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Analysis of students mathematical representation abilities in geometry learning in vocational high school

Euis Gusanti Sri Rahayu[1*], Al Jupri[2]

[1]Department of Mathematics Education, School of Postgraduate Studies, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia
[2]Department of Mathematics Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No.229 Bandung 40154, Indonesia

[*]euisgusanti@upi.edu

Abstract. The background of this research is the ability of students to solve the geometry problems in grade XII of vocational high school. Students are less able in solving problem, not using mathematical expression and are not persistent in expressing their argument. This research aims to know students ability in mathematical representation in solving geometry problems. This research used descriptive qualitative method. Data was collected by interview, documentation, and test. This research involved three students including three group : upper level students, middle level students, and lower level student. Data analysis techniques through data reduction, data presentation, and conclusions. Validity of data by using triangulation technique. The result showed that : (i) the average ability to solve geometry problems with visual representation is in medium category because it is able to draw the geometry to clarify the problem and solve the problem of geometry (ii) Mathematical representation expressions, in the upper level students is capable of making mathematical model but have not been able to solve the problem of geometry, while students with middle level and lower level have not been able to create mathematical models, (iii) The ability of word representation or written text of vocational high school students 14 Garut is still low because students have not written steps in solving geometry problems.

1. Introduction

According to the NCTM [1] math skills that must be mastered including is the ability of solving problems (problem solving), the ability of reasoning and proof (reasoning and proof), mathematical communication skills (communication), and the ability of mathematical representation (representation). NCTM [2] revealed that the translation is a representation of a problem or idea in new forms, including from a picture or a physical model into the shape of symbols, words or sentences. The ability of representation is the mental picture of a student in the learning process. Mental picture was reflected in various forms. Among them, in verbal form, pictures, or concrete objects.

National Council of Teachers of Mathematics [2] explain the importance of the ability of representation and understanding in learning mathematics. The ability of a diverse representation will encourage students to develop and understand math concepts more deeply. The ability of representation used in the study of mathematics as a physical object, drawing, graphics, symbols, and very helpful thought processes and communication students. Sumarmo [3] also confirmed that the understanding of mathematical concepts and principles needed to be done to resolve the problem as a provision dealing with the problems of everyday life. The ability of representation is one of the General purpose of the learning of mathematics in schools. Most of the students have not been able to

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link the material learned knowledge that is used or utilized. Because learning mathematics are given not only the transfer of knowledge but something that should be understood by the students that will be needed in everyday life.

The interview results with one of the XII grade Mathematics teachers in SMKN 14 Garut, admitted that there are still so many students who have difficulties in understanding the issues that related to the distance of a point to a line. The interviews results conducted with the mathematics teachers are not much different from the observations and students interviews.

Mudzakkir [4] classify mathematical representation into three forms, (1) the visual representation in diagrams form, graphs or tables, and images; (2) the equation or mathematical expressions; (3) words or written text (Suryana, 2012). Problems that emerge in SMK N 14 Garut, is concerning with mathematical representations of the student refers to the criteria of Mudzakir's representation. So the researchers interested in conducting research in SMK N 14 Garut with the benefit to get an overview about the ability of mathematical representation in resolving a matter of geometry subject related to the chapter of distance point to a line.

2. Method

The research methodology of this study is qualitative descriptive. The subject in this research are 3 students of the 12th grade students from Multimedia and Engineering program at SMK N 14 Garut. The technique of data collection in this research: 1) Test the ability of the material representation of the geometry. 2) Interview to obtain information that strengthens the research results. The validity of the data using triangulation techniques by means of comparing the interviews results with mathematical representations of the test results. The geometry topics that used in Sugiyono [5] analysis with the following stages: 1 data reduction, 2) representation of data, 3) conclusions/verification. The reduction of the data in the form of test results and interviews with the students. Then the data is presented in the form of a narrative text. Once it is drawn a conclusion about the ability of the student in resolving the question of the geometry representation with distance point to a line sub topics.

