Analysis of Students Mathematics Reasoning Ability in View of Mathematical Problem Solving Ability

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Abstract. The purpose of this study is to analyze students' mathematical problem solving abilities based on Gagne's solving steps and analyze students' mathematical reasoning abilities in terms of mathematical problem solving abilities, this study is a qualitative study, data collection used is the provision of tests and interviews, research instruments used is a matter of mathematical reasoning ability tests and mathematical problem solving abilities, the subjects used were 30 students of class X MI PA 1 of SMAN 3 Tasikmalaya for tests of mathematical problem solving abilities and 5 of them for mathematical reasoning ability tests and interviews based on purposive sampling techniques By using the analysis of Miles and Huberman's model data, the results are obtained that (1) Mathematical problem-solving abilities of students who are able to fulfill the steps of understanding the problem are students with who can solve two indices Ator reasoning ability, students who are able to meet the steps to understand the problem and state the problem in an operational form are students who can meet 3 indicators of reasoning ability, students who meet the steps to formulate a hypothesis are students who can complete 4 indicators of reasoning ability, participants students who are able to meet the hypothesis testing steps are students who can complete 5 indicators of reasoning ability, students who are able to fulfill all the steps of problem solving are students who can complete all indicators of reasoning ability. (2) SP-08 is able to complete 5 indicators of reasoning ability, SP-09 is able to complete all indicators of reasoning ability, SP-19 is able to meet 4 indicators of reasoning ability, SP-31 is able to meet 2 indicators and SP-34 meets 3 indicators of mathematical reasoning ability.

1. Introduction
Problem solving is a very important part of the mathematics curriculum, because in the learning and completion process, it is possible for students to gain experience using the knowledge and skills they have to apply to problem solving that is not routine. Mathematical problem-solving ability is related to mathematical reasoning ability, several indicators of mathematical problem-solving ability according to Gagne are presenting problems in a clearer form, and stating problems in operational form. This relates to one of the indicators of mathematical reasoning ability according to Romadhina which is to present mathematical statements in writing, oral, pictures, diagrams.

Based on the results of an interview with one of the teachers in SMA Negeri 3 Tasikmalaya shows that students still have difficulty in solving non-routine questions that require high thinking skills. These difficulties are found when students plan to solve the problem solving problem. In addition, the level of mathematical reasoning ability of students can influence in solving problems of mathematical problem solving abilities.

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Based on research conducted by Devy Eganinta Tariga (2012) different reasoning abilities of students have different characteristics also in solving problems [1]. The difference can be seen when students understand the problem in determining sufficient requirements and necessary conditions and when planning problem solving. In addition, the results of research conducted by Sallahudin, Irwan, and Ilham (2017) There is an influence of mathematical reasoning ability on the ability to solve mathematical problems such as in planning solutions, carrying out resolutions, and re-examining students who have low reasoning abilities experience difficulties in these steps [2].

The problem is an obstacle, difficulty, challenge or a situation that requires a solution or solution. Mathematical problems are divided into two types of problems namely, routine problems and non-routine problems. Routine problems are problems that often arise in learning mathematics, these problems are studied by students so they tend to be easy to solve because the form of the problem and the procedure for solving it are stored in cognitive memory and do not require a long process. Non-routine problems are unusual problems that require more than understanding and solving routine problems. Non-routine problems tend to be difficult to solve because it requires a process that involves creativity and higher thinking.

Ruseffendi (2006) states that "Problems in mathematics are problems which he himself is able to solve without using routine methods or algorithms" [3]. According to Lester and Kroll (Hendriana, Rohaeti, Sumarmo, 2017) Problem is a situation where an individual or group of people faces a task where there is no complete algorithm to find the solution [4]. Hudoyo (Hendriana et.al, 2017) argues that mathematical problems are problems that are not routine, there are no specific rules and or laws that can be immediately used to find solutions or solutions [4].

Gagne (Ruseffendi, 2006) argues that there are five steps that must be taken in solving problems, namely (1) Presenting problems in a clearer form. (2) State the problem in an operational (solvable) form. (3) Develop alternative hypotheses and work procedures that are thought to be good for use in solving the problem. (4) Men test hypotheses and do work to obtain results (data collection, data processing, etc.), the results may be more than one. (5) Re-check (check) whether the results obtained are correct, or perhaps choose the best alternative solution [3].

Keraf (Hendriana et.al, 2017) explains the term reasoning in general as "a thought process that seeks to connect known facts to a conclusion" [4]. In mathematics, mathematical reasoning is a process of mathematical thinking in obtaining conclusions mathematics based on facts or data, concepts, and methods available or relevant [4]. Copi (Shidiq, 2014) states "Reasoning is a special kind of thinking in which inference takes place, in which conclusions are drawn from premises" [5]. Thus it is clear that reasoning is an activity, process or activity of thinking to draw a conclusion or make a new statement based on several statements that are known to be true or that are considered true.

