# Students' Mathematical Problem Solving Ability in Linear System with Two Variable

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**Abstract:** Considering that mathematics has an important role in learning and in everyday life, the process of learning mathematics that hones the problem solving skills of people who play a role in solving the problem, usually mathematics based on this problem uses questions that contain elements of contextual problems that intersect with students' daily lives. . The aim is to describe students' mathematical problem solving abilities on the material of a two-variable system of linear equations. Class VIII students are the subjects of this research. The indicators according to Polya are (1) Understanding the Problem, (2) Developing a Plan, (3) Implementing a Solution Plan, (4) and Reviewing the Overall Answer. The result of this research is to have an average in the medium category. In the process of completing all Polya indicators, students were able to meet all indicators, but students who had moderate mathematical problem solving abilities were only able to fulfill the indicators of planning and reviewing overall answers, while students with low mathematical problem solving abilities could not fulfill all existing indicators.

**Keywords:** mathematical problem solving ability, system of two variable linear equations.

*Abstrak: Mengingat matematika mempunyai peranan penting dalam pelajaran maupun kehidupan sehari-hari, proses belajar matematika yang mengasah kemampuan pemecahan masalah orang yang ikut berperan dalam penuntasan masalahnya, biasanya matematika yang berlandas masalah itu menggunakan soal berunsur permasalahan-permasalahan kontekstual yang bersinggungan dengan kehidupan sehari-hari siswa. Tujuannya untuk menggambarkan kemampuan pemecahan masalah matematis siswa pada materi sistem persamaan linear dua variabel. Siswa kelas VIII menjadi subjek pada penelitian kali ini. Indikator menurut Polya yaitu (1) Memahami Masalah, (2) Menyusun Rencana, (3) Melaksanakan Rencana Penyelesaian, (4) dan Melihat Kembali Jawaban Keseluruhan. Hasil dari penelitian ini adalah mempunyai rata-rata dalam ketegori sedang. Dalam proses penyelesaian semua indikator Polya siswa mampu memenuhi semua indikator, namu pada siswa yang memiliki kemampuan pemecahan masalah matematis sedang hanya mampu menenuhi indikator menyusun rencana dan melihat kembali jawaban keseluruhan, sedangkan siswa yang berkemmapuan pemecahan masalah matematis rendah tidak bisa memenuhi semua indikator yang ada.*

*Kata kunci: kemampuan pemecahan masalah matematis, sistem persamaan linear dua variabel.*

▪ **INTRODUCTION**

The role of education is very important for the development of a country. Good quality education is education that can shape character and attitudes that are oriented towards a global mindset (Du and He 2022; Nugraha 2018). Lately, there have been various kinds of technological development products that can be used in the world of education to provide opportunities for educators and practitioners to try to improve the quality of education through improving the learning process and finding methods that are in accordance with scientific and technological developments.

Mathematics is a subject that is studied by all students in primary and secondary schools. Considering that mathematics has an important role in lessons and everyday life, the process of learning mathematics that hones the problem solving skills of people who play a role in solving the problem (Siagian, Saragih, and Sinaga 2019; Stephan and Akyüz 2013), usually mathematics based on the problem uses questions that contain contextual problems that intersect with students' daily lives (Lester 1994; Raudho, Handayani, and Syutaridho 2020). Polya explained that problem solving is an attempt to find a way out of a goal that is not so easy to achieve immediately (Hendriana, Eti Rohaeti, and Sumarmo 2021; Polya 2021). In a similar sense, Krulik and Rudnik argued that problem solving is a process in which a person uses skills, knowledge, and understanding that has been obtained and then completed in conditions that are not yet familiar to him (Hendriana, Rohaeti, & Sumarmo, 2021: 44). Then Utari emphasized that solving problems can be in the form of creating, finding techniques or ideas (Roebyanto & Harmini, 2017:14).

By using word problems in learning mathematics it is expected that students are able to complete learning that is considered difficult, students are able to do it if these students have good problem solving skills. Because the ability to solve problems is one of the goals in achieving learning, this in the process of solving or solving it requires conditions that are not fixed, changing and always competing. By solving problems students will learn to develop strategies that are appropriate to existing problems (Rofi'ah, Ansori, & Mawaddah, 2019). However, in reality there are still some students who are less skilled in the problem solving process, especially in word problems, this is because students work on the same questions so that students are not used to different questions and result in mistakes in solving math problems, and the questions given are different. with what has been taught (Hendriana, Johanto, and Sumarmo 2018; Widodo et al. 2021). Students when solving questions in the form of stories, students' answers are only random, because for them mathematics is material for calculations without having to arrange the steps correctly (Hermawati, Jumroh, and Sari 2021; Valle et al. 2007).

