Analyzing students' mathematical problem-solving ability on linear inequality system in two-variable

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Abstract

This research aims to analyze the mathematical problem-solving ability of students on the topic linear inequality system of two variables in class X MIPA 2 SMA Negeri 2 Bantul for 34 students. This research is categorized into three categories are low (0 < N ≤ 65), middle (65 < N ≤ 80) dan high (80 < N ≤ 100). The instrument used in this study is a description test with three questions and is supported by interviews with one student in each category. Based on the results of the analysis, the criteria and percentage of mathematical problem-solving abilities of SMA Negeri Bantul students were obtained: (1) 6 students are in the high category with a percentage of 17,65%; (2) 13 students are in the middle category with a percentage of 38,24%; (3) 15 students are in the low category with a percentage of 44,12%. In summary, the average mathematical problem-solving ability of students in class X MIPA 2 SMA Negeri 2 Bantul is in the low category of 63.32%.

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INTRODUCTION

Education is an investment in the future where the glory and progress of a nation are very dependent on the implementation of current education. Through education, it is hoped that it can improve the quality of a nation to develop in a better direction and prepare students to face problems with different situations and conditions, especially in the era of globalization and after the Covid-19 pandemic. Education plays a very important role in building people to have skills and knowledge, such as (1) having the ability in the world of technology; (2) being able to communicate effectively; (3) able to think critically; (4) can solve a problem; and (5) able to collaborate (Wahyono & Pujiriyanto, 2010)

Mathematics is one of the knowledge that has an impact on the development and progress of other knowledge. Mathematics learning is taught from elementary school to the university level. The objectives of learning mathematics listed in the 2013 Curriculum (Kemendikbud., 2014) such as: "(1) Understanding mathematical concepts; (2) Using patterns as conjectures in solving problems and being able to make generalizations based on existing phenomena or data; (3) Using reasoning on properties and performing mathematical manipulations; (4) Communicating ideas, reasoning and being able to compile mathematical proofs; (5) Have an attitude of appreciating the usefulness of mathematics in life; (6) Having attitudes and behaviors that are in accordance with the values in mathematics and learning; (7) Perform motor activities that use mathematical knowledge; (8) Using simple teaching aids and technology results to carry out mathematical activities. Based on the above, problem-solving ability is one of the focuses in learning mathematics that must be possessed by every student. This is because, in mathematics lessons, it is not only the results that are important but the process of reaching the solution. According to Sukartono (2018), Solving a problem is a basic

activity in human life because it involves a thought process in order to be able to solve the problems encountered in everyday life.

In fact, many students have difficulty in learning mathematics, especially in problem-solving so that which has an impact on their learning achievement. This also happened in SMA Negeri 2 Bantul, especially in class X MIPA 2. Based on the results of an interview with one of the mathematics teachers at SMA Negeri 2 Bantul, which was held on December 20, 2021, it was revealed that students still had difficulty in solving math problems and constructing their own knowledge. In addition, students also tend to only be given multiple choice questions, so students' ability to solve mathematical problems consisting of understanding problems, planning problem solving, carrying out problem-solving plans, and reviewing the completeness of problem-solving is still low. This is because, in mathematics lessons, it is not only the results that are important but the process of reaching the solution. According to (Sukartono, 2018), solving a problem is a basic activity in human life because it involves the thought process in order to be able to solve problems encountered in everyday life.

The strategies used in solving problems, in addition to showing how quickly and efficiently problems are solved, are also about what can be learned during the problem-solving process (Martin, I., & Kadarisma, G, 2020)

Based on the problems described above, researchers are interested in conducting research with the title Analysis of Mathematical Problem Solving Ability in Class X MIPA 2 SMA Negeri 2 Bantul as a reference in understanding and directing students in order to develop students' mathematical problem-solving abilities.

RESEARCH METHOD

This type of research is in the form of descriptive qualitative research. The subjects in this research were 34 students of class X MIPA 2 at SMA Negeri 2 Bantul. The material taken is the system of inequalities of two variables which is one of the Compulsory Mathematics materials for class X odd semesters. The instrument used in this research is to use the description test and interviews.