According to Holton, Stacey, & FitzSimons (Sandra Herberta, et al, 2015) "Mathematical reasoning is a broad term encompassing several different types such as induction, deduction, abduction" [6]. The statement means that mathematical reasoning is a broad term that includes several different types like induction, deduction, abduction.

Romadhina (Hendriana et.al, 2017) which refers to the Technical Guidelines of the Director General of the Ministry of National Education's Decree No. 506 / C / Kep / PP / 2004, detailing indicators of mathematical reasoning ability, namely (1) Present mathematical statements in writing (2) conjecture. (3) Perform mathematical manipulation, (4) Draw conclusions, compile evidence, provide reasons or evidence for the correctness of the solution (5) Draw conclusions from statements (6) Check the validity of an argument (7) Find patterns or properties of mathematical symptoms to make generalizations [4].

Based on the facts in schools students have difficulty in completing the problem solving process. Therefore this study was conducted to analyze students' mathematical reasoning abilities and mathematical problem solving abilities in terms of mathematical reasoning abilities.

2. Method

Effective This research is a qualitative research, data collection used is the provision of mathematical reasoning ability tests and mathematical problem solving skills and interviews, the research instrument
used is a matter of mathematical reasoning ability tests and mathematical problem solving abilities, the subjects used are 30 students of class X MIPA 1 of SMAN 3 Tasikmalaya for tests of mathematical problem solving abilities and 5 of them for tests of mathematical reasoning abilities and interviews based on purposive sampling techniques, namely one student from each of the criteria for evaluating mathematical reasoning abilities developed by Thomson.

The test questions given have been tested by two validators so that the evaluation results produced are good. Then an interview was conducted to find out more about the respondents’ questions using the think-aloud method

3. Result and Discussion

3.1 Analysis of Mathematical Reasoning Ability

This mathematical problem-solving ability test is carried out for the selection of research subjects. Students are grouped based on the steps of mathematical problem solving ability according to Gagne by using a mathematical problem solving ability test instrument that has been validated by the validator. This mathematical problem solving ability test consists of one problem description.

The determination of this group is carried out for each student in class X MIPA 1 of SMA Negeri 3 Tasikmalaya, the thing that is considered in group determination is the students’ answers in completing the mathematical reasoning ability test questions. Following are the results of the analysis of the mathematical problem solving ability test data.

Students who fulfill the steps of presenting problems in a clearer form are mostly only able to present mathematical statements in writing or modeling problems into mathematical models when submitting allegations or making calculations of students with these criteria having difficulty meaning that there are errors so the answers are wrong. Students who meet up to the steps stated the problem in an operational form, there are 16 people, this group is the most because of all students in class X MIPA 1 only able to fulfill 2 steps, judging by the answers of most students most students are able to present a statement mathematics in writing or modeling a problem into a mathematical model, and put forward allegations but students have difficulty in doing mathematical manipulation, drawing conclusions.

Students who meet the steps of compiling hypotheses and work procedures, there is only 1 person, judging by the answers of these students are able to present mathematical statements in writing or modeling problems into mathematical models, submit suggestions, but students have difficulty in doing calculations, compile evidence, and draw conclusions. Students who fulfill the steps of the Men hypothesis test and do work to obtain results, there are 2 people, seen from the answers students are able to present mathematical statements in writing or modeling problems into mathematical models, submit guesses, carry out mathematical manipulation, but students have difficulty in terms of compiling evidence.

Students who meet all the steps in solving mathematical problems, there are 2 people, these students are able to solve the problems given properly and correctly. Students are able to present a statement in writing, able to make guesses, draw conclusions, compile evidence, check the validity of arguments, and find patterns found in the problems in the problem. Based on the results of the analysis of mathematical reasoning ability tests, the results of grouping the mathematical reasoning abilities of class X MIPA 1 students in Table 1 are obtained:

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined.

| Table 1. Grouping Mathematical Reasoning Capabilities |
|------------------------------------------------------|
| **Step of Problem Solving**                          |
| 1 | 2 | 3 | 4 | 5 |
| SP-04 | SP-01 | SP-19 | SP-08 | SP-09 |
| SP-06 | SP-02 | SP-20 | SP-14 |
| SP-10 | SP-03 |
The results of grouping in Table 1 subsequently selected one subject from each group based on the steps of mathematical problem solving by considering the results of tests of mathematical problem solving abilities. The research subjects to be analyzed for their mathematical problem solving abilities are in the following Table 2.

| No | Subject Code | Step Of Problem Solving |
|----|--------------|------------------------|
| 1  | SP-08        | √                      |
| 2  | SP-09        | √                      |
| 3  | SP-19        | √                      |
| 4  | SP-31        | √                      |
| 5  | SP-34        | √                      |

Based on Table 2, researchers have determined 5 research subjects. SP-08 is a subject that is expected to represent students who fulfill 4 steps, SP-09 is a subject that is expected to represent students who fulfill all steps, SP-19 is a subject that is expected to represent students who fulfill 3 steps, SP-31 is a subject that is expected to represent students who meet 1 step of problem solving, SP-34 is a subject that is expected to represent students who meet 2 steps of problem solving. Subjects were taken in accordance with the results of tests of mathematical reasoning ability and the subject stated willingness to be the subject of researchers.