The low ability to solve mathematical problems can be seen when the teacher gives practice questions in the form of story questions on the System of Two Variable Linear Equations (SPLDV) (Rachmawati, Sugandi, and Prayitno 2019), some students only memorize formulas without understanding the process of obtaining the formulas. In addition, when given word problems with distracting data, many students were fooled and thought that all the data provided in the questions had to be used to find a solution (Astriani, Surya, and Syahputra 2017; Indahsari and Fitrianna 2019).

Everyone needs problem solvers to solve a problem in real life (Hermawati et al. 2021; Rosita and Abadi 2019). In this study using (Polya 2021), namely there are 4 steps of polya in solving mathematical problems, namely: Understanding the problem (identifying the elements that are known, asked, and the completeness of the required elements), Developing a Plan (Formulating a mathematical problem or compiling a mathematical method), Implementing the Plan Completion (Choosing and implementing strategies to solve a mathematical or non-mathematical problem), Looking Back at the Overall Answer (explaining the results according to the problem and re-checking the correctness of the results or answers).

This study aims to mention the ability of mathematical solving in the material system of two-variable linear equations.

▪ **METHOD**

The research method used is descriptive qualitative research. Class VIII B students of SMP Negeri 3 Losari–Brebes became the population in this study. The sample selection used purposive sampling, namely three students who fulfilled each category of mathematical problem solving abilities, namely high, medium, and low. This research uses a case study design, because the research focuses on one event that has been selected and wants to be known in depth, ignoring other events (Rahardjo 2017). The test became the instrument used in this study with 3 description questions that referred to 4 indicators of mathematical problem solving ability, namely understanding the problem, making plans, carrying out the solution plan, and looking back at the overall answer. Then the test results were used to determine problem solving abilities. The data collection techniques used were SPLDV questions and interviews.

The research procedure that the researcher carried out consisted of 3 stages, namely the preparation stage, the implementation stage, and the analysis stage. In the preparatory stage, researchers compile and create or adapt problem-solving ability test questions (Yanida, 2020; Agustin, 2016). In the implementation phase, the researcher gave critical thinking skills test questions and conducted interviews with subjects who had been selected based on the level of mathematical problem-solving abilities. In the analysis phase, the researcher examines the results of students' answers that have the same answer results, presents test data, classifies data and groups based on problem-solving abilities and draws conclusions from the research results.

▪ **RESULT AND DISSCUSSION**

After obtaining data on mathematical problem solving abilities, the KPMM data is grouped into high, medium and low categories which have been processed into scores by researchers adopted from Saryantono (2013). The results of the calculation of the KPPM data grouping obtained the data mean, variance, standard deviation are 27.13; 28.38; and 5.33, respectively.



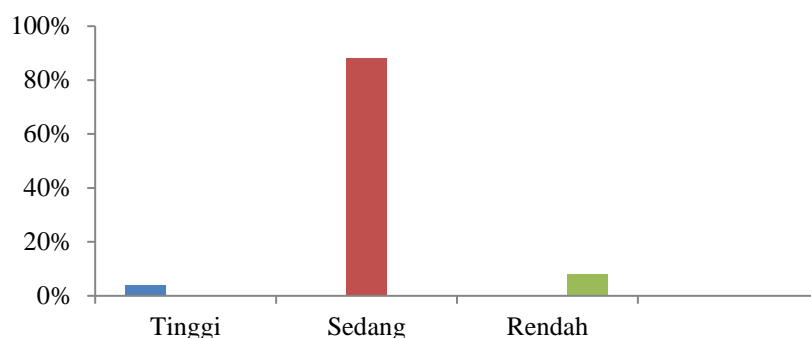**Figure 1.** Mathematical Problem Solving Ability Data

**Figure 2.** Problem solving abilities in which high, medium and low are indicated by blue, red and green.

Based on the results of data on problem-solving abilities obtained from problem-solving ability test questions and interviews with junior high school students in one of the Brebes districts. The results are included in the medium category, students are still not able to do the first and third indicators, because students are still not confused in applying existing methods. This is in accordance with research that has been carried out by (Siahaan, Dewi, and Said 2019) which states that subject one in solving problems according to plan and re-checking the results obtained is better with other subjects. Below is an explanation of the results obtained by using a two-variable system of linear equations problem:

1.1. In a market parking location, there are 90 vehicles consisting of cars and motorbikes. If you count the total wheels there are 248 pieces. The cost of parking a car is IDR 5,000, while the cost of parking a motorbike is IDR 2,000. What is the amount of parking money income from existing vehicles?



