

Math Learning Problematics on the Subject of 3D Topics

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Abstract. In the 21st century, the ability to be mastered by students is increasingly complex, such as the ability of critical thinking, creative thinking skills, communication skills, ability to cooperate, as well as ability in reasoning. The ability of reasoning in students is crucial to learn and develop. The reasoned ability is not only needed when studying mathematics but is indispensable when determining decisions in life. The instrument in this study is how the mathematical reasoning process of students is low, moderate and high on the subject matter of three dimensions. The study aims to know students' learning difficulties relating to the students' mathematical reasoning ability on surface area material and the volume of three-dimensional space. This research is a qualitative descriptive study with a case study approach. The subject of this study involved 30 students. The instrument in this research is a mathematical reasoning ability test. The results showed that 40% of students had high reasoning ability, 40% of students had moderate reasoning ability, and 20% had low reasoning ability. Students with high reasoning ability have no significant difficulty in completing the instrument in this study, students with reasoning ability are having difficulty in calculating and interpreting the intent of the question, and students with low reasoning ability have difficulty in drafting a completion plan. The study concluded that the students' reasoning ability on the three-dimensional material belongs to the medium category.

Keywords: problematics, dimension three, mathematical reasoning.

INTRODUCTION

In the 21st century, the ability to be mastered by students is increasingly complex, such as the ability of critical thinking, creative thinking skills, communication skills, ability to cooperate, as well as ability in reasoning. The ability of reasoning in students is crucial to learn and develop. One of them is in mathematics. Mathematics is a branch of science that has an important role in the development of science and technology, application of other fields of science and in the development of mathematics itself. As it was proposed by Sujono (Fathani, A. H, 2009, p.19) that "mathematics is a science of reasoning logic and as a science in interpreting ideas and conclusions". Because of the importance of mathematics in everyday life, mathematics is used as one of the mandatory lessons at every level of education in school. The school mathematics standard includes the standard of content or the material (mathematical content) and the mathematical processes (Shadiq, 2009, p.2). The standard process consists of solving problems (problem-solving), reasoning (reasoning), and communication. Reasoning is included in the purpose of mathematics that is so that students have the ability to: (1) understand the concept of mathematics, explaining the linkages between concepts and apply the concept of logarithm in a flexible, accurate, efficient, and appropriate in problem solving, (2) using reasoning on patterns and properties, conducting mathematical manipulation in making generalization, drafting evidence, or explaining

mathematical ideas and statements, (3) solving problems that include the ability Understand the problems, designing mathematical models, completing models and interpreting the acquired solutions, (4) Communicating ideas with symbols, tables, diagrams, or other media to clarify circumstances or problems, (5) have an attitude of appreciation the usefulness of mathematics in life, namely to have curiosity, attention, and interest in learning mathematics, as well as tenacious attitude and confident in problem-solving (standard Isi Permendiknas No. 22 year 2006). The National Council of Teacher of Mathematics (NCTM, 2000) also stated that there are five mathematical learning objectives: problem-solving skills (problem-solving), reasoning ability (reasoning and proof), communication skills (communication), connection capabilities (connections), and the ability of representation (representation). From the Permendiknas and the NCTM, it can be seen that the ability to be owned by a student is one of reasoning ability.

Depdiknas states that mathematical materials and reasoning mathematics, are two things that can not be separated, namely the mathematical material understood through reasoning and reasoning understood or trained through the study of mathematical material (Shadiq, 2004, p.3). From the statement above, it can be reviewed that students should understand the mathematical material and be able to properly review it. Differences in the level of the reason of the students cause mathematics to be considered difficult subjects, because students must memorize the formula and understand the intent of the question, then create visualizations in working on the

object in Math. Most students still have difficulties in applying formulas, understanding theorem theorems, even the most prominent students are still experiencing difficulties in understanding math problems or problem-solving steps.

