

Mathematical problem-solving ability of information technology faculty students through a realistic approach

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Abstract: Computer Systems study program students have a low understanding of the material. The mid-term and final exam scores show the level of students' understanding is still low. In addition, the results of previous research also show that students have difficulty completing mathematical calculations. The purpose of this study is to describe students' problem-solving abilities. The research method used is the descriptive method. The instrument used for data collection was a problem-solving ability question developed with a realistic approach. Three validators have validated this problem-solving question, and small-scale testing has stated that the results are valid and reliable. The study results show that 35.71% of students got a good category, 28.57% got the sufficient category, 7.15% got a less category, and 28.57% got the very less category. Aspects of problem-solving abilities that still need to be improved are planning problem-solving, solving problems according to plan, and re-checking the procedures and results of the solution. From the results of this study, applying the problem-solving learning model with a realistic approach to improve students' problem-solving abilities can be done for further research.

Keywords: Mathematical Problem-Solving Ability; Realistic Approach; Polya's Problem-Solving; Descriptive Method

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INTRODUCTION

One of the tools to measure success in understanding the material is to look at students' conceptual understanding. Based on previous research on students' conceptual understanding and problem-solving abilities in fundamental physics courses, the student's conceptual understanding abilities in fundamental physics courses were still low in the extrapolation indicator. It was because students had difficulty concluding a problem and in their mathematical calculations (Puspitasari, 2022; Puspitasari & Febrinita, 2020). Apart from that, the low understanding of concepts can also be influenced by the basic knowledge that students have and the learning model used (Siahaan et al., 2021). Other research related to the 21st century 4C abilities of students in the Faculty of Information Technology, Unisba Blitar, especially the computer systems study program, showed low results in critical thinking skills. Based on this research, students experienced obstacles in solving problems, and their ability to complete mathematical calculations was still low (Puspitasari et al., 2023). Apart from this research, issues related to solving mathematical problems also arise in mathematics courses.

There are two study programs in the Faculty of Information Technology (FTI) Unisba Blitar, including computer systems and informatics engineering. The research will focus on students of the computer systems study program according to the results of previous research. In addition, based on the average UTS and UAS scores of basic mathematics for computer systems students are 49.4 and 44.9. The low average UTS and UAS scores indicate that students' understanding of basic mathematics courses is still weak. Based on the problem identification carried out at the beginning of the research, the cause of the low UTS and UAS scores is that students still have difficulty understanding and solving the problems given.

Problem-solving ability is the ability of students to use the thinking process that includes data collection, information analysis, developing problem-solving strategies, and determining appropriate strategies to solve problems (Branca in Ahdhianto et al., 2020). Another definition states that mathematical problem-solving ability is the skill to solve problems using mathematical science. This mathematical problem-solving ability is important because the purpose and overview of learning mathematics is to solve problems (Lesi & Nuraeni, 2021). Several indicators to measure students' problem-solving abilities are determined based on Polya's mathematical problem-solving abilities.

Polya's problem-solving ability indicators include understanding the problem, planning a strategy, implementing the plan, and evaluating the results (Ita & Abadi, 2019). Understanding the problem is the ability of students to write down something that is known and asked, sufficient information, the requirements for solving, and state the problem in mathematical form. In the second indicator, namely planning a strategy, students are asked to recall matters that have been experienced before or look for a solution pattern so that they can compile steps to solve the problem. In the third indicator, students can carry out the problem-solving design. In addition, students also write down the steps to solve the problem in detail. The last indicator is that students can evaluate the correctness of the solution steps and draw conclusions (La'ia & Harefa, 2021). The research instrument used was a problem-solving ability question developed with a realistic approach. That is because a realistic approach will make it easier for students to understand the problems presented (Mangelep & Kaunang, 2018).

The realistic approach is an approach that uses problems that exist in real situations or everyday environments. The everyday environment is a situation in students' daily lives and often experienced in their activities. The realistic approach invites students to build knowledge and understanding of a science or problem (Syahri, 2017). The realistic approach invites students to develop thinking skills to solve problems or understand a material (Fannisa et al., 2022; Haryonik & Bhakti, 2018). Questions made with a mathematical approach will make it easier for students to understand the problems presented (Domu et al., 2022). In addition, the realistic approach makes it easier to compile questions. The reason is that many questions can be raised from various situations on the theme of everyday life (Hadi & Radiyatul, 2014).