3.2 Analysis of Student Test Results for Mathematical Problem Solving Abilities in terms of Mathematical Reasoning Capabilities

Mathematical reasoning ability of students who meet all the steps of mathematical problem solving, SP-09 meets all indicators of mathematical reasoning ability, because SP-09 uses its own thinking ideas to solve mathematical reasoning ability test questions. SP-09 is able to give correct answers, this can be seen from SP-09 which is able to understand the problem by presenting the problem in a clearer form and being able to make guesses, SP-09 is also able to carry out mathematical manipulation, draw conclusions from the questions asked in the problem because SP-09 understands the concepts of elimination and substitution so that SP-09 is able to check the validity of an argument, but initially SP-09 experiences confusion when modeling the story problem, but after re-understanding SP-09 is able to understand the problems that exist in the problem. SP-09 is able to test the hypothesis obtained by him well and correctly because SP-09 is able to understand the completion steps in the material of the Three Variable Linear Equation System (SPLTV) and is able to explain from where the answers were obtained, and SP-09 is able find the mathematical pattern correctly. This is in line with research conducted by
Tarigan, Devy (2012) which states "Students with high reasoning abilities are able to complete the steps correctly and precisely".

Mathematical reasoning ability of students who meet the 4 steps of mathematical problem solving, SP-08 is able to meet five indicators of mathematical reasoning ability. SP-08 is able to understand the problems that exist in the problem, it can be seen that SP-08 is able to present problems in a clearer form, and because SP-08 is able to explain what is in the answers and is able to model a statement into a mathematical model properly. SP-08 is also able to submit suspicions from questions asked on the problem, besides SP-08 is also able to draw conclusions from an answer to this because SP-08 understands the concept of elimination in SPLTV material, SP-08 has difficulty when the indicators check the validity of a argument, because SP-08 forgets how to solve problems with a substitution method or a method that is different from the previous one.

Mathematical reasoning abilities of students who meet 3 steps of mathematical problem solving, SP-19 is only able to meet 4 of the 7 indicators of mathematical reasoning ability. SP-19 is able to understand the problem contained in the problem, this can be seen when SP-19 is able to present the problem in a clearer form because SP-19 is able to model a statement into a mathematical model, SP-19 is able to state the problem in an operational form or can be solved because SP-19 is able to decipher an equation in a form that can be solved. The SP-19 was able to make a guess, but the SP-19 lacked accuracy in calculations so that when the SP-19 drew the conclusions it found there were differences. Even in the calculation phase, the SP-19 experiences an error in the process of elimination so that the answers obtained are wrong, the SP-19 also has difficulty in checking the validity of an argument. This happens because the SP-19 has not fully understood the concept of elimination and substitution in the SPLTV material, but the SP-19 is able to find mathematical patterns.

Students' mathematical reasoning ability is only able to fulfill 2 steps of problem solving, SP-34 is only able to present a statement in writing by writing down what is known and is also able to submit allegations. SP-34 experienced difficulties when the questions were given by researchers, SP-34 was confused about how to model it in the form of mathematical models, but SP-34 was able to do calculations or could complete the process of elimination or substitution. SP-34 has not been able to understand what is asked about the problem solving ability of mathematics. This happens because SP-34 has not been able to understand the problems that exist in the problem, and also has not fully understood the concepts that exist in the SPLTV material.

Mathematical reasoning ability of students who only meet 1 step of problem solving, SP-31 is only able to present statements in writing by writing down what is known in the problem. SP-31 does not really understand what is asked about the problem, SP-31 is also unable to carry out the process of elimination or substitution correctly because SP-31 does not understand the concept of elimination or substitution calculation on the material of the Three Variable Linear Equation System (SPLTV), SP-31 have difficulty when understanding the questions given by researchers because the subject is not able to model a statement in the form of a mathematical model. SP-31 is only able to model the 2 statements in the problem. This is in line with research conducted by Tarigan, Devy (2012) which states "Students with low reasoning abilities are not able to complete the steps correctly and precisely"

4. Conclusion

Mathematical problem-solving abilities of students who are able to meet the steps to understand the problem are students with who can complete two indicators of reasoning ability, students who are able to fulfill the steps of understanding the problem and state the problem in an operational form are students who can meet 3 indicators of reasoning ability, students who meet the steps to formulate hypotheses are students who can complete 4 indicators of reasoning ability, students who are able to fulfill the hypothesis testing step are students who can complete 5 indicators of reasoning ability, students who are able to fulfill all steps of problem solving are students which can solve all indicators of reasoning ability.

SP-08 is able to complete 5 indicators of reasoning ability, SP-09 is able to complete all indicators of reasoning ability, SP-19 is able to fulfill 4 indicators of reasoning ability, SP-31 is able to meet 1 indicator and SP-34 meets 2 indicators of mathematical reasoning ability.
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