Widjaja (2010,p.5) expressed a sense of mathematical reasoning delivered by Ball, Lewis & Thamel, that mathematical reasoning or mathematical reasoning is the foundation for the construction of mathematical knowledge. Azmi (2013, p.11) displays the statement presented by Brodie "Mathematical reasoning is reasoning about and with the object of mathematics." Or it can be interpreted that mathematical reasoning is reasoning about mathematical objects. Shadiq (2007, p.3) states the definition of reasoning according to Copi i.e. reasoning is an activity, process or activity of thinking to draw a conclusion or create a new statement based on some statements that are known to be true or that is considered true called the premise. According to Suriasumantri (2010, p.42) reasoning is a process of thinking in drawing the conclusion of knowledge. Based on the description it can be concluded that reasoning is a process or activity of thinking to draw conclusions or to make a correct new statement based on some statements that are known to be true or deemed correct to construct knowledge in mathematical objects.

According to Wardhani (2010,p.27), mathematical problems can be distinguished into two types, namely routine problems, and non-routine problems. Routine problems are problems that are done due to sloppy or less thorough. While the nonroutine problem is a problem because it has not understood the existing procedure. In this study, the mathematical problems to be researched are routine problems about geometry, especially three-dimensional material. Geometry is one of the important aspects of learning mathematics that must be understood by learners, because the concept of geometry is closely related to the context of everyday life, especially in the third dimension (Clements & Sarama, 2011; Panaoura, 2014; Rofii et al. 2018). Geometry is one of the basic methods not only used by people to understand and explain the environment, shelter and human movement in its environment (National Research Council, 2009) but also as a Ponda The foundation that has a vital role in supporting the mastery of algebraic concepts, numbers, arithmetic as well as The subsequent mathematical concepts (The National Mathematics Advisory Panel, 2008). The third dimension is one of the mathematical subjects given in X grade high school. In fact, each student is expected to understand the basic concept of three-dimensional material. At the next stage students are expected to be able to calculate the distance between two points,

calculating the distance between points to the line, calculating the distance between points to the field, calculating the distance between two parallel lines, calculating the angle between the two lines, calculating the angle between the line and the field, specifying the position between the lines, and calculating the distance between the two unspecified lines. And the ability to be mastered in three-dimensional material is the ability of the students to understand the intent of the visualization of the space and sketching up space from the sentence of the story in question.

Many students consider this three-dimensional material a difficult matter. Students must memorize the formula and understand the intent of the problem, then create a visualization according to the known indicators. Based on the above background, researchers will conduct research under the title "Mathematical learning problematics on the three-dimensional subjects". With the problem, that is, what are the problems experienced by students of one high school in Magelang in solving the issue of three dimensional?

MATERIALS AND METHODS

The type of research used is qualitative descriptive research. Qualitative research was chosen to know deeper and detailed issues to be examined. The subject in this study is 30 students of the class of one high school in Magelang which is selected in purposive sampling. The collection of data in this study uses the instruments of questions, interviews, and documentation. The shell of the test material is three dimensional material. This research uses the instrument (test) in the form of a description (essay) amounting to 4 questions. The scope of material used is three dimensional material.

The problem solving stage that will be used in this research is the problem solving phase according to G. Polya. The selection of the troubleshooting stage according to G. Polya because the problem solving stages expressed by G. Polya is simple, the activity at each stage is clear, and allows students to gain experience using knowledge and skills that have been owned to solve the problem. According to G. Polya The problem solving phase is as follows: (1) understanding the problem (understanding the problem), (2) making a plan for completion (devising a plan), (3) implementing the plan (carrying out the plan), (4) re-interpret the results (looking back).

In this study, mathematical reasoning indicators were used in the following table:

Table 1. Mathematical reasoning indicators.

