding because she understands each concepts and then find the connection between concepts but can not solve the problem correctly.

Class activity begins with observing a sketch of a total solar eclipse phenomenon. This activity is divided into several steps. The first step is that students are asked to name two angles, which form a straight line when being combined. At first, students are still confused to mention the

angle in question. Almost all students think that the angle is the same as the straight line itself.

Here is a snippet of conversation between researchers and students.

Researcher : please mention which angles form a straight line

Student : I don't know, ma'am.

Researcher : look at the line CL on the sketch. How many angle are there?

Student : two, $\angle CIJ$ and $\angle LIJ$

Researcher : those two are called supplementary angle. Now name the others

Student : so is it true that the addition $\angle CIJ$ and $\angle LIJ$ is equal to 180^0

Researcher : yes, that's right, because they form a straight line.

Finally, with the help of the facilitator the student can understand the concept of the angle of the plane, and furthermore he finds the nature of the angular angle that the sum of the sideways angles is 180^0.

There are also students who find it difficult to grasp the meaning of the sentence in the question, but even though there has been given explanations and even examples, this student cannot immediately find the properties. In this case, the researcher as a facilitator guides the students to reach the intended concept, starting with asking the large angles wich form a straight line.

Researchers than ask students to find the property of opposite angle. Some of them still do not understand the concept. Here's a snippet of student interview.

Researcher : can you draw lines intersect to one another?

Student : like this?

Researcher : great. Now take a look at line EI and HG, at which point they intersect?

Student   : point J

Researcher   : therefore $\angle HJI$ and $\angle EJG$ are opposite angle

Student   : yes, ma'am. I understand

Researcher   : what about their size?

Student   : they have the same size

At first, students still not sure about how to find the property of the opposite angle, but the the help of researchers plays a very important role that help students to finally find the properties of the supplementary angle and opposite angle.

Furthermore in the next activity, the students are asked to prove the property of the opposite angle. Student thinking on this activity is the same as previous activity. They can understand the property of opposite angle. However, they can't afford to use supplementary angle's property to prove the property of opposite angle. The conversation is stated below.

Researcher : what is the property of opposite angle?

Student : they have the same size.

Researcher : how about the supplementary angle?

Student : the sum of the angles is 180^0.

Researcher : what is the connection between the property of supplementary & opposite angle?

At the end, student can't relate the property of opposite angle to prove the property of supplementary angle.

Conclusion

Based on the result and discussion above, from total of 4 subjects, the understanding of 3 subjects belongs to instrumental understanding, while the other one belongs to relational understanding. As for their thinking process, there are 3 subjects who can use mathematical model, but only 1 of them who can do mathematical manipulation to solve problem.

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