Junior High School Students’ Understanding and Problem Solving Skills on the Topics of Line and Angles

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Abstract. Line and angles is important topics to learn to develop the geometry skills and also mathematics skills such as understanding and problem solving skills. But, the fact was given by Indonesian researcher show that Indonesian students’ understanding and problem solving skills still low in this topics. This fact be a background to investigate students’ understanding and problem solving skills in line and angles topics. To investigate these skills, this study used descriptive-qualitative approach. Individual written test (essay) and interview was used in this study. 72 students grade 8th from one of Junior High School in Lembang, worked the written test and 18 of them were interviewed. Based on result, almost of student were have a good instrumental understanding in line and angles topic in same area, but almost all student have a low instrumental understanding in line and angles topic in different area. Almost all student have a low relational understanding. Also, almost all student have a low problem solving skills especially in make and use strategy to solve the problem and looking back their answer. Based on result there is need a meaningfulness learning strategy, which can make students build their understanding and develop their problem solving skill independently.

1. Introduction

One of important mathematics topics to learn is geometry. Geometry linked all topics in mathematics and also linked mathematic topics and real world [1]. Geometry also facilitates efficient use of knowledge acquired through the topic of geometry in problem-solving, daily life and other school subjects [1]. Some of learning geometry goals is to developed students understanding and problem solving skills [3,4]. Geometry can helped students to develop their understanding and problem solving skills [5]. Understanding skills is the most basic skills to build and develop another mathematics skills in geometry. Without understanding, it is difficult for student to master the geometry. But, the fact was given says Indonesian students understanding skills still weak. Biber, Tuna and Korkmaz revealed that the students did some mistakes in lines and angles topics, those are, students only see the image geometry was given without considering the nature of geometry it self, although, students know the nature of the geometry by the picture, students fail to associate a trait with other knowledge that necessary to find a solution of the problem, one of the students generalize the actual properties only apply to certain conditions, and students do not fully understand the concept of parallelism on the angles topic [6]. Setiadi in his research revealed student’s difficulty to understand the angles concept that existed at the geometry space [7].

Second skills that also be a goal in learning geometry is problem solving skill. Problem solving skills is the heart of learning geometry and be a focus development in mathematics and also geometry learning [8]. This skill can increase higher order thingking of students such us logic, critical thinking,
creative thinking, and reasoning thinking [9]. Although this skill was considered important, Indonesian students still do not master this skill. Such as the Uhti’s research, was found, Indonesian students have a low problem solving skills because students just focus on one step and when answer is presented another problems, students will be confused [10]. Similarly, Wardhani explains that only 20% of Indonesian students can answer correctly one of problem solving geometry problems regarding the concept around the square, rectangle and parallelogram [11]. According to Delyana, almost of student cannot make and use the strategy to solve the problem, it’s happen cause of student not used to with non-routin problem [12].

The fact that student understanding and problem solving skills are still weak, be a fondation for this study to investigate student understanding and problem solving skill in Junior High School, so we can make the good and right learning stategy to increase both of that skills. Topics which be the focus to investigated is line and angles topics, because this topic is the most basic in geometry and much used in our daily live [13, 14].

2. Method
This study used descriptive qualitative approach to investigated students understanding and problem solving skills. Samples of this research are 72 students of class 8 (14-15 years) taken from two classes in one of Lembang Junior High School. All of students have learned the material lines and angles. This study used individual test (essay) followed by interviews. Individual test taken from various sources that are student books and thesis in Annisa [15]. Students work on individual written test for approximately 80 minutes, extra time that given about 4-5 minutes. As much 18 of 72 students are interviews. Descriptive analysis taken to analyzing the results obtained by students answersheet, video interviews, and researcher’s journal interviews. Skemp indicators used to assess students understanding and Sumarmo indicators used to assess students problem solving skills.

3. Result and Discussion

| Table 1. Number of students with correct answer |
|-----------------------------------------------|
| 1 | 2 | 3a | 3b | 3c | 3d | 4a | 4b | 5 | 6 tipe 1 | 6 tipe 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| J | 64 | 72 | 44 | 37 | 37 | 35 | 60 | 61 | 36 | 20 | 17 |
| JB | 32 | 60 | 7 | 14 | 0 | 0 | 27 | 39 | 1 | 1 | 0 |
| % JB | 50 | 83 | 16 | 38 | 0 | 0 | 45 | 64 | 3 | 5 | 0 |

Nb: J = Number of student who have done a task. JB = Number of student who solved a task correctly. % JB = percentage of students with correct answer.

Table 1 show the number of correctly answer by students. From this table, can be seen that, most of student can answer test number 2, but not in same situation for number 3c, 3d, and 6 type 2, all of students can not answer these test with correctly. For test number 5 and 6 type a, only one students can answer correctly.

![Figure 1. Student answer no 1](image1)

![Figure 2. Student answer no 2](image2)
Based on number 1 and 2 result, almost all students (±66,5% of students) have the basic skills, those are instrumental understanding in understand and interpret the angles. This Skills was basic understanding skills and also the basic skills to develop other skills [16,17]. Figure 1 and Figure 2 show that students have an understanding about angles, in meaning, types, and method to measure the angles using the arc. Students skills in understanding the angles, also shown in interviews. The interviews show that students understand about what angles is, what that influence the angles size is, and determine the type of angles, though the angle is not served it’s size. The following interview transcript with student ‘A’, show that student understanding about what that influence the angle’s size is.

Researcher : To change angles become bigger or smaller, what should we do?
A : We can move the position of this line. (pointing at \( \overline{\text{AB}} \) and \( \overline{\text{AC}} \))
Researcher : Which one? Both of them, or only one?
A : we can move only one or both of them.
Researcher : How shifted it? Make it close together or make it apart?
A : You can choose both of them.

