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Junior High School Students' Mathematical Reasoning Ability Analysis in Systems of Linear Equations and Applications

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Abstract. This study aims to determine students' mathematical reasoning abilities in systems of linear equations and applications. This research was conducted in the odd semester of the 2018/2019 academic year. The population in this study were all students of class VIII in one of the Junior High Schools in Bandung with a total sample of 32 students. The research instrument used was in the form of a test of mathematical reasoning. The research method used is qualitative research design. Data were analyzed using data reduction, data presentation, and conclusion. Based on the results of the study it can be concluded that the mathematical reasoning ability of junior high school students in SPLDV material is still low.

1. Introduction

The content of meaning in the 2013 Curriculum is clearly requires that the competency of graduates in the field of mathematics studies is to bring about an increase and balance of soft skills and hard skills which include aspects of attitudes, knowledge and skills in the field of mathematics. As one of the disciplines taught at every level of school education, mathematics is expected to contribute in order to develop the ability to think logically, because mathematics is a means of scientific thinking that plays an important role in efforts to develop science and technology for human welfare. Mathematics learning must elaborate aspects of creativity and innovation, critical thinking and problem solving, communication and collaboration [1]. Aspects of creativity and innovation are intended for students to use various techniques to create useful new ideas, detail, improve, analyze, and evaluate their ideas to develop and maximize creative efforts and demonstrate the authenticity of findings, both individually and or in groups. Aspects of critical thinking and problem solving are intended for students to reason effectively. They think systemically, understand that between parts are interact with each other. In line with several opinions about reasoning, Fisher [2] and Happy [3] suggests that reasoning is the core of mathematics, good reasoning ability will describe its mathematical abilities.

However, the facts revealed in several research results indicate that students' mathematical reasoning abilities are still low. Low ability students' mathematical reasoning, expressed in the research results that the weakness of some junior high school students is in finding a pattern or general shape and in making generalization, although students have been able to find order pattern for the three steps. The two results above show the weakness of mathematical reasoning which is thought to have an impact on its inability to solve problems [4,5].



Students' difficulties in mathematical reasoning is one of the many problems that occur in the teaching-learning process. Students' ability to understand and analyze mathematical concepts, use deductive methods, and draw conclusions in an argument is still low [6]. The low ability students' mathematical reasoning ability, visible when the teacher gives some non-routine matter on materials Systems of Linear Equations Two Variables (SPLDV). Based on the above, the formulation of the problem of this research is how Junior High School students' mathematical reasoning ability in system of linear equations and applications.

2. Method

This research is a qualitative research. This study aims to describe students' mathematical reasoning in the Systems of Linear Equations and Applications (SPLDV). This research was conducted in the odd semester at one of the Junior High Schools in Bandung. The population in this study were all eighth-grade students of Junior High School in Bandung in the 2018/2019 school year. The subjects of this study were 32 students. The research instrument used was in the form of an instrument about mathematical reasoning abilities and assessment rubrics. The data used is obtained through test activities, namely by conducting a test consisting of four questions of mathematical reasoning ability, with detailed indicators used in this study as follows:

a. Presenting a mathematical statement in writing

1) Students can write the meaning of SPLDV using their own language.

2) Given a graph about SPLDV, students can present mathematical statements properly.

b. Provide reasons or evidence for the correctness of the solution

SPLDV is given with complete substitution. Students are asked to provide explanations and reasons for the correctness of the solution

c. Estimating the answer and solution process

Given an example of SPLDV, students can guess the solution from the SPLDV and explain the solution process.

The data analysis technique used in this study is the analysis of qualitative data including: (1) data reduction is the process of selecting key things, simplification, and focusing on important things. In this case the researcher records the results of the interview and collects test data and documentation from the informants related to students' mathematical reasoning in solving problems, (2) presenting data in the form of information in the form of narrative texts compiled, summarized, and arranged so that they are easily understood and plan further research work. Researchers compile relevant data that into information that can be inferred and has a particular meaning, (3) conclusion is the stage of data analysis presented in tabular form. To find out the percentage of errors for each indicator of mathematical reasoning, the following formula is used:

$$P = \frac{\text{Total } \sum s}{\text{Total } \sum s + \text{Total } \sum b}$$

Description:

P = Presentation of errors experienced by students

$\sum s$ = Amount of wrong questions (experiencing errors in problem solving and mathematical reasoning) of the total questions

$\sum b$ = number of correct questions (not having errors in solving mathematical reasoning problems) of the total questions.

To find out the high and low percentage of students' mathematical reasoning ability, researchers used the reference as seen on table 1.

Table 1. Percentage of students' abilities [7]

Percentage (%)	Criteria
$0 \leq P < 20$	Very low
$20 \leq P < 40$	Low
$40 \leq P < 60$	Medium
$60 \leq P < 80$	High
$80 \leq P < 100$	Very High

Desc: P is the percentage of student errors in the matter of mathematical reasoning.