**Figure 3.** EAP answer

The EAP subject stated what was known and asked in the questions completely and correctly, that is, there were 90 vehicles consisting of cars and motorcycles, there were 248 wheels in total and the cost of parking a car was Rp. from existing vehicles? In compiling a plan the subject makes an example, namely the car becomes variable A and the motorbike becomes variable B and there are 2 correct equations. EAP subjects

use mixed methods, correct answer steps and are able to make correct and appropriate conclusions.

P : Do you understand what number 1 means?

EAP : I understand. It is known that there were 90 vehicles consisting of cars and motorcycles, if there are 248 wheels in total, and the cost of parking a car is 5,000 while a motorbike is 2,000. then suppose the car is A, the motorbike is B. And the equations are A+B=90 and 2A+4B=248, then what is being asked is 5,000A+2,000B….?. In conclusion, the amount of parking fee income from existing vehicles is IDR 282,000 from (34×5,000) + (56×2,000) ↔ 170,000+112,000=282,000

Based on the results of the EAP interview on question number 1, it is known that the EAP subject answered clearly every question that was given. EAP also explains what is known and asked in the questions completely and correctly. Then run in detail the method and the steps are correct. The EAP subject has also conducted an examination and made the correct conclusion.



**Figure 4.** LS answer

The LS subject mentioned what was known in the problem completely and correctly, that is, there were 90 vehicles consisting of cars and motorbikes, if there were 248 wheels in total, the car was Rp. 5,000 and the parking fee for a motorcycle was Rp. parking money from existing flags. The LS subject completes the incomplete examples and mathematical models, and mentions the method to be used in solving them, namely the elimination method. However, during the operation, the LS subject was incomplete, because the LS did not mention the results of the first elimination so that the value for the first elimination did not exist, namely -68/-2b = 34. The LS subject was able to conclude answers from solving problems even though there were errors in arithmetic operations.

P : you are number 1 do you understand what that means??

LS : I understand, but I think there is a mistake in your calculation

During the interview, the LS subject can explain calmly, clearly, and firmly about what is known and what is asked in the questions. LS also explains in detail the examples and methods used. Then when doing the calculations it was not quite right

because there was one step that was not completed and the calculation was wrong so the results were also wrong but the subject was able to straighten out the wrong answers on the answer sheet. LS also corrects the answers that have been done and is able to draw conclusions.



**Figure 5.** HAT answer

Based on the results of the HAT test, the subject was able to say what was known and what was asked in question number 1 correctly but incompletely. The HAT subject in making plans, did not write down examples and mathematical models so that the information written was incomplete. HAT uses the elimination method correctly but the answers are not correct. Then the subject makes a complete conclusion, it's just not quite right.

P     : Are you number 1 doing it yourself or not?

HAS : nope

Based on the results of the interview with HAT, the subject was unable to work on the problem. It can be seen from the answers of the subjects who could not do the question.



**Figure 6.** EAP answer

The EAP subject, in the step of understanding the problem, said that it was known what was in the question correctly and correctly, namely, the price of 1 bunch of spinach was 2x the price of 1 bunch of kale, Mrs. Devi bought 20 bunches of spinach and 50 bunches of kale at a price of Rp. 225,000, then what was asked was how much should be Dartem pays if he buys 25 bunches of spinach and 60 bunches of kale? Then EAP states the example correctly but when creating the mathematical model it is not complete. The method used by the subject is a mixed method, the operation process is correct, it's just that the subject makes the wrong mathematical model, so the completion process is wrong and the final conclusion is wrong.

P : what is known and asked from problem number 3?

EAP : the price of 1 bunch of spinach is twice the price of 1 bunch of kale, Mrs. Devi bought 20 bunches of spinach and 50 bunches of kale at a price of Rp. 225,000, Mrs. Dartem bought 25 bunches of spinach and 60 bunches of kale. How much do you have to pay Ms. Dartem?

P : Try to explain the steps to the solution!

EAP : (explains what the subject wrote on the answer sheet but with the similarities between the two using 25x+60y)

P : why use that one (25x+60y)?

EAP : Yes sis, because I don't know the other thing in common. So just use that one

The results of the interview regarding question number 2 with the EAP subject were that initially the subject confidently stated what was known and asked in the problem correctly and completely. But in the next step the subject is a bit confused in solving it. Even though it was wrong, the subject made an effort to complete question number 2 to the end.