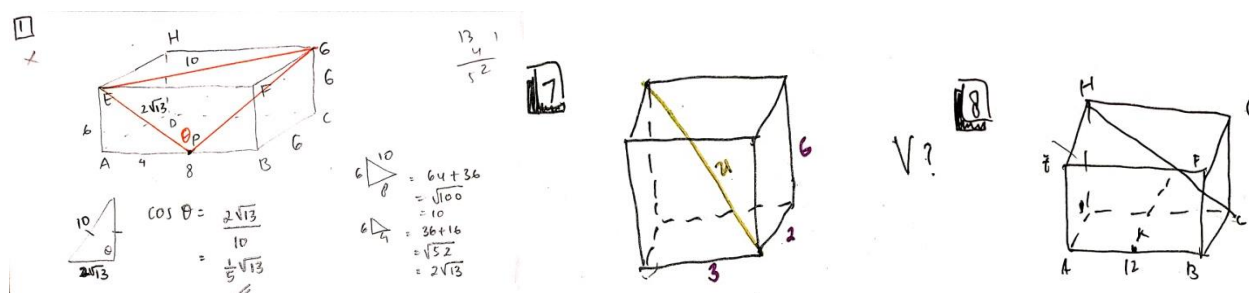
Phase solving	Problem Reasoning Indicators
Understand Problem	<ol style="list-style-type: none"> 1. Students can explain the problems found in the After reading the question. 2. Students can mention what is known and asked in the Problem. 3. Students can describe statements or data and provide explanations/reasons that can support data described.
Make plan	<ol style="list-style-type: none"> 1. Students can estimate answers and process solutions. 2. Students can use patterns/ways and relationships to Analyze the situation at hand.
ImplementPlan	<ol style="list-style-type: none"> 1. Students can compile and test the approximate response has been determined. 2. Students can use data that supports and To find a solution to the problem.
CheckBack	<ol style="list-style-type: none"> 1. Re-check the results of the answers andCompletion. 2. Can draw a valid conclusion.

RESULTS AND DISCUSSION

Low Subject Capability Analysis

At the stage of understanding the problem, subjects with low ability can read the question appropriately, then be able to describe what is known and write it on the answer sheet. In the next stage, the stage of creating a problem-solving plan, subjects with low ability can plan a problem-solving process. Visible from their ability in determining the initial steps of completion. The first step of completion of the problem is describing the building of the space as known in the matter. At the stage of implementing a problem-solving plan, the subject with a

low ability can describe the wake of the room then begin to compose the completion plan and show the asked part. At this stage students are able to determine the known point, indicating the area or angle asked. Based on the results of the student's response analysis there is an error subject in the formula selection, some subjects can choose the formula appropriately, but they do wrong at the calculation stage. In the next step of re-examining the problem resolution, the subject cannot do so because of errors that were performed at the previous stage.

**Figure 1.** Low Subject Capability Analysis.

Medium Subject Capability Analysis

At the stage of understanding the problem, the subject with moderate ability can read the question appropriately, then able to describe what is known and write it on the answer sheet. At the stage of creating a troubleshooting plan, subjects with moderate ability can plan a troubleshooting process and be able to determine a completion step. At the stage of implementing a problem-solving plan subject with moderate ability can describe the wake of the room then begin to compose the completion plan and show the asked part. At this stage the subject is able to determine the known point,

indicating the field as well as the angle being asked, right in selecting the formula used for the completion process. Based on the students' answers analysis, it can be seen that subjects with moderate ability have been able to determine the length of the rib that is unknown, but at the calculation stage, there is a mistake. At the stage of re-examining the problem resolution of the subject with moderate ability does not do so, visible from the absence of scribble on the student's answer sheet.