The test given in this study aims to obtain qualitative data regarding students' mathematical problem-solving abilities. The instrument used is in the form of a description of the material system of inequalities of two variables, totaling 3 questions. In addition to using the description test, the researcher conducted interviews with several students to get more valid results. The indicators of students' mathematical problem-solving abilities are presented in Table 1.

Table 1. Indicators of mathematical problem-solving ability

No	Indicator of Mathematical Problem Solving Ability
1.	Understanding the problem
2.	Planning problem solving
3.	Carry out problem-solving planning
4.	look back at troubleshooting.

(Polya, 1973)

The scoring used in the problem-solving ability test is as presented in Table 2.

Table 2. Criteria of mathematical reasoning assessment

Indicator	Score	Scoring Description
Understanding the problem	0	No writing down what is known and asked
	1	Incomplete in writing what is known and asked
	2	Writing down what is known and asked, but there is a mistake.
	3	Complete and correct in writing what is known and asked
Planning troubleshooting	0	No problem-solving plan
	1	Salah menyusun suatu perencanaan
	2	The planning is correct but incomplete.
	3	Complete and correct planning
Carry out problem-solving planning	0	There is no problem solving
	1	There is a solution, but the solution is not clear.
	2	Using the correct settlement strategy but the completion steps and results are wrong.
	3	Using the correct solution steps and the correct result
Revisit the completeness of the troubleshooting	0	Does not make any information
	1	Conduct process checks and write wrong conclusions
	2	Conduct inspections to see the correctness of the process and results but not complete writing conclusions
	3	Conduct process checks and write correct and complete conclusions

Modified from (Mawaddah & Anisah, 2015)

Table 3. Criteria for mathematical problem-solving ability test results (N)

Criteria	Score
High	$80 < N \le 100$
Medium	$65 < N \le 80$
Low	$0 < N \le 65$

(Ratnawulan, E., & Rusdiana, A, 2014)

RESULTS AND DISCUSSION

Based on the results of a written test from 34 students in class X MIPA 2 SMA Negeri 2 Bantul on the material of a two-variable inequality system using a problem-solving ability test instrument consisting of 3 questions. The results obtained from this study are an analysis of students' answers based on the instrument of mathematical problem-solving ability. Based on the scoring guidelines in Table 2, data are obtained as in Table 4.

Table 4. Category and Percentage of Problem Solving Ability Test Results

Criteria	Number of Students	Percentage (%)
High	6	17,65%
Medium	13	38,24%
Low	15	44,12%

Based on Table 4 shows that based on the mathematical problem-solving ability test of students in class X MIPA 2, as many as 6 students are in the high category if the percentage is 17.65%. The mathematical problem-solving ability of students who are in the medium category is 13 students if the percentage is 38.24%. While the mathematical problem-solving ability of

students who are in the low category, as many as 15 students, if the percentage is 44.24%. The researcher then carried out an analysis of the results of students' answers based on the mathematical problem-solving ability test by referring to the problem-solving ability indicators according to (Polya, 1973), namely understanding the problem, planning problem solving, implementing the problem-solving plans, implementing the problem-solving plans, and reviewing the completeness of problem-solving. The average test results of the mathematics problem-solving ability indicators of class X MIPA 2 students can be seen in Table 5.

Table 5. Percentage of Each Indicator of Problem Solving Ability Test

Indicator of Problem Solving Ability	Percentage	Criteria
Understanding the problem	68,30%	Medium
Planning problem solving	66,67%	Medium
Carry out problem-solving planning	64,71%	Low
Revisit the completeness of the troubleshooting	43,79%	Low

Based on Table 5, the percentage of each indicator of the mathematics problem-solving ability test of students in class X MIPA 2 shows that the percentage of students who understand the problem is 68.30% and is in the medium category. The percentage of students who are able to plan problem-solving is 66.67% and is in the medium category. The percentage of students carrying out problem-solving planning is 64.71% and is in the medium category. In contrast, the percentage of students with indicators of being able to review the completeness of problem-solving is in a low category, namely 43.79%.