3. Result And Discussion

Through interviews, the researchers can determine the method of settlement used by students, as well as matching between answers on the answer sheet with the actual grasp.

3.1 Visual Representation Ability

Visual representation ability is measured by using the indicators i.e., students are able to draw an illustration of the distance of the point to the line on the objects space has been provided in the matter.

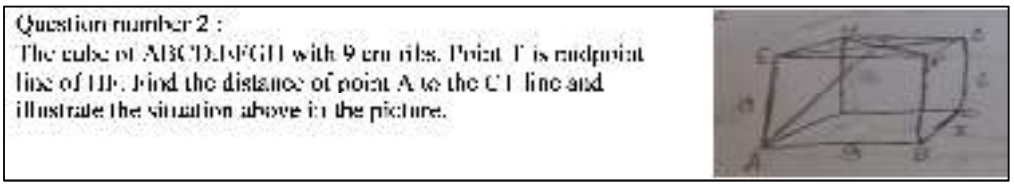

Figure 1 Upper Level Visual Representation Ability

In Figure 3.1, exposing the WH was only able to draw a sketch of the cube, but has not been able to make the illustration of the distance point to the line at 3D Geometry. Based on the interviews results. WH less understood the concept of sketching the image distance point to a line of a space. The interview results are as follows:

Researcher : "What kind of line that shown from point A to point T?" (Pointing the image)

Subject WH : "It is shown the distance that will be calculated" (pointing the image)

Based on the answer sheet and interviews results, that the WH subject understand the problems number 2 but has not been been able to show the image geometry. If it triangulate with the mudzakir's theory that Stated the criterion resolves problems with being able to make a visual representation of

the geometry image correctly then it can be inferred that the WH subject can not solve the problem of visual representation in number 1 precisely.

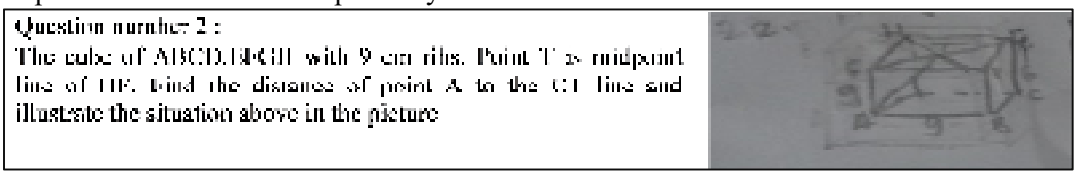

Figure 2 Middle Level Visual Representation Ability

In Figure 2 shows that the subject has not been able to properly make an illustration from distance point to a line on a space, to clarify problems and facilitate the settlement of the given question. Based on the interview results the subjects is less understood the illustrated concept of the object distance to the point of space. The interview results with the subject RM are as follow

Researcher: "Are you really sure that the image shown the distance point from A to the CT line?" (pointing to the picture)

Subject RM : "In my opinion, is the distance from point A to CT line is equal to A point distance A to T point?" (pointing at the picture)

Researcher: "Why do you think so?"

Subject RM : "I think the distance point from A to CT line is equal with the distance point A to point T"

Based on the answer sheet and interview results, it is notice that the subjects RM has already understand the issue, but he is still missed in understanding the concept of calculating the distance point to a line so it's caused confusion in the geometri image creation. If triangulate with mudzakir's theory that States that the criterion resolves problems with visual representation capability of drawing the graph precisely, then it can be inferred the subjects RM cannot solve the problem in number 2 about visual representation appropriately.

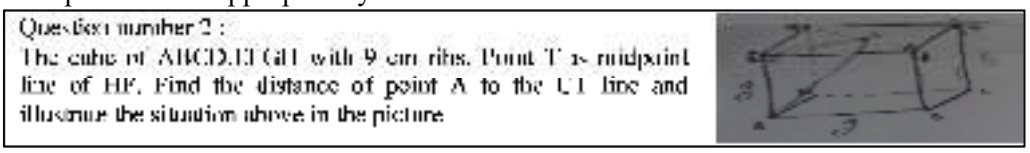

Figure 3 Lower group Visual representation ability

Figure 3 shows the subject MA not understanding the problem. MA only know that in the problem asked is the point distance to a line. Here summary of interview results with MA:

Researcher first : "How do you solve this problem?"