Several previous studies form the basis of the theory in this study. The first study found that students' mathematical problem-solving abilities were still low in statistics courses, especially in understanding problems (Sriwahyuni & Maryati, 2022). The second study stated that improving problem-solving skills by applying a learning model with constructivist learning theory (Dewi et al., 2020). The third study is that learning tools developed with a realistic approach can improve mathematical problem-solving abilities (Domu & Mangelep, 2019). The fourth study stated that students' mathematical skills increased by applying a realistic approach (Khotimah & As'ad, 2020). The fifth study states that learning devices developed with a realistic approach will help strengthen mathematical concepts (Haryonik & Bhakti, 2018). The sixth study focuses on developing questions with a realistic approach. The results of this study show

that questions with a realistic approach are easy for students to understand (Mangelep & Kaunang, 2018). The results of previous studies provide information about the benefits of a realistic approach and aspects of problem-solving abilities that are still low. Lectures can use a realistic approach to develop learning tools that influence improving mathematical skills. In addition, lectures can implement constructivist learning to improve problem-solving skills. The difference between previous research and this study was the realistic approach. That approach develops questions about problem-solving ability. In addition, the research subjects are students who are prepared according to the KKNI to have abilities equivalent to level 6, while junior high school students are at level 1 and high school students at level 2.

The research problem that has been found based on field observations and theoretical studies is that the mid-term and final exam scores of students in fundamental mathematics courses are still low, and their mathematical problem-solving abilities are still low. Therefore, the researcher researched to describe students' problem-solving abilities. The novelty of this study is the result of the analysis of students' mathematical problem-solving abilities. The results of this study are a reference for increased fundamental mathematics learning. One of the follow-ups is to develop learning tools with a realistic approach to improve students' problem-solving abilities. In addition, questions about problem-solving skills with a realistic approach are a reference in compiling questions for evaluation or to measure students' thinking abilities.