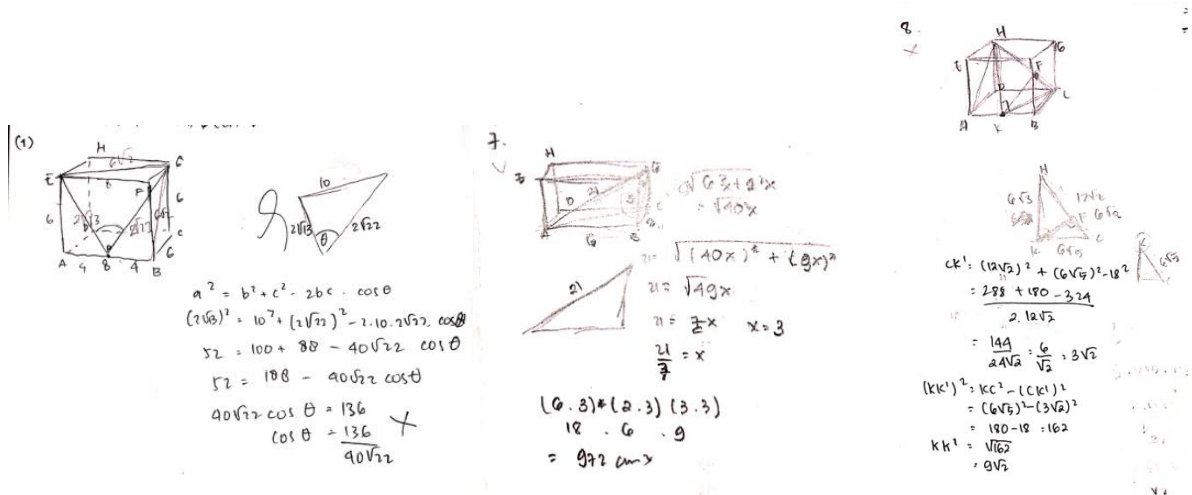


Figure 2. Medium Subject Capability Analysis.

High Subject Capability Analysis

At the stage of understanding the problem, a high-ability subject can read the question appropriately, then be able to describe what is known and write it in a sense on the answer sheet. At the stage of creating a problem-solving plan, a high-capability subject is capable of planning the problem-solving process and being able to determine the finishing steps. At the stage of implementing the problem-solving plan with a high ability can describe the wake of the space then begin to compose the completion plan and show the asked part. At this stage the subject is able to determine the known point, indicating the field as

well as the angle being asked, right in selecting the formula used for the completion process. Based on the student's answer analysis, it can be seen that high-proficiency subjects are able to determine which elements are not yet known in question and can resolve calculations appropriately and get the correct results. At the re-examine stage problem-solving subjects with high ability were able to re-examine the answer at the calculation stage, and correct the formula they chose. Visible from the answer sheet, the subject makes a scribble on the reply and then repeats it next to the answer that was believed to be wrong.

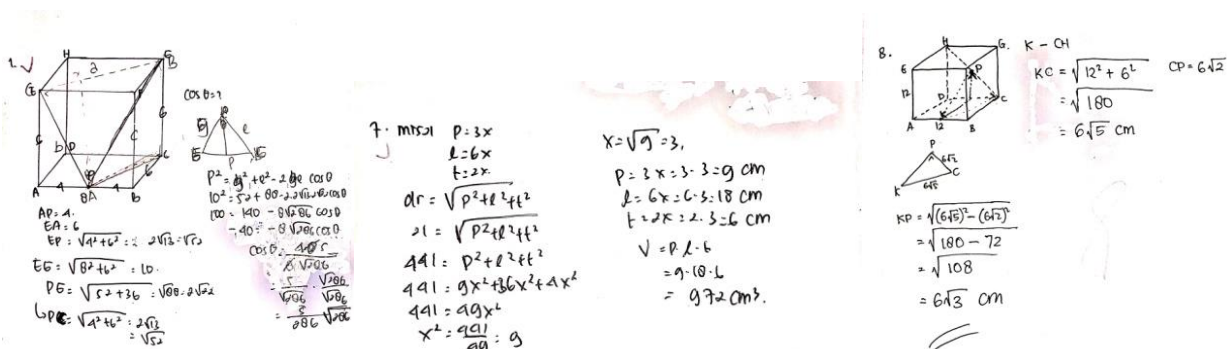


Figure 3. High Subject Capability Analysis.

CONCLUSION

Based on the results of analysis and discussion in the previous chapter, researchers conclusions on the process of mathematical reasoning ability of students with low, moderate, and high capabilities in solving problems based on the following troubleshooting stages.

1. Low subject capability analysis

Analysis of subjects with low proficiency demonstrates the process of mathematical reasoning

in solving problems until the stage of implementing a problem-solving plan. Subjects with low ability can only write down what is known in the problem and describe the space in question.

2. Moderate subject capability analysis

Analysis of the subject with the ability to demonstrate mathematical reasoning processes in solving problems until the stage of implementing a problem-solving plan. The subject can be reasoned when solving the problem with a single plan and is

not a reason for solving the problem using another planned plan of solving in the stage of creating a troubleshooting plan.

3. High Subject Capability analysis

Analysis of subjects with high ability can demonstrate the process of mathematical reasoning at each stage of solving the problem.

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