Based on the analysis of student answers on the indicator of understanding the problem, 68.30% of students were able to write down what was known, asked, and wrote down information from the problems given. In the indicator of planning problem solving, 66.67% of students are able to write down the steps that must be taken in solving the problems given. Students are able to make plans to get solutions to the problems given. In the indicator of carrying out problem-solving plans, 65.03% of students are able to carry out problem-solving plans that have been made, but students have problems completing calculations from the plans made so that the final results become less precise. While the indicator of looking back at the completeness of problem-solving is 44.12% of students checking the completeness of solving the problems made and making a conclusion from the problems given. Most students do not write conclusions from the problems given. Based on the average percentage of students' mathematical problem-solving abilities in class X MIPA 2, they are in a low category, which is 63.40. The results of the analysis of student answers show the ability of students to solve the problem of the inequality system of two variables, which can be seen in the following explanation.

High category
The results of the student's mathematical problem-solving ability test on the material of the two-variable inequalities system showed that there were 6 students who had high mathematical problem-solving abilities. If it is presented, the percentage is 17.65%. One of the results of student completion in the high category can be seen in Figure 1.
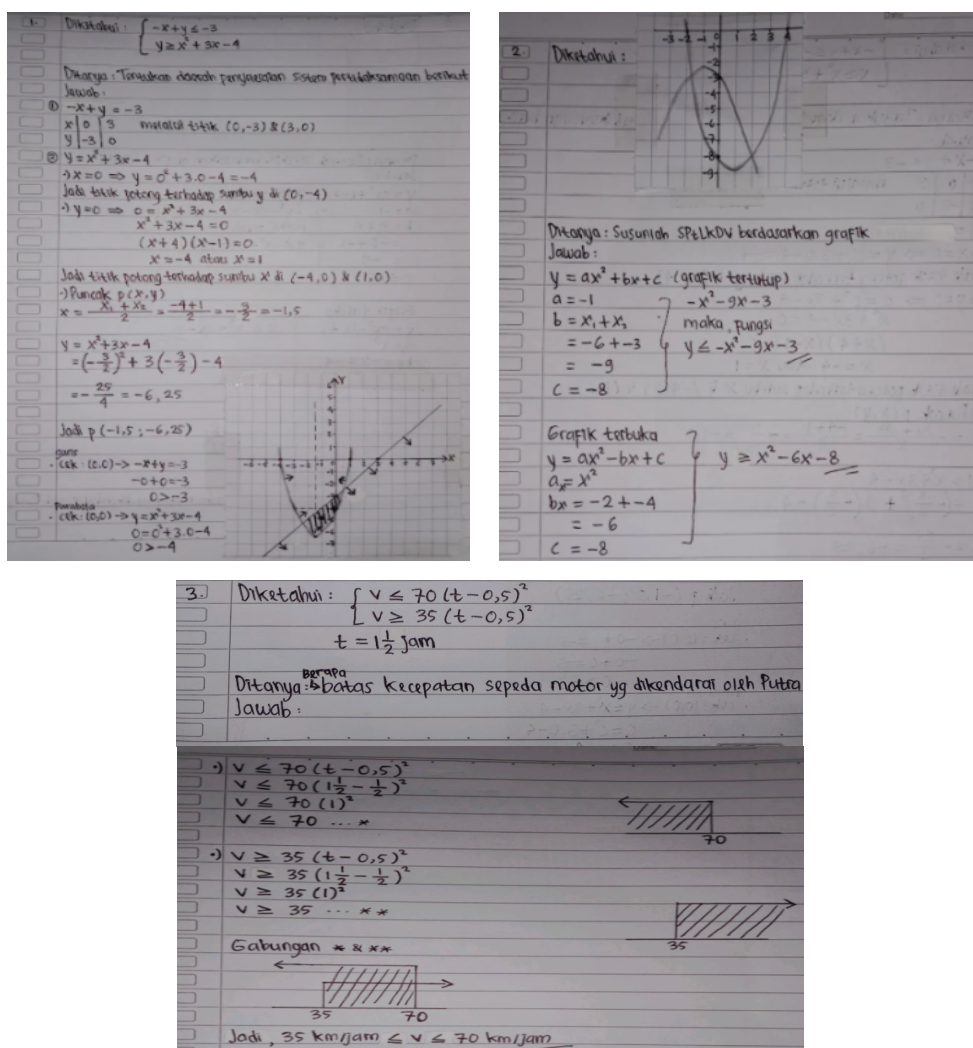
Figure 1. The first figure (a), the second one (b), and the third (c) Example of Completion of High Category S6 students

Figure 1 is the completion of S6 students who are in the high category. S6 students are able to understand the problem well, namely being able to write down what is known and asked in the questions given. In addition, S6 students can make a problem-solving plan correctly. In carrying out the problem-solving plan made by S6 students, there were no problems for questions number 1 and 3, while for number 2, S6 students had errors in solving the problems given. S6 students are wrong in determining the coefficient of b in the given inequality.