METHODS

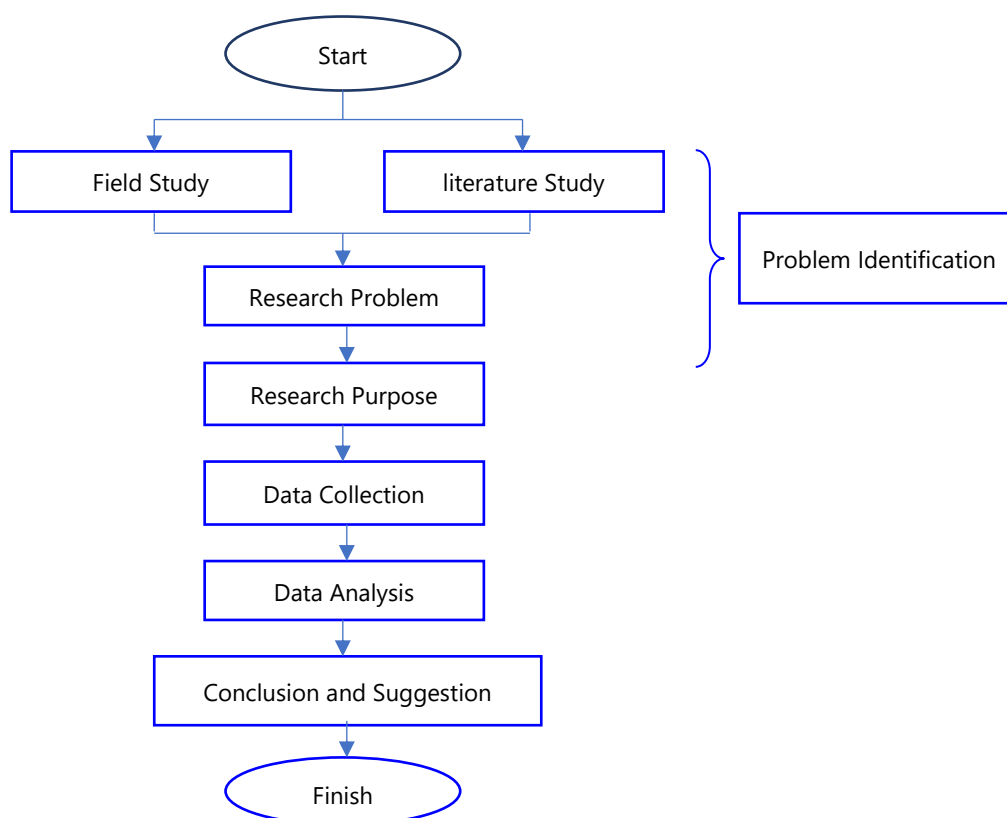


Figure 1. Research Stages

The research problem is that students still have difficulty solving problems about mathematics, and it impacts understanding concepts for fundamental physics. Therefore, a study is needed to solve this problem. This study used a descriptive method with a quantitative approach. The stages of the research are problem identification, data collection, data analysis,

and conclusion. Data collection techniques used in this study include observations of students' mid-term and final exam scores, interviews with lecturers in charge of fundamental mathematics, fundamental physics, and numerical methods, literature reviews for theories needed in the research, and tests to measure students' problem-solving abilities. There were 14 students in the Computer Systems study program as subjects of study. Figure 1 shows the complete research stages.

The stages of this research are identifying problems, formulating problems, collecting data, analysing data, and drawing conclusions. Initial data collection through observation, interviews, and literature reviews. Data on students' mathematical problem-solving abilities by providing research instruments in the form of tests. The instruments have been previously developed and declared valid and reliable (Puspitasari et al., 2024). The instrument is a question developed with a realistic approach. During the data collection process, interviews were conducted with each student to strengthen and complete the data on mathematical problem-solving skills, especially for the fourth indicator exploration, namely re-examining the procedure and results of the solution. The fourth research step is data analysis. In this data analysis stage, the scoring guidelines to assess all student answers are in Table 1 (Hadi & Radiyatul, 2014).

Table 1. Scoring Guidelines for Problem-Solving Ability Assessment

Rated aspect	Score	Explanation	
understanding the problem	0	Misinterpreting/completely wrong. (Not mentioning/writing what is known and what to look for from the question)	
	1	Misinterpreting part of the question, ignoring the question conditions. (Mentioning/writing what is known and what to look for from the question incorrectly)	
	2	Understanding the problem in full. (Mentioning/writing what is known and what to look for from the question correctly)	
planning strategy	a	0	No plan, making irrelevant plans (Not presenting a sequence of solution steps at all)
	1	Making a solution plan that cannot implemented, so that the plan is impossible to implement. (Presenting a sequence of impossible solution steps)	
	2	Make a plan correctly but with wrong results / no results. (Presenting the correct sequence of solution steps but leading to the incorrect answer)	
	3	Making a correct but incomplete plan (Presenting the proper sequence of solution steps but incomplete)	
implementing the plan	4	Making a plan according to the procedure and leading to the correct solution (Presenting the proper sequence of solution steps but leading to the correct answer)	
	0	I am not doing the calculation.	
	1	Performing the correct procedure and possibly producing the correct answer but miscalculating.	
	2	Performing the correct process and getting the proper result	
evaluating the result	0	There was no inspection or no other information	
	1	There was an inspection, but it was not complete.	
	2	Students inspected to see the truth of the process.	

Based on the assessment with the guidelines (Table 1), Equation 1 is the formula to find the value of students' problem-solving abilities.

$$Problem - solving\ ability\ value = \frac{score\ obtained}{10} \times 100 \dots\dots\dots (1)$$

A value of 10 in the Formula 1 is the maximum score for students' mathematical problem-solving ability. Based on this value, Table 2 is the criteria for students' mathematical problem-solving ability (Arikunto, 2013).

Table 2. Mathematical Problem-Solving Ability Category

No.	Nilai	Category
1.	80 - 100	Best
2.	65 – 79,9	Good
3.	55 – 64,9	Sufficient
4.	40 – 54,9	Less
5.	0 – 39,9	Very less

Based on Table 2, the best category, good category, sufficient category, less category, and very less category are good for the student's mathematical problem-solving ability. A frequency distribution table will be used to draw a mapping of problem-solving ability. The value also can be used to find the percentage of each criterion (La'ia & Harefa, 2021).