**Figure 7.** LS answer

The LS subject did not write down the known information in the problem, but the information asked in the written problem was 20x+60y. The subject writes the examples correctly and makes the mathematical model complete and correct. Then on the answer

sheet, LS uses the complete and inaccurate substitution method, because of the excess 0 which should be the value of x = 2,500. Furthermore, the subject makes conclusions from solving the problem correctly.

P    : Can you do number 3 or not?
LS   : No, this can cheat

Based on the results of the interview for number 2 on the LS subject, it resulted that the subject did not understand the problem.



**Figure 8.** HAT answer

Based on figure 6, the HAT subject does not write down what is known or what is asked. The subject made an analogy and a mathematical model, but there was no information that it was an analogy and a mathematical model. In the step of carrying out the settlement plan, being able to complete it completely is just an excess of numbers and being able to make a correct conclusion.

P    : what number do you do yourself?
HAT : (Hesitating and confused in answering the question) number 3

The subject worked on number 3 without hesitation in answering the questions given. When asked the question "how do you try?", the subject answered hesitantly without really understanding the problem. HAT is able to draw conclusions, but the statement is wrong, that is, what should be Mrs. Dartem is actually Mrs. Devi. The subject did not look back at the overall answer.

1. High Student Mathematical Problem Solving Ability

First, the EAP subject is able to understand the problem well. It can be seen from the EAP subject being able to mention and write down elements of information that are known in the questions correctly and correctly. Then when mentioning and writing down what elements are asked of the questions this subject also does the right thing. This shows that the EAP subject has fulfilled the one problem solving indicator according to Polya. Second, this subject has been able to carry out the planning properly. EAP is also able to make examples and mathematical models of the problems in the questions completely and correctly. Thus that the EAP subject was able to show and fulfill the two problem solving indicators according to Polya. Third, EAP has been able to determine the method used correctly. EAP is also able to fully explain the method steps used in the process of carrying out the settlement plan so as to produce the

right answer. This can be said that the EAP subject has been able to fulfill the three problem solving indicators according to Polya. Fourth, the EAP subject has done this step well. Then have re-examined the overall answers that have been done and are able to make a conclusion that is obtained correctly. With this it can be said that the EAP subject has fulfilled the four problem solving indicators according to Polya.

2. Moderate Student Mathematical Problem Solving Ability

First, LS subjects are less able to understand the problem well. At this stage, LS is less able to mention and make elements that are known and asked in full in the questions. Thus the LS subject is less able to fulfill one problem solving indicator according to Polya. Second, the LS subject has been able to carry out the planning properly. LS is also able to make examples and mathematical models of the problems in the questions completely and correctly. Thus that the LS subject was able to show and fulfill the two problem solving indicators according to Polya. Third, LS has been able to determine the method used correctly. However, they are unable to fully explain the method steps used in the process of carrying out the settlement plan, resulting in inaccurate answers. This can be said that the LS subject is less able to fulfill the three problem solving indicators according to Polya. Fourth, Subject LS has done this step quite well. Have re-examined the overall answers that have been done and are able to make a conclusion that is obtained inaccurately. With this it can be said that the LS subject sufficiently fulfills the four problem solving indicators according to Polya.

3. Low Student Mathematical Problem Solving Ability

First, the HAT subject was unable to understand the problems contained in the questions properly. At this stage, HAT is less able to mention and make elements that are known and asked completely and correctly. This shows that HAT is not able to meet the problem solving indicator according to Polya. Second, did not do well in planning because of the inability of the subject to make and explain the examples and mathematical models he made. So that both of them did not meet the two problem solving indicators according to Polya. Third, the HAT subject was unable to carry out the settlement plan properly. This is due to not being able to carry out the steps of the method used so that the results are not right. In this way, it can be said that the HAT subject does not meet the three problem-solving indicators according to Polya. In the step of looking back at the overall answer, the HAT subject did not do it. The HAT is unable to carry out the previous steps so it does not re-examine the overall answers and does not draw conclusions correctly. This shows that the HAT subject is unable to fulfill the four problem solving indicators according to Polya.

▪ **CONCLUSION**

Based on the results obtained, it can be concluded that students are able to fulfill all indicators of problem solving ability according to Polya, namely understanding the problem, making plans, completing the settlement plan, and looking back at the overall answer. However, in the first and third indicators, students are still confused about analyzing and completing the steps to be taken, and are not sure of their solving abilities. It can be seen from the interview answers above.

For this reason, further research is suggested by researchers to continue this material but with different treatment, other abilities, or using class action.

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