In the indicator, looking back at the completeness of problem-solving, S6 students are able to correctly write the final conclusions made based on the problem-solving process made. Overall, S6 students have mathematical problem-solving abilities that are in the high category based on the analysis of answers that have been made.

Medium category

Based on the results of the problem-solving ability test for the two-variable inequalities system in class X MIPA 2, which has a medium category of as many as 13 students, the percentage who has a medium category has a percentage of 38.24%. The following is one of the answers of S25 students who are in the medium category, which can be seen in Figure 2.
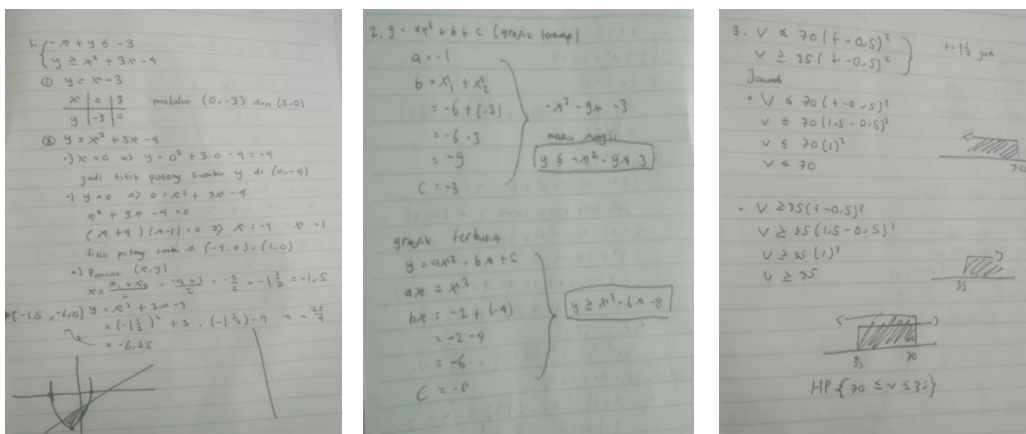
Figure 2. The first figure (a), the second one (b), and the third (c) Examples of
Completion of S25 Students in the Medium Category

Students who have a problem-solving ability category in the medium category are able to understand the problem well, can make a problem-solving plan that is incomplete, can carry out the problem-solving process, but there are errors in the counting process and can review the completeness of problem-solving but do not make a conclusion based on analysis of the problem-solving ability tests that have been carried out. Students who have mathematical problem-solving skills in the medium category have a score of 65 < N 80.

Figure 2 is an example of the completion of S25 students based on the problem-solving ability test given. S25 students are incomplete in writing what they know and are asked based on the questions given. In making a problem-solving plan, S25 students are able to make a problem-solving plan correctly. In the criteria for implementing a problem-solving plan for S25 students, there is an error in the counting process for question no. 2, so the final result of the system of inequalities of two variables obtained is an error. For indicators, reviewing the completeness of problem-solving for S25 students as a whole is incomplete in writing the conclusions from the problems given. Based on the average problem-solving ability test, S25 students are in the medium category, with a percentage of 72.22%.

Low category

The test results of students' mathematical problem-solving abilities on the material of a linear inequality system of two variables showed that there were 15 students who had low mathematical problem-solving abilities. When presented, the percentage is 44.12%. The results of the completion of one of the S2 students in the low category can be seen in Figure 3.

Students who have a low category are less able to understand the problem and less precise in planning the problem-solving process. There was an error in carrying out the problem-solving plan, and I did not look back at the completeness of the problem-solving and did not make a conclusion from the problem-solving that was solved. Students who have problem-solving skills in the low category have a value of N 65.