From Table 1 and Figure 3 we can see that students have no instrumental understanding. Student’ answers in Figure 3 show that student confused about the location of line, they confused where the location of line is. After further exploration by interviewing some students, this case occurs because students were not able to read the concept of parallel lines and intersected line on space geometry. But, when students who interview were given question about parallel and intersecting line in one area (rectangular), all of student who interview can answer it. It shows that student have no a instrumental understanding in two different plane and same time its show that student have not relational understanding. This result is consistent with Annisa, where students are asked to show two intersecting lines, students are not able to answer, however the students were able to draw the picture alone, he remembers with intersecting lines, but he could not show when the drawing is different from what he has learned [15].

Result that given in Table 1 for test number 3c and 3d, showed none of students can answer these test correctly. About 40% student didn’t answer this test and the rest gave wrong answer. Interviewed also showed that students can not answer these test correctly. Students can not explain what perpendicular line is and what crossed line is. Students didn’t know, when two line are in different plane, then there will be no a intersection point formed by these lines. Students say that the crossed lines is lines which crossing, without notice that both lines are in different plane. Students can’t understand about lines in different area. It’s showed that students can not complete the unfamiliar question. This can be happened, maybe cause of question that always use in mathematic learning (final test, students worksheet, etc) not using this concept (perpendicular and crossed line in different plane).

Students answer on number 4a and 4b show that they understand about supplementary angles and complementary angles concepts. Almost all students can used supplementary angles and complementary angles concepts, also vertical angles concepts (± 55% of students). This show that student’s instrumental understanding was good. But, their relational understanding is still weak. 67%
student not used the one variable linear equation system with one variable concept on their 4a and 4b answer with correctly. Example of students answer showed in Figure 4, 5, and 6.

Only a few students can answer like Figure 7 (±20% of students). Almost of students only used direct way (algoritic) to solve the problems. Even in Figure 4, that show students was wrong in used one variable linear equation system concept. They didn’t understand variable is something that must be found, so variable can not be adding with the constants. According to Jupri this student’s error was namely error type AE (understanding algebraic expressions) [18].

![Figure 4. Student ‘A’ answer for number 4](image1)

![Figure 5. Student ‘B’ answer for number 4](image2)

![Figure 6. Student ‘C’ answer for number 4](image3)

![Figure 7. Student ‘D’ answer for number 4](image4)

Students’ answers for test number 5 and number 6, showed that students problem solving is still weak. From Table 1, we can see that only one student can answer number 5 and number 6 with correctly. According to interview, from number 5, revealed that, students unable to read the unfamiliar problems, especially if the problems were already contains some problems. Actually, students understand about supplementary angles concept, sum of angles in triangle, also about angles that form by parallel lines that cut by transversals line, but they unable to used these concepts to solve the problem on number 5. These findings, indicate that the student does not full fill the indicator of problem solving according to Sumarmo, that is, identify elements that are known, asked and the adequacy of the data and create a mathematical model also create and implement relevant strategies [19].

In this question, some of students made an error in applying the one variables linear equations concepts, it can be seen in Figure 8. Seen that, students adding the variable with constants, in this case students not understand that constants in a variable is not the value of the variable. Figure 7 showed that students write $x = 17x$, this failure by adding $12x ad 5x$, so $x = 17x$. 
According to Table 1 showed that only one students can answer test number 6 type a correctly other students, were not able to answer this questions (you can see the correct answer in Figure 9). All of students can not found the concepts of angle that form by parallel lines which cut by transversal line is exist in this question. Generally, students understand about this concepts, but they cannot understand how to used this concepts in this problems. They just know, but they unable to apply this concept. Student also didn’t, that possible to make another parallel line which parallel with parallel line that exist in this question. This fact suggests that, in addition they can not apply the concept of angle, they also do not understand the rules on parallel lines.

In test number 6 type b, most of students can found the correctly procedure to answer it, but, most of students can not read and understand the problem correctly. This test (number 6 type b) ask students to summing over angles was formed, but all students who answered do not add up all the angles that they have, they are only looking to get the measure of angle that form by ball rebound. This shows that students still have weak to understand the given problems, especially in story problem. Students unable to read the data that given in the story problems, but they are not careful with what is asked. Student unable to identify the necessary elements of the problems correctly, like one of the student’s answers on Figure 10.

According to interview for number 5 and number 6, almost of students do not have the last indicator in the problem-solving skills, that is, to re-examine the answers they have made [20]. Only few students that re-examine their answer, but they only re-examine the quantification not the validity of the procedure.
4. Conclusion
According to test result and interview data, it can be seen that students already have instrumental understanding about line and angles in one area, but students don’t have the instrumental understanding about line in different plane. Students understand about what angles is, what that influence the angle’s size is, and how to measure the angle. Students understand the meaning of parallel lines, intersecting lines and perpendicular lines if lines in same area (in one area), but students not understand if lines in different areas (two area). Students also not understand about crossed lines. On average, result showed that student’s relational skill still a weak. Students difficult to relate one concept to another.

Result also showed, almost all students have a weak problem-solving skills. Students are not able to read the problem correctly, students' difficult to reading the concept that exist in question, so that students are also difficulties in determining the right solution. Other than, on average, students not re-examine their solution. If they are a few students who do re-examine, they only check their calculation, not the accuracy of the procedure that they used. The fact obtained that the student’s relational understanding and problem solving skills of is still relatively weak, it could be caused by focus of learning that remains centered on the low thinking skill which only procedural and less contains the challenge [4,8,18].

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