RESULTS AND DISCUSSION

Students of computer system study programs were given Problem-solving questions with a realistic approach to measuring mathematical problem-solving abilities. The questions had gone through the expert validation stage and the small-scale testing stage. The expert validation results obtained a score of 3.0, and the small-scale testing results were five problem-solving questions with a significance value of less than or equal to 0.05 and a reliability value of 0.914. Details of the problem-solving questions with a realistic approach given to students shown in Table 3.

Table 3. Problem-Solving Questions with a Realistic Approach

No. Question	Question Description
1.	<p>Three brothers, Rafan, Rafif, and Fatan, were taken to the market by their mother to shop. When they were at the market, their mother bought each langsung fruit. The total weight of the langsung fruit shopped by the three brothers was 11 kg. If Rafan's duku is multiplied by two and added to Rafif's duku, the weight will be the same as Fatan's duku. If Rafan's duku is added to Rafif's duku and then subtracted from Fathan's duku, the result is still 1 kg short!</p> <ol style="list-style-type: none"> How many variables are in the problem? Write them down! Write the system of linear equations! Write the matrix form of the system of linear equations! If the price of one kilo of duku is Rp. 8000.00, using the matrix form of answer c, determine the price of langsung fruit owned by Rafan!
2.	<p>Mr. Somad has a field in the form of a right triangle. The sum of the longest side, the middle side, and the shortest side of the field is 24 m. The longest side is 2m longer than the middle side. If the shortest side of the field is multiplied by two and added to the middle side, the result is 4 m shorter than the circumference of the field.</p> <ol style="list-style-type: none"> Write down the variables used to illustrate the problem! Write down the linear equation system! Write down the matrix form of the linear equation system in answer (b)! If one-third of Mr. Somad's field was planted with corn and the rest with chilies, how much of Mr. Somad's field with chilies? (solve with the matrix form of answer c)
3.	<p>Ana has a small shop that sells stationery. On Sunday, she went shopping at Gloria's shop to buy out-of-stock stationery. While shopping, she noted that the price of three journals,</p>

No. Question	Question Description
	two pencils, and three pens was Rp 15,700. The charge for two journals and three pencils was Rp 9,200. The charge for four pencils and three pens was Rp 11,000. a. Write down the variables used to illustrate the problem b. Write down the system of linear equations! c. Write down the matrix form of the system of linear equations in answer (b)! d. If Ana wants to buy two dozen notebooks, three dozen pencils, and one and a half dozen pens, determine how much money Ana must pay to the store cashier! (solve with the matrix form of answer c)
4.	On Eid al-Fitr, Dani, Dini, and Dudi accept pocket money from their brother. The brother came from Jakarta. The total pocket money for the three of them was Rp. 150,000.00. The summation of Dani and Dini's money is the same as twice Dudi's money minus Rp. 30,000.00. However, the summation of Dani and Dudi's money is Rp. 30,000.00 is more than twice Dini's money. a. Write down the variables used to illustrate the problem b. Write down the system of linear equations! c. Write down the matrix form of the system of linear equations in point (b)! d. If their mother donates 2% of the pocket money to orphans, how much does each child donate? (solve using the matrix form of answer c)
5.	Mr. Cahyo has three children. Their names Deksa, Elisa, and Firda. Deksa is four years older than Elisa, and Elisa is three years older than Firda. If the ages of the three are added together, the result is 58 years. a. Write down the variables used to illustrate the question b. Write down the linear equation system! c. Write down the matrix form of the linear equation system at point (b)! d. Using the matrix compiled in point c, determine who cannot participate in the presidential election held in February 2024!

Results of Solving Mathematical Problems with a Realistic Approach

The fourteen students of computer system study programs have worked on mathematical problem-solving questions. The results of the problem-solving abilities are shown in Table 4.

Table 4. Problem-Solving Ability Score Results

No.	Value	Category
1.	50	Less
2.	74	Good
3.	74	Good
4.	66	Good
5.	56	Sufficient
6.	56	Sufficient
7.	74	Good
8.	32	Very less
9.	56	Sufficient
10.	20	Very less
11.	74	Good
12.	24	Very less
13.	58	Sufficient
14.	32	Very less

Based on the results in Table 4 show that one student has a score of 20, one student has a score of 24, 2 students have a score of 32, one student has a score of 50, 3 students have a

score of 56, one student has a score of 58, one student has a score of 66, and four students have a score of 74. Furthermore, the value acquisition is categorized based on the problem-solving ability criteria in Table 2. The categorization results show that four students are in the very less category, one in the less category, four in the sufficient category, and five in the good category. The calculation of the percentage of problem-solving ability results is shown in Table 5.