Based on the analysis of the results of the answers from S2 students shows that S2 students have not been able to understand the problem well. This can be seen from the results of the answers written. S2 students do not write down the information that is known and asked in the questions. In the indicator of making plans for solving problems, master's degree students can make plans for solving problems, but they are not quite right. This can be seen in questions number 1 and 2. In the indicator of completing the problem-solving plan, master's students still experience problems in solving them both from calculations or applying the concept of the plan

made. Meanwhile, the indicators of looking back at the completeness of problem-solving S2 students do not re-check the completion steps that have been made and do not write down the conclusions of the problems given so that the results of the mathematical problem-solving ability test of S2 students are in a low category.
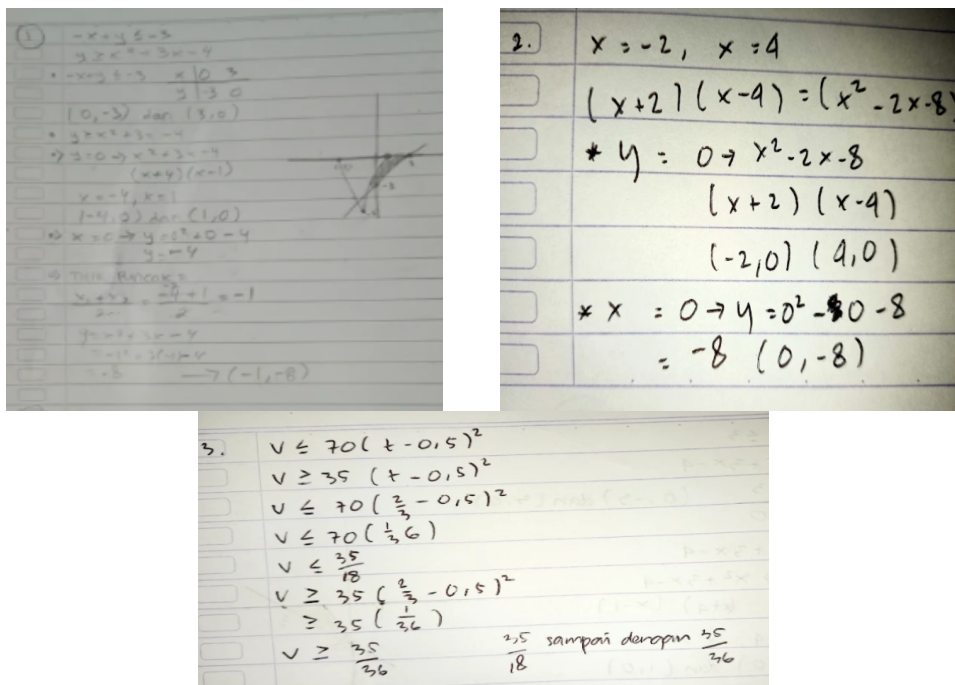

Figure 3. The first figure (a), the second one (b), and the third (c) Examples of Completion of Low Category S2 Students

Based on the description above shows that the percentage of students who got the high category was 17.65%, the medium category was 38.24%, and the low category was 44.12%. This shows that there are still many students who have low mathematical problem-solving abilities. Several factors that cause the low ability of students' mathematical problem solving, namely students do not understand well the problems given. Students do not write in a coherent way what is known, asked, and the steps to solve it. Problem-solving ability is an ability that a person has in an effort to be able to solve problems because they do not have the right solution to be applied directly (Suryani et al., 2020). In addition, students need to improve their numeracy skills and practice questions related to mathematical problem-solving. Problem-solving ability is a learning approach that optimally involves active students that allow students to explore, observe, experiment, and investigate (Bernard et al., 2018)

CONCLUSION

The ability to solve math problems of class X MIPA 2 SMA Negeri 2 Bantul is in the low category with a percentage of 63.32%. The percentage of each indicator, according to Polya, is understanding the problem 68.30%, planning problem solving 66.67%, implementing the problem-solving planning 64.71%, and looking back at problem-solving 43.79%.

Categories and percentages of mathematical problem-solving abilities in class X MIPA 2 SMA Negeri 2 Bantul consist of a low category of 15 students with a percentage of 44.12%, a medium category of 13 students with a percentage of 38.24%, and a high category of 6 students with a percentage 17.65%.

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