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Analysis of mathematical thinking types reasoning students in completing the problem-solving question

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Abstract. This study aims to analyze or examine the mathematical thinking student type of reasoning in completing problem-solving question. The subjects in this study were 29 students from one of the schools in Palembang, totalling 29 students will be taken 6 students after the test. The instrument used in this study is a problem solving question totalling 2 items. In this research the mathematical thinking is more focused on the ability of reasoning which is divided into 3 types namely deductive and inductive. The results of the analysis of mathematical thinking type reasoning show that from question number 1 there are three different answers from 6 subjects, from the answers and results of their interviews can be concluded that in working on number one, 3 students use deductive reasoning, 2 students use inductive reasoning and 1 student is wrong in using formulas, and from question number 2 of the six students only three can meet the three indicators of inductive reasoning, most only arrive at the stage of expression of generality.

1. Introduction

Problem solving is usually in the form of a non-routine problem in a task that is required thinking further because the procedure (algorithm) is not clear enough [1]. Solving problems means finding ways or ways to achieve goals or solutions that do not easily become apparent [2]. Mathematical thinking is defined as activity developing a mathematical point of view, assessing mathematical processes and abstractions, and always having a tendency to apply them [3]. Making guesses, reasoning, proof, abstraction, generalization and specialization are important aspects in mathematical thinking [4]. Categorizes mathematical thinking in 7 main themes, namely reasoning, modeling, mathematization, generalization, abstraction, proving, representation, and symbolization. In this article the researcher will discuss more about reasoning [5]. The ability of reasoning is one component of the standard process in Principles and Standards for School Mathematics in addition to the ability to solve problems, representations, communication and connections. Reasoning is an activity, process and thought activity to draw conclusions or make a new statement that is correct based on a statement whose truth has been proven or has been assumed before [6]. Mathematical reasoning (mathematical reasoning) is a thought process carried out to obtain conclusions. Karadag categorizes reasoning into 3 types, namely deductive reasoning, inductive reasoning and logical analysis [5]. The word deduction comes from the Latin word de ducere (de which means 'of', and the word ducere which means 'leads', 'leads') [7]. Thus, the word deduction can be interpreted as sending from something to something else. As a term in reasoning, deduction is a thought process that starts from an existing proposition, leading to a new proposition in the form of a conclusion. Khan state that inductive reasoning is a process of reasoning in which the

premise of an argument can support the correctness of conclusions, even though the argument cannot ascertain the truth of the conclusions [8].

Problem solving is a very important thing in mathematics, in solving problems solving problems, of course, good reasoning skills are needed. When children solve problem solving problems in solving these problems they automatically build their reasoning abilities. According to NCTM reasoning is an integral part of mathematics. Although reasoning has an important role in mathematics education and problem solving, the fact is that most students do not have these skills or abilities [9]. As explained by the author Napitupulu in the investigations conducted at one secondary school, it was shown that in general students performed poorly on mathematical reasoning [10].

This study aims to describe the mathematical thinking type of student reasoning in solving problem solving problems. How students solve problem solving problems, both by using deductive reasoning and inductive reasoning.

2. Research methodology

This type of research is qualitative descriptive research. This research was conducted at one of the schools in Palembang. Subjects in the study were 29 students. Of the 29 students 6 students will be taken after the written test is done. The instrument used in this study is a problem solving amounting to 2 items. The problem solving problem is used to look at the mathematical thinking type of student reasoning. In addition to giving test questions the researchers also conducted interviews to see further the students' reasoning abilities.

The indicators used in this study are planning and making predictions of completion, using general mathematical statements (definitions, traits, theorems, formulas, etc.), using algorithms flexibly, accurately, and efficiently, stages of perception of generality, expression of generality, stage symbolic of generality. The data in this study were obtained from the analysis of student answer sheets and interviews. It should be noted in this study not to see the truth of the students' answers but the way students think in solving the problem solving problem. Do students solve problems using deductive, inductive or logical analysis.

3. Results and discussion
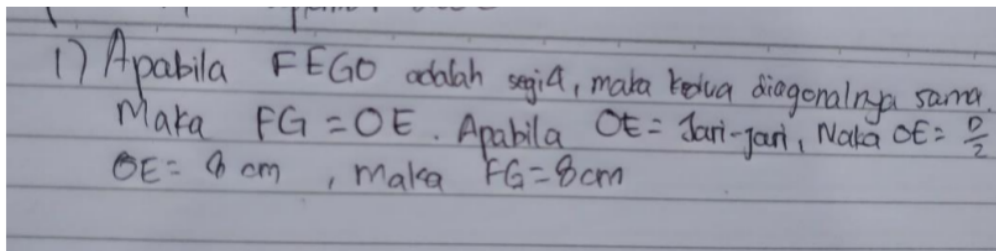
3.1. Subject answer no. 1

Figure 1. Answer of subject S_1, S_4, S_6 about number 1.

The figure 1 is the answer to question number 1, there are three subjects who have answers like the picture above. From the answers above the subject is able to see number one questions with other points of view so that they are not fixated on the existing circle in a square shape, the subject plans to solve the number one problem using the square they see. The subject uses a mathematical statement to solve the number one problem, and the steps used are also correct.
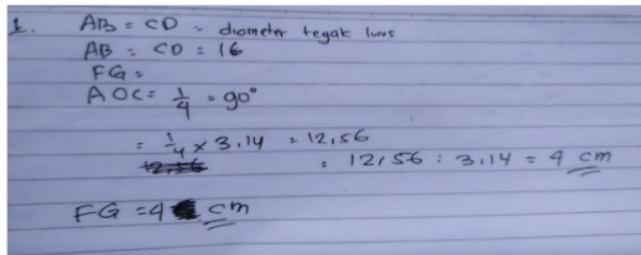
Figure 2. Answer of subject S_2 about number 1.