Table 5. Percentage Results of Each Category of Problem-Solving Ability

No.	Category	Percentage
1.	Very good	0,00 %
2.	Good	35,71 %
3.	Sufficient	28,57 %
4.	Less	7,15 %
5.	Very less	28,57 %

Table 5 shows that the results of students' mathematical problem-solving abilities are divisible into four categories. These categories are good, sufficient, less, and very less. The percentage of each category does not exceed 50%. In addition, no students obtained problem-solving abilities in the very good category. Next, from each category, one subject is taken to be analysed in more detail regarding the problem-solving process. The analysis process refers to the question assessment rubric and the problem-solving stages of the Polya model. The description of the student's work result takes one sample of problem-solving from the five questions. The question analysed is number 2.

Description of Solving Problems with a Realistic Approach to Subjects with a Good Mathematical Problem-Solving Ability Category

The results of students with good problem-solving skills are in Figure 1. Figure 1 shows that in understanding the problem, students can exemplify and write down the variables contained in the matter. In the aspect of planning a solution, students can write down the mathematical form of the information contained in the matter using the variable exemplifications written previously, write down the form of the Linear Equation System (LSS) of the problem along with its matrix form but do not write down the augmented matrix of the SLS matrix. In addition, to determine the solution to the problem, students first determine the value of each variable and then calculate the area of land to be planted with chilies by finding the total land area minus the area of land planted with corn.

In implementing the plan, students use the Gauss-Jordan Elimination method by changing the augmented matrix with the Elementary Row Operation (OBE) rule. However, students can not write the OBE steps correctly. For example, in the first stage of OBE, students change the second row in the augmented matrix by writing the formula ($row\ 1 - row\ 2$). This writing is not quite right because, in the OBE rule, changing rows can be done by adding multiple rows with other rows. So, for this case, it should be written ($row\ 1 + ((-1) \times row\ 2)$), which means the first row is added with (-1) times the second row. In addition, writing ($row\ 1 - row\ 2$) can make students assume that the subtraction operation between rows is an OBE stage.

Although the student has not written the OBE steps correctly, the results of the augmented matrix changes for each stage are correct. Therefore, the student gets the right value for each variable. Furthermore, from the variable values, students can determine the area of land planted with chilies very well, which is $16\ m^2$. Finally, when evaluating the results, students do not check whether the answers obtained are correct and appropriate and do not write conclusions from the results of the solutions obtained.

② a) Tuliskan variabel \bar{y} digunakan :

- 1) x = panjang sisi terpendek
- 2) y = panjang sisi sedang
- 3) z = panjang sisi terpanjang

b) Tuliskan sistem persamaan linear!

- 1) Jumlah sisi terpanjang, sisi sedang, sisi terpendek adalah 29 m.
 $x + y + z = 29$
- 2) Sisi terpendek dipalikan dua dan dijumlahkan dengan sisi sedang adalah 9 meter lebih pendek dari keliling ladang.
 $2x + y = (x + y + z) - 9$
- 3) Sisi terpanjang lebih besar 2 meter dibanding sisi sedang.
 $z = y + 2$

c) Tulis bentuk matrix dari persamaan linearnya!

Persamaan ke ① = $x + y + z = 29$
 ② = $2x + y = x + y + z - 9$
 $2x + y - x - y - z = -9$
 $x - z = -9$
 ③ = $z - y = 2$

Jadi : $x + y + z = 29$
 $x - z = -9$
 $z - y = 2$

$$\Rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & -1 \\ 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 29 \\ -9 \\ 2 \end{bmatrix}$$

d) Hitung luas lahan \bar{y} dapat ditanami cabe

matrix $\begin{bmatrix} 1 & 1 & 1 & 29 \\ 1 & 0 & -1 & -9 \\ 0 & -1 & 1 & 2 \end{bmatrix}$ $\xrightarrow{2 \times 1}$ $\begin{bmatrix} 1 & 1 & 1 & 29 \\ 0 & -1 & 0 & -8 \\ 0 & 0 & 1 & 10 \end{bmatrix}$