The subject of MA : "I do not know, madam. What do you mean, ma'am. I do not understand?"

Based on the answer sheet and interviews results , that the subject MA was not able to draw correctly, if triangulate with the Mudzakir theory that States the criterion of the problem solving of visual representation by drawing the geometry correctly, then it can be inferred the subject MA can not solve the problem of visual representation No. 1 exactly.

Based on the results of test and interview it can be concluded that the ability of the visual representation of students on the higher group, the medium group and lower groups have not been able to create geometry figure to. This is same with the research from Widiati [6] which stated that the ability of visual and verbal representation is equivalent with the school level as well as the types of learning and the ability of the symbolic representation is the ability the most difficult was occupied by students. In general students who are having difficulty in understanding a given problem and the difficulty of representing the given problem into a mathematical form, resulted in the resolution procedure is made unclear and erred in calculation.

3.2 Equation or Mathematical Expression Ability

The capability of representation of mathematical expression or equation can be measured with indicators,: 1) makes the equation or mathematical model of the problem available. 2) solve the problem of calculating the distance of a point to a line with a mathematical expression involving

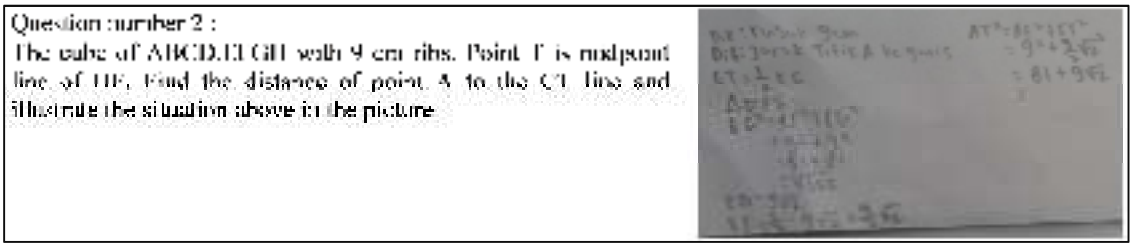

Figure 4 Upper Level Equation or Mathematical Expression Ability

The subject of the WH is not yet able to make mathematical models precisely, because there is still a less precise mathematical expressions in part EG 2 = √ (162). Although the subject WH are able to calculate the distance point to point, but the subject WH have not been able to calculate the distance to the point referred to in the question. The following interview results between researcher and subject WH:

Researchers : "Are you sure, this is the formula to calculate the distance A to point T?" (pointing to the answer)
The subject WH : "Sure madam, because AET forming a right triangle then I use the Pythagorean formula to figure the distance from point A to point T"
Researcher : "Then, why do you write $EG^2 = \sqrt{162}$?" (pointing to the answer)
The subject WH : "Oh yes Madam, It Should be written, $EG^2 = 162$"

Based on the test and the interview results noted that the WH has yet to completely solve the problem of no 2 using mathematical expression or equation form. If it triangulate with Mudzakir's theory, that to resolve the problems with expression or equation is a representation of ability criteria expression. Thus, it can be concluded that the WH has not been able to resolve the problem of the representation of mathematical expression number 2 exactly.

