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Analysis of Students' Problem-Solving Ability on Two-Variable Linear Inequalities Based on Polya's Steps

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Abstract

This study aims to describe the ability of students at SMA Negeri 1 Ngabang in solving linear inequality problems of two variables through Polya's steps: understanding the problem, planning a plan, carrying out the plan, and checking the results. This is a descriptive qualitative research involving 36 students from class XA as the population. Three students were selected to represent high, medium, and low ability categories based on problem-solving test results. Data were collected through tests and in-depth interviews. The results show that overall, students' problem-solving abilities are at an adequate level, though they still face various difficulties. Students with medium ability tend to ignore the checking stage, as seen in question number three where they did not complete the graphical part of the solution. As a result, small mistakes went unnoticed, affecting the final answers. Students with low ability faced deeper difficulties, ranging from understanding the problem, formulating a solution plan, identifying important information in the question, to converting the problem into a mathematical model. Furthermore, these students were not accustomed to verifying answers before submission. This condition highlights the need for intensive guidance and training from teachers, particularly for low-ability students, especially in understanding the problem and applying Polya's problem-solving strategy.

Keywords: Problem-Solving Ability, Linear Inequality of Two Variables, Polya's Steps

INTRODUCTION

Mathematics is a fundamental foundation for studying other sciences and a key pillar of technological progress and modern knowledge. Essentially, mathematics functions as a tool to form thinking patterns in both everyday routines and in facing advancements in science and technology. Therefore, this subject is taught starting from kindergarten (Miftahul Jannah and Miftahul Hayati, 2024). Mathematics is a structured discipline that studies relationships, thinking methods, language, and the art of analyzing everything through deductive logic. This helps humans solve various problems in the fields of social, economics, and others. Furthermore, mathematics focuses on abstract concepts expressed in numbers and symbols to communicate ideas based on facts and logical truths in a specific context (Eko Siswanto, 2024). Problem-solving is considered important because students are not just memorizing concepts but also understanding the process, including the steps to reach a solution. This ability is vital as it directly relates to daily life, where students face various challenges (Shafira Hidayah et al., 2023).

The ability to solve problems is crucial for training students' thinking (Shafira

Hidayah et al., 2023). In mathematics learning, problem-solving ability is one of the main standards, emphasizing not only conceptual mastery but also the development of thinking skills (Maria Delian Frilian Berek, Nyamik Rahayu Sesanti, 2025). Problem-solving ability is the process of facing and solving problems using various strategies (Maria Naimnule1, Yohanes Jefrianus Kehi2, 2022). Problem-solving ability is an intellectual activity that focuses on strategies and skills in finding solutions to the problems encountered (Hardiningsih et al., 2023). However, students in Indonesia still face serious challenges in achieving global standards. According to the PISA results (OECD, 2023), Indonesian students' problem-solving ability in mathematics is still relatively low, with the majority at basic levels (level 2 and 3), and only a few reach high levels. This indicates that many students have difficulties when dealing with mathematical problems that require higher-level thinking abilities (Maria Naimnule1, Yohanes Jefrianus Kehi2, 2022). One weakness in problem-solving is when students analyze the problem, and they tend not to check their results (Sagita et al., 2023).

One area of mathematics that is important to learn is the linear inequality of two variables. This topic is taught in the first semester of class X (Nurhayati and Ratnaningsih, 2023). Based on observations and interviews with mathematics teachers at SMA Negeri 1 Ngabang, the linear inequality of two variables was chosen because this material demands high problem-solving skills, from understanding the concepts, interpreting the solution area, to executing the correct steps. If students' understanding of the basic material is weak, they will struggle with more advanced materials like linear programming and mathematical model analysis.

The common problem is that many students struggle to understand the problem, especially in extracting information from the question. Additionally, students tend not to check their work before submitting it. Small mistakes can have serious consequences on the final results. These difficulties arise from a lack of review, insufficient focus during learning, and less engaging learning methods, which contribute to weak problem-solving abilities (Sagita et al., 2023). Therefore, students need to be equipped with effective problem-solving strategies, such as using Polya's problem-solving steps to help them systematically analyze problems and find appropriate solutions (Irma Alvesya and Nicky Kurnia Tumalun, 2025). According to Polya (2004), there are four problem-solving steps: (1) understanding the problem, (2) planning the plan, (3) executing the plan, and (4) checking the results. The researcher chose Polya's steps because they offer a systematic solution approach and provide detailed insights into the difficulties students face, allowing for the identification of the weakest aspects of their problem-solving abilities. Therefore, the study is titled "Analysis of Students' Problem-Solving Skills in the Linear Inequality of Two Variables Based on Polya's Steps at SMA Negeri 1 Ngabang.".