$\xrightarrow{b2 \times -1}$ $\begin{bmatrix} 1 & 1 & 1 & 29 \\ 0 & 1 & 0 & 8 \\ 0 & 0 & 1 & 10 \end{bmatrix}$

$\xrightarrow{b1 - b2}$ $\begin{bmatrix} 1 & 0 & 1 & 21 \\ 0 & 1 & 0 & 8 \\ 0 & 0 & 1 & 10 \end{bmatrix}$

$\xrightarrow{b1 - b3}$ $\begin{bmatrix} 1 & 0 & 0 & 11 \\ 0 & 1 & 0 & 8 \\ 0 & 0 & 1 & 10 \end{bmatrix}$

$x = 11, y = 8, z = 10$

Luas segitiga = $\frac{1}{2} \times \text{alas} \times \text{tinggi}$
 $= \frac{1}{2} \times 6^3 \times 8 = 24 \text{ m}^2$

Menentukan lahan \bar{y} di tanami cabe
 * jagung $\frac{1}{3} \times 24 = 8 \text{ m}^2$

Sisa lahan (ditanami cabe) = $24 \text{ m}^2 - 8 \text{ m}^2 = 16 \text{ m}^2$

Figure 2. Subject Work Results with Good Problem Solving Category

Description of Solving Problems with a Realistic Approach to Subjects with the Category of Sufficient Mathematical Problem-Solving Ability

Students with sufficient category completed questions as presented in Figure 2. Students can write down the information and variables contained in understanding the problem. Then, students can write down information from the problem in mathematical form and compile the corresponding SPL in planning strategy. However, students do not write down the augmented matrix form of the SPL. Students used the Gauss-Jordan Elimination method through OBE to determine the value of each variable. Students use the value of each variable to determine the area of land planted with chilies. In implementing the plan, students can write the OBE formula

to change the augmented SPL matrix. However, students make a mistake in the calculation. The errors made by students cause inaccurate final results. Finally, students do not show any activity to check the answers in the aspect of evaluating the results. In addition, students do not write conclusions at the end of the answer.

2. a. Variabel : x = sisi terpendek
 y = sisi sedang
 z = sisi terpanjang

b. Sistem persamaan linier

- 1) $x + y + z = 24$
- 2) $24 + y = (x + y + z) - 4$
 $2x + y - x - y - z = -4$
 $x - z = -4$
- 3) $z = y + 2$
 $-y + z = 2$

c. Matriks.

$$\begin{pmatrix} 1 & 1 & 1 \\ 1 & 0 & -1 \\ 0 & -1 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 24 \\ -4 \\ 2 \end{pmatrix}$$

d. Luas cabai = $\frac{2}{3}$ Ladang

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 24 \\ 1 & 0 & -1 & -4 \\ 0 & -1 & 1 & 2 \end{array} \right) \xrightarrow{b_2 + (-b_1)} \left(\begin{array}{ccc|c} 1 & 1 & 1 & 24 \\ 0 & -1 & -1 & -20 \\ 0 & -1 & 1 & 2 \end{array} \right)$$

$$b_3 + (-b_2) \Rightarrow \left(\begin{array}{ccc|c} 1 & 1 & 1 & 24 \\ 0 & -1 & -1 & -20 \\ 0 & 0 & 2 & 22 \end{array} \right) \xrightarrow{\frac{1}{2} \times b_3} \left(\begin{array}{ccc|c} 1 & 1 & 1 & 24 \\ 0 & -1 & -1 & -20 \\ 0 & 0 & 1 & 11 \end{array} \right)$$

$$b_1 + b_2 \Rightarrow \left(\begin{array}{ccc|c} 1 & 0 & 0 & 4 \\ 0 & -1 & -1 & -20 \\ 0 & 0 & 1 & 11 \end{array} \right) \xrightarrow{b_2 \times (-1)} \left(\begin{array}{ccc|c} 1 & 0 & 0 & 4 \\ 0 & 1 & 1 & 20 \\ 0 & 0 & 1 & 11 \end{array} \right)$$

$$b_2 + (-b_3) \Rightarrow \left(\begin{array}{ccc|c} 1 & 0 & 0 & 4 \\ 0 & 1 & 0 & 9 \\ 0 & 0 & 1 & 11 \end{array} \right) \rightarrow \begin{matrix} x = 4 \\ y = 9 \\ z = 11 \end{matrix}$$

$$L_{\text{cabai}} = \frac{2}{3} (x \times y) = \frac{2}{3} (4 \times 9) = 24 \text{ m}^2$$