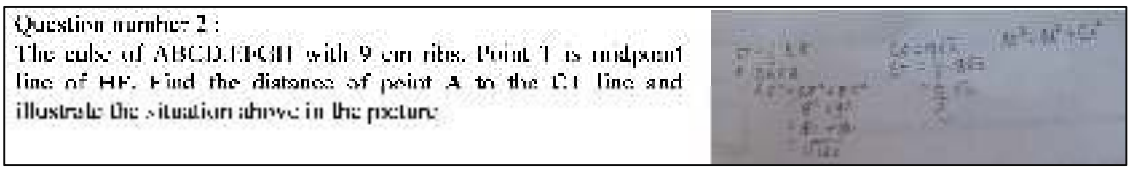

Figure 5 Middle Level Equation or Mathematical Expression Ability

Figure 3.5 the RM answer sheet Number 2 representations of Mathematical Expression/Equation Subject RM are already able to create mathematical models and are able to calculate the distance point to point, but there are still errors in writing mathematical expressions $EG^2 = \sqrt{162}$ supposed $EG^2 = 162$. The subjects of RM is not able to answer question number 2 correctly until it is finished. Related to this problem, the interview results with RM:

Researcher : " In the last test. Please, explain the answer?" (pointing to the answer)
The subjects RM : " To calculate the distance from point A to the CT, we must seek first the distance of point E to G, then the distance E to T, and last the distance of the point A to point T"
Researcher : " Did you write the Pythagorean formula? "
The subjects RM : "Sure madam, it looks like I was making a mistake in writing the formula. It should be like this $AT^2 = AE^2 + AT^2$ "
Researcher: : Look at this, is it true $EG^2 = 81 + 81$ then $EG^2 = \sqrt{162}$?
The subjects RM : "Right madam" (answer with confidence)

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Based on the test and the interview results that RM already understand the issue number 2 and know how to use mathematical expression or equation form. But RM is still not noticed that there is an error in the writing of a mathematical expression, moreover the subjects of RM less savvy about using the Pythagorean formula when searching for long point E to point G. If it triangulated with Mudzakir theory that to resolve problems with expres2sion or equation is a representation of ability criteria expression. Thus, it can be concluded that RM is not solving mathematical expression representation No. 2 appropriately.

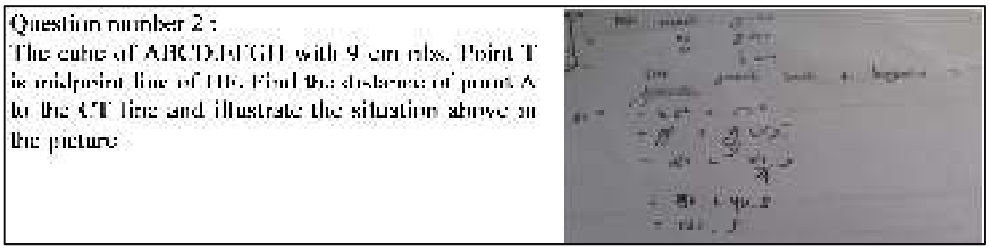

Figure 6 Lower Level Equation or Mathematical Expression Ability

Figure 6 MA answer sheet to question Number 2 representations of Mathematical Expression/Equation figure 6 shows that subject MA seem to be confused in solving mathematical expression representation at number 2. The subject of MA responded with unstructured. The following summary of the interview with the subject of MA:

Researcher : "did you do like this in the last test, where did you get this?" (pointing to the acquisition length ET = ½ cm in student answer sheet)
Subject MA : "I mean ET = ½ of the length of EG
Researcher : "how long EG?"
Subject MA :9 cm"

According to the Above Analysis results, it can be conclude that students with high grades are able to make a mathematical equation. Students with moderate and low grade have not been able to make a mathematical equation because it has yet to master the concept. This is equal with the results of the of Wijaya's [7] research which stated that the concept faulty is in error translating the question into a mathematical model.

3.3 The ability of word representation or written text

The ability of word representation or written texts of students can be measured by the indicators: 1) able to write down the steps of completion to determine the distance a point to a line with words. 2) able to answer the question using it requires or written text.