METHODS

This study used descriptive qualitative research, where the researcher presented the results in the form of a description of students' difficulties in solving problems related to the linear inequality of two variables. Descriptive qualitative research is an approach used to systematically describe the process of

data identification and analysis sourced from literature (Saefullah, 2024). Qualitative research focuses on descriptions to answer research questions, focusing on processes and meanings that allow for the development of new theories and comprehensive data collection (Waruwu, 2024).

The research was conducted at SMA Negeri 1 Ngabang, located on Jl. Veteran Ngabang, Kelurahan Hilir Kantor, Kecamatan Ngabang, Kabupaten Landak, Kalimantan Barat, in January 2026. This research used written tests and interviews as instruments. The data collection technique involved written tests given to 36 students from class XA and interviews with 3 students selected based on their written test results, representing high, medium, and low ability categories as research subjects. The written test consisted of 3 questions, and the interview questions were validated by one mathematics education lecturer and one mathematics teacher.

The data collection technique involved reviewing the test results provided to students. These results were analyzed based on the mistakes students made when solving problems, referring to Polya's steps. There are four stages in Polya's steps: understanding the problem, planning the plan, executing the plan, and checking the answers before submission. The data analysis technique used in this study was Miles and Huberman's interpretive data analysis, which consists of three stages: data reduction, data presentation, and conclusion drawing (Qomaruddin and Sa'diyah, 2024).

The data analysis technique was to evaluate the students' problem-solving test answers using the formula (Taqiyudin et al., 2024):

Table 1. Problem-Solving Ability Categories

Scale Rating	Student Ability Level
80 - 100	High
60 - 79	Medium
0 - 59	Low

RESULTS AND DISCUSSION

Based on the research conducted at SMA Negeri 1 Ngabang, focusing on the topic of linear inequality of two variables and analyzed using the indicators of Polya's problem-solving steps, the procedure includes understanding the problem, planning the plan, executing the plan, and checking the results (Polya, n.d.). This research involved 36 students from class X at SMA Negeri 1 Ngabang. Based on the results of the problem-solving test given, three students were selected as subjects, each representing high, medium, and low ability categories. The category determination referred to Polya's steps

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Table 2. Problem-Solving Test Results of Students

Category	Score (in percent)	Research Subject
High Ability	100%	NDNT
Medium Ability	88.89%	KHZ
Low Ability	0%	VL

The researcher selected subjects considering their problem-solving ability as assessed by the written test results. Based on the problem-solving test results and interviews conducted with the three subjects, a description of the students' performance in each problem-solving ability category was obtained and analyzed according to Polya's steps.

a. High Ability Student Category

Table 3. Problem-Solving Ability Analysis for High Ability Subjects

Steps	Question No. 1	Question No. 2	Question No. 3
Understanding the Problem	Correctly understands the information given in the question and clearly knows what is being asked	Correctly understands the information given in the question and clearly knows what is being asked	Correctly understands the information given in the question and clearly knows what is being asked
Planning the Plan	Able to create a suitable mathematical model to solve the problem	Able to create a suitable mathematical model to solve the problem	Able to create a suitable mathematical model to solve the problem
Executing the Plan	Able to determine the solution area accurately and graph the solution area precisely	Able to determine the solution area accurately and graph the solution area precisely	Able to determine the solution area accurately and graph the solution area precisely
Checking the Results	Able to verify and check the answers before submitting	Able to verify and check the answers before submitting	Able to verify and check the answers before submitting

Table 4 shows that students with high ability mastered all stages of problem-solving according to Polya's steps. These students were able to understand the problem correctly, plan, execute the plan with accurate calculations, and carefully check the results. This is consistent with findings from Murtiyasa and Wulandari (2022) who stated that students can reach the correct answer if they have a good understanding of the problem. Fariha (2021) stated that in the planning stage, students are able to design and organize strategies

systematically and rationally. Ahmad et al. (2024) stated that high-ability students are able to connect the obtained information with the question asked and develop strategies based on the information available. Afifi and Febrianti (2022) added that at the final stage, high-ability students verify their answers by reviewing the solution steps and recalculating the answers to prevent mistakes. This shows that high-ability students understand the material of linear inequality of two variables well and can apply problem-solving strategies systematically.