Figure 3. Subject Work Results with Problem Solving Category Sufficient

Description of Solving Problems with a Realistic Approach to Subjects with the Category of Poor Mathematical Problem-Solving Ability

The results of students' solutions with the less category are in Figure 3. The results of students' work show that in understanding the problem, students are able to write down the information and variables contained in the matter. In planning the solution, students are able to write down the mathematical form of the problem information. However, students have not written down the linear equation in simple terms. In addition, students can write the SPL correctly in matrix form. In implementing the plan, students do not show the method used. Students also do not write down the strategy for determining the value of each variable. From

the final answer obtained, students write that the area of land planted with chilies is $(1 - \frac{2}{3})$ Of the land. In fact, the previous sentence states that the land with corn plants is $\frac{1}{3}$, so the remaining land with chilies is $(1 - \frac{1}{3})$ Of the land. It shows that students do not understand the problem correctly, resulting in an inaccurate solution process and obtaining answers. Finally, in evaluating the result, students did not show any activity in checking the answers obtained. In addition, students also did not write conclusions at the end of the answer.

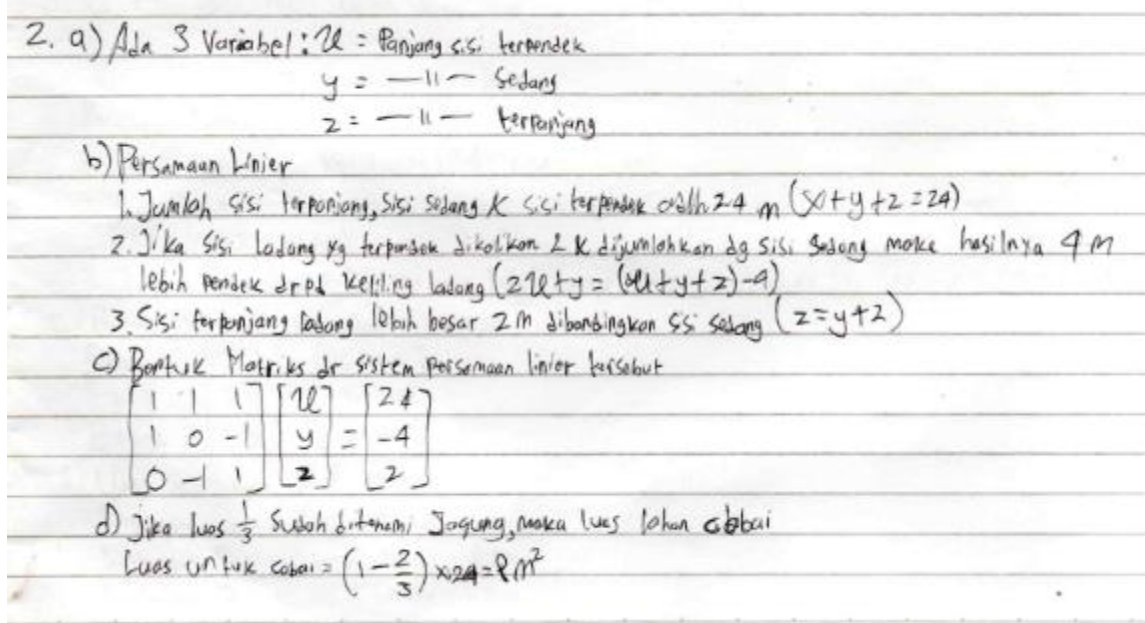


Figure 4. Subject Work Results with Problem Solving Category Less

Description of Solving Problems with a Realistic Approach to Subjects with a Very Less Mathematical Problem-Solving Ability Category

Figure 4 shows the results of student solutions with the Very Less category problem-solving ability.