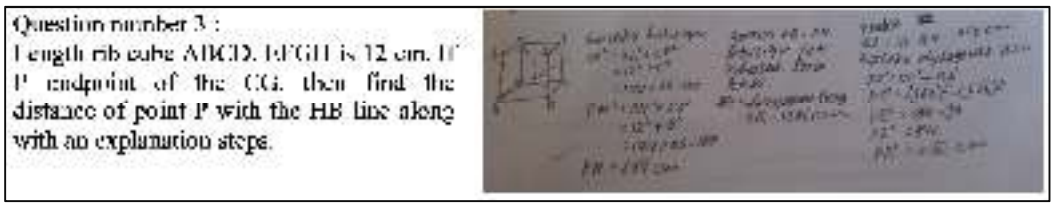

Figure 7 Upper level word representation or written text ability

Figure 3.7 shown the subject of the WH already able to write down the steps of completion problem by using words, it is seen from the answers to the subject of WH. Although on the last step there is an error in the process of calculation of square numbers $\left(6\sqrt{3}\right)^2$ the contents should be 108 not 96. The following summary of the interview with the subject of WH:

Researchers : "Question number 3 please explain how the steps to calculate the distance of a point to a line?"
Subject WH : "First create an image of the cube, specify a point P and draw BH line. Then draw a line from point P that is perpendicular to the BH line, for example I named it PZ line
Researcher : "The intent is to make a projection of a point P to the BH line?"

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Subject WH : "Hehehe, yeah madam"
Researcher : "That it?"
Subject WH : "No Madam , we should calculate the distance for BP, PH, and then find the PZ length. PZ is the distance the point P to BH".

Based on the interview results t and answer shee, the subject of the WH can conclude the problem of given representation. WH is also capable of answering the problems with words or written text. It if it triangulate with Mudzakir's theory, then it can be inferred that the WH can resolve the issue of a written representation/words precisely.

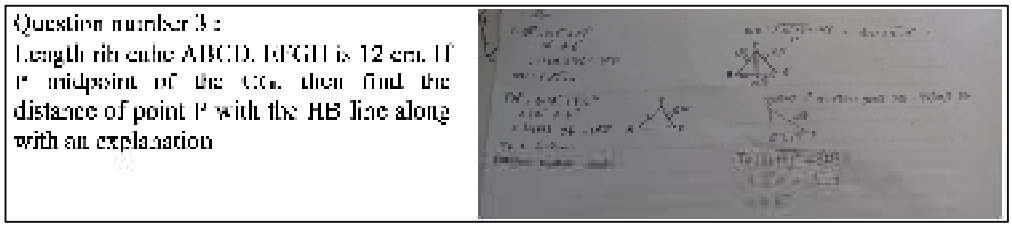

Figure 8 Middle level word representation or written text ability

Figure 8 Shown the subjects of RM didn't answer questions completely. Although the overall answer made by the subjects of RM is correct, but the subjects of RM didn't answer the question "how to resolve this problem?" the answers will be shown in the interviews results between researchers and the subject

Researcher : "Why you didn't answer the question number 3 completely?"
Subjects RM: "Which one ma'am?
Researcher : " The question number 4, i asked you to explain the steps of completion in determining the distance of a point P to BH? Why you didn't answer?
Subjects RM: "I did not pay attention to the question, ma'am"

Based on the above description and the interview results it can be concluded that students haven't write completion steps perfectly, because at the time answer student yet renders the first step that is drawing the wake geometry. Although the subjects of RM already understand the issue, but have not been able to write down the steps in finding a settlement of the distance point towards the line.

MA subjects do not answer the problem number 3. For this reason, MA is considered unable to solve the problem of word representation or written text ability.

4. Conclusion

Based on the test and student interviews results, it is known that the ability of mathematical representation of the students is still low. This is shown from: (1) students are still difficult to understand what is known in the matter, so as to visualize what is known, the less precisely; (2) Students still difficulty in describing the answers in the form of graphs, this is due to mistake of the students in understanding the problem; (3) the students have yet to write down the steps systematically, so still a difficulty in turning problems into mathematical models; (4) Students still undecided in a posing argument and not yet sure against yourself, so still a difficulty in a posing argument.

5. Acknowledgements

We thank to grade XII students of SMK N 14 Garut who have activity participated in this study.

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