b. Medium Ability Student Category

Table 5. Problem-Solving Ability Analysis for Medium Ability Subjects

Steps	Question No. 1	Question No. 2	Question No. 3
Understanding the Problem	Correctly understands the information given in the question and clearly knows what is being asked	Correctly understands the information given in the question and clearly knows what is being asked	Less attentive in understanding the information given in the question and clearly knows what is being asked
Planning the Plan	Able to create a suitable mathematical model to solve the problem	Able to create a suitable mathematical model to solve the problem	Able to create a suitable mathematical model to solve the problem
Executing the Plan	Able to determine the solution area accurately and graph the solution area precisely	Able to determine the solution area accurately and graph the solution area precisely	Able to determine the solution area accurately
Checking the Results	Able to verify and check the answers before submitting	Able to verify and check the answers before submitting	Cannot verify and check the answers before submitting

Students with medium ability showed adequate understanding in solving the linear inequality of two variables problems using Polya's steps. They successfully understood the problem and planned the correct solution (Rindiani et al., 2025). The students were able to identify key information in the problem, indicating a good understanding of the problem. However, in question number 3, they failed to include the elements that were known and asked in the question. Furthermore, the students were not thorough when reviewing their work, leading to errors such as failing to graph the solution area, which went unnoticed. This situation shows that while the students have mastered the material, they still need guidance in checking their answers before submission (Rahmatiya and Miatun, 2020). This finding is consistent with the view of Novita Ningrum and Venty Meilasari (2024), who noted that medium-ability students often complete the steps up to the execution stage but frequently neglect the checking step.

Interviews indicated that these students did not verify their answers before submitting them. This highlights that even though they have mastered the material, they still need guidance in revising their answers before submission.

c. Low Ability Student Category

Table 6. Problem-Solving Ability Analysis for Low Ability Subjects

Steps	Question No. 1	Question No. 2	Question No. 3
Understanding the Problem	Cannot understand the information given in the question and clearly knows what is being asked	Cannot understand the information given in the question and clearly knows what is being asked	Cannot understand the information given in the question and clearly knows what is being asked
Planning the Plan	Cannot create a suitable mathematical model to solve the problem	Cannot create a suitable mathematical model to solve the problem	Cannot create a suitable mathematical model to solve the problem
Executing the Plan	Cannot determine the solution area accurately or graph the solution area precisely	Cannot determine the solution area accurately or graph the solution area precisely	Cannot determine the solution area accurately or graph the solution area precisely
Checking the Results	Cannot verify and check the answers before submitting	Cannot verify and check the answers before submitting	Cannot verify and check the answers before submitting

Students with low ability face significant challenges in solving problems. They struggle to understand the problem, comprehend the information in the problem, and find the correct solution steps. Additionally, they have difficulty creating an appropriate mathematical model and making conceptual and calculation errors in solving the problem. Similar challenges arise when they cannot understand the problem's instructions, leading them to be unable to identify and write the information given in the question (Fariha, 2021). These students also cannot explain the relationship between the given information and the question accurately (Irianti, 2020). When executing the plan, these students fail to realize that the steps they take are incorrect (Arjuna Yahdil Fauza Rambe, 2020). At the final stage, they do not check their answers before submission. According to Meika et al. (2022), this is influenced by the students' lack of concentration when solving the problems, as many students have not yet reached this stage due to weak mastery of basic material. Their understanding of the material is still minimal, so they cannot solve it correctly and fail to follow the proper problem-solving procedure (Putri Agustina, 2022). This situation emphasizes the need for intensive practice and further guidance, particularly in analyzing problems and applying the correct strategy.

CONCLUSION

The results of the study titled Analysis of Students' Problem-Solving Ability on Linear Inequality of Two Variables Based on Polya's Steps at SMA Negeri 1 Ngabang showed that students' problem-solving abilities were considered adequate, although some students still faced difficulties. This was particularly evident among students with medium ability, who tended not to check their answers before submission. This was clearly seen in question number three, where students did not complete the part of graphing the solution area. As a result, small mistakes went unnoticed, which impacted the final answers.

Students with low problem-solving abilities faced much greater difficulties in solving the problems. These students struggled with understanding the problem, determining the correct steps for solving it, and converting the problem into an appropriate mathematical model. Moreover, these students failed to check their answers before submitting them. This situation indicates that students with low ability require additional guidance from teachers, particularly intensive practice in understanding the problems and applying Polya's problem-solving strategies.

Based on the findings from this study, several recommendations can be considered for future research. First, it is suggested to develop problem-solving test questions using a broader approach to allow students to explore various approaches or problem-solving steps. Second, serious consideration should be given to managing learning time, as the learning process requires special attention to completing tasks and sufficient time. Therefore, with proper time management, the research can proceed smoothly and generate accurate data in line with the desired objectives.

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