The figure 2 is the answer to question number 1 completed by the S2, based on the results of interviews with the S2, in solving the number one problem S2 wants to use a quarter circle around, although in the process S2 is still wrong in using the formula and the procedure used is still not correct.
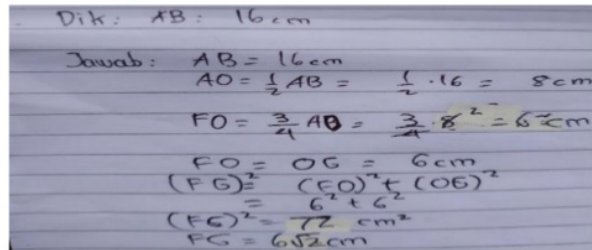

Figure 3. Answer of subject S_3, S_5 about number 1.

The figure 3 is the answer to the number 1 problem that is solved by two subjects who have the same strategy in solving the problem. From the picture above the subject uses the phytagoras theorem to solve the problem. Based on the results of interviews with the two subjects in determining the length of the FO they suppose that if the length is Fo ¾ length AO, here they use inductive reasoning even though there is a general mathematical statement in the procedure.
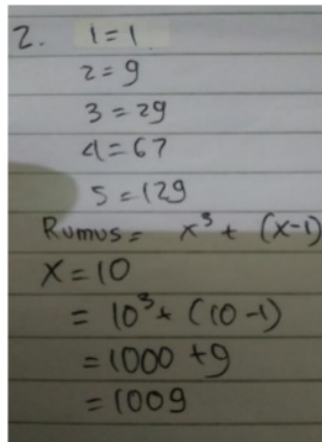
3.2. Question answer no. 2

Figure 4. Answer to the subject S_1, S_3, S_4 question number 2.

The figure 4 is the answer to question number 2 completed by three subjects who have similar answers. In completing the question the subject can see the problem a pattern from the results so the subject has entered the stage of the perception of generality interview with the researcher. Of the 3 subjects only 2 subjects were able to full fill the three indicators, S1 was not able to enter the third stag namely symbolic of generality.

Figure 5. Answer of subject S_2, S_5 questions number 2.

The figure 5 is the answer to question number 2 which is solved by two subjects who have the same strategy. In solving the number two problems the subject has been able to find out if the problem can be solved with a pattern meaning the subject has entered the stage of perception of generality. However, the subject is not able to enter the stage of symbolic of generality or the stage of changing the pattern obtained into a general form or symbol.

Figure 6. Answer subject S_6 question number 2.

The figure 6 is the answer to question number 2 that was completed by S6. In working on question number 2, based on the results of the interview, S6 has learned that the problem can be done in a pattern, and S6 can also change the pattern obtained in the form of symbols or more general forms so S6 has fulfilled the three types of inductive reasoning indicators.

3.3. Discussion

Based on the description above in solving number one questions 50% of students who have been analyzed and conducted interviews using inductive reasoning and incorrect use of formulas. In this case students have not been able to use deductive reasoning properly. Question number one itself is used to test students' deductive reasoning. The above results are similar to the research conducted by Nike in their study explaining if students with normal and superior intelligence abilities use inductive reasoning

to solve problem solving problems, and students with very superior abilities use deductive reasoning to solve problem solving problems [11]. This shows if most students solve a problem using inductive reasoning. Mathematics at school in the end students are expected to be able to think deductively, but in the learning process can use an inductive mindset with the intention to adjust to the stage of intellectual development of students [12]. So basically students are more emphasized to use deductive reasoning. But in this study students were more inclined to inductive reasoning to solve these test questions because of the type of questions faced by students. In mathematics learning which is usually done by teachers in schools in the learning process of mathematics, teachers generally concentrate too much on the practice of solving problems that are more procedural and mechanistic [13]. Because students are familiar with procedural questions that are directly obtained by using formulas, theorems, etc. When students meet with problem solving problems or non-routine questions students must understand the problem well then students can use theorems, formulas, properties, etc.

Problem number two is a patterned problem where in solving number two questions inductive reasoning is needed, in this research inductive reasoning is more directed at generalization ability. Students are said to be able to understand generalizations if they are able to master three aspects following the perception of generality, expression of generality, symbolic of generality. Of all students who have been analyzed and conducted interviews, there are only 3 students who are able to enter the stage of symbolic of generality or at the stage students have been able to produce a general rule and pattern or students have also been able to formulate symbolically general. 3 students are able to solve question number two to the point of knowing if a problem can be solved or solved by using patterns or stages of perception of generality and identifying existing patterns to find the next pattern or stage of expression of generality. The other 2 students only succeeded in the first stage, namely perception of generality, so students were still having difficulty finding a general pattern of an existing pattern or rule or the stage of symbolic of generality, as obtained by Aprilita et al, in the study that most students can only reach the stage of perception of generality and the stage of expression of generality, only a few students can reach the stage of symbolic of generality [14]. As explained in discussion number one, basically students are more likely to solve questions with deductive reasoning, so students have difficulty finding the general form of the symbolic of generality stage in solving patterns.

4. Conclusion
Based on the description above, it can be concluded that students use all types of reasoning to solve test questions, both deductive and inductive reasoning. In number one question number there are only three students who use the remaining deductive reasoning using inductive reasoning and cannot understand the problem. In question number two students use inductive reasoning, but most students only arrive at the stage of perception of generality and the stage of expression of generality. Although there are still students who are capable at the next stage, namely symbolic of generality.

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