3. Result and Discussion

This research was conducted in class VIII of one of the Junior High Schools in Bandung, with a total sample of 32 students by giving 4 test questions of students' mathematical reasoning abilities. Interviews were conducted to teachers and students. From the workmanship questions that have been completed student data obtained mathematical reasoning abilities of students in solving ability SPLDV terms of indicators mentioned on table 1. For more details, begin with an analysis of student answers.

Table 2. Errors in each indicator and number of errors in each indicator of mathematical reasoning ability.

Indicator	Total Item $\sum B$	$\sum S$	% Errors
Presents a mathematical statement in writing. Students can write the meaning of SPLDV using their own language.			
Given a graph about SPLDV, students can present mathematical statements properly.	31	1	31,25
Provide reasons or evidence for the correctness of the solution. SPLDV is given with complete substitution. Students are asked to provide explanations and reasons for the correctness of the solution.	16	16	50,00
Estimating the answer and solution process. Given an example of SPLDV, students can guess the solution from the SPLDV and explain the solution process	21	11	34,37

Table 2 shows the percentage of errors for each aspect of the indicator Mathematical reasoning ability: (1) Presenting a mathematical statement in writing by writing the meaning of SPLDV using its own language that is equal to 31, 25% classified as low criteria; (2) Presenting a mathematical statement in writing by presenting a mathematical statement from a given graph which is equal to 50.00%, then classified as a medium criterion; (3) provide the reasons or evidence of the truth that is equal to 34.37 then classified in the low criteria; (4) estimating the answer and process of the solution that is equal to 9.37% then classified as very low criteria.

In the indicators of mathematical reasoning abilities almost all students can present written mathematical statements by writing SPLDV interpretation using their own language. Even if the answer is not entirely true as expected, but the authenticity of the answer of what students write correctly and not deviate from the correct answer so that it can be understood by the teacher. The second indicator is to present a statement from the graph, students begin to face problems in filling out answers. Based on the results of several student answers, most students rewrite the two equations that emerge then they complete the two equations so that the intersection points are obtained according to the image. Some students cannot identify or do not even understand the purpose of the graph given, so half of the errors are not filling in the answers. Indicators about giving any reason or evidence to the truth of the answers classified as a percentage of errors is high,

if the views of the process and the results of the students' answers, they cannot make an argument, fear of being wrong in writing down the answers, lack of insight and understanding of the concept against any steps to resolve the problems SPLDV. The percentage of errors that fall into the very high category is the last indicator, namely in estimating the answers and the solution process. Most students do not fill in the answers because they are not interested in working on a matter that takes no arguments or reasons for the answer, the student is weak in a matter of simple little application changed and modified. In line with the facts revealed in several research results indicate that students' mathematical reasoning ability is still low In connection with the low ability of mathematical reasoning abilities, also expressed by Fisher and Yaniawati [8]. The study reported that the average score of mathematical reasoning abilities obtained by students only reached 37.75 and the highest score was 55.50, while the ideal score was 100. The average percentage score of students only reached 41.52% of the ideal maximum score. In general, the results of the study concluded that the students' mathematical reasoning ability was still low.

The mathematical problem-solving abilities of Class VIII students in one of the Junior High Schools in Bandung, as seen from the indicators of mathematical reasoning ability are as follows:

- a. Indicator of students' ability in presenting mathematical statements in writing, errors in this indicator are classified as low criteria i.e. 31 by 25%, this error includes errors in writing words and sentences.
- b. Indicator of the ability of students to provide reasons or evidence of the correctness of solutions, errors in this indicator are classified as high criteria that is equal to 65.63%. Errors occur when students transform the information they know in a problem into the correct mathematical sentence. This is because students do not understand the meaning or purpose of the sentence in the question.
- c. Indicator of students' ability to estimate answers and process solutions, errors in this indicator are classified as very high criteria that is equal to 90.63%, this error includes students' mistakes in understanding basic concepts, low ability of students to capture information by putting it into a simple argument. This error is also accompanied by students' mistakes in reading mathematical models or in other words the students' low ability to identify, organize data in the form of formulas / formulas into a written statement.

4. Conclusion

Analysis of mathematical reasoning ability errors experienced by class VIII students at one of the Junior High Schools in Bandung was seen from the results of students' work in solving SPLDV problems caused by mistakes in writing words and sentences. Errors occur when students transform the information they know in a question into the correct mathematical sentence. This is because students do not understand the meaning or purpose of the sentence in the question. This error includes students' mistakes in understanding basic concepts, the students' low ability to capture information by putting it into a simple argument, accompanied by the students' low ability to identify, organize data in the form of formulas / formulas into a written statement.

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