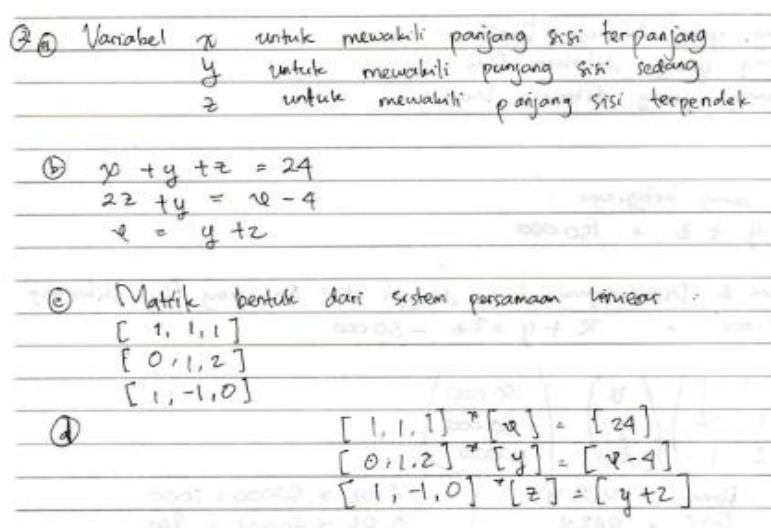


Figure 5. Subject Work Results with Problem-Solving Category Very Less

From the results of the work in Figure 4, in the aspect of understanding the problem, students are able to write down the information and variables contained in the matter. Furthermore, in the planning strategy, students have written the mathematical form of the problem

contained in the problem in the form of a linear equation. However, students did not write the form of the SPL, the SPL matrix, and the augmented matrix of the SPL. In addition, the writing of the matrix is not correct. The matrix is written horizontally with a comma hyphen [1,1,1]. Writing this matrix form can give rise to the assumption that [1,1,1] is not a matrix but a pair of three points x, y, z with $x = 1, y = 1,$ and $z = 1$. Furthermore, students did not write down the calculations when implementing the plan and evaluating the results. That is why students do not write down the answers to questions.

Overall, the description and comparison of students' problem-solving abilities can shown in Table 6.

Table 6. Comparison of Problem-Solving Ability for Each Category

Rated aspect	Student Abilities			
	Good	Sufficient	Less	Very Less
understanding the problem	Writing variables, SPL, and matrices correctly	Writing variables, SPL, and matrices correctly	Writing variables and matrices correctly, but SPL is not yet simple.	Writing variables correctly but still wrong in writing SPL and matrices.
planning a strategy	Making a correct plan but not complete/accurate in writing the planning stage	Making a correct plan but not complete/accurate in writing the planning stage	Making a plan that is incomplete, and there are no stages for determining each variable.	Students cannot use plans to solve problems.
implementing the plan	Getting the correct results, but there are several completion steps that are not quite right.	Get wrong results, and there are several solution steps that are not correct.	The result is incorrect, and students do not write down the steps to find the value of each variable.	Not doing calculations
evaluating the result	Writing the final results of solving the problem but not including a conclusion	Writing the final results of solving the problem but not including a conclusion	Students do not write conclusions from solving the problem and also do not write other information.	There is no inspection, and there is no other information.

Mathematical Problem-Solving Ability of Information Technology Faculty Students through a Realistic Approach

The problem-solving ability categories of 14 Computer Systems study program students are 35.71% good, 28.57% sufficient, 7.15% less, and 28.57% very less. Students in good categories and sufficient categories are able to write variables, linear equation systems (SPL), and matrices correctly. Therefore, they get a score of 2. Students with the less category have not written SPL more simply. Likewise, students in the Very Less category make mistakes writing SPL and matrices. Therefore, both categories get a score of 1 (Hadi & Radiyatul, 2014).

In implementing the plan, the students with a good category can make a plan for solving SPL with Gauss Jordan elimination, but the writing is incomplete, so they get a 3. For students in the less category, they have written a formula to write the area of the field planted with chilies but have not used the Cramer method or Gauss-Jordan elimination to calculate the value of each variable. For students in the less category, they have written a formula to write down the area of the field planted with chilies but have not used the Cramer method or Gauss-Jordan elimination to calculate the value of each variable. Based on these results, students in the sufficient and less categories score 2. Furthermore, students in the very less categories write a plan that cannot calculate the answer to the question. So, the students get a score of 1 (Hadi & Radiyatul, 2014).

The third aspect of problem-solving ability is solving the problem according to plan. Students in the Good, sufficient, and less categories get a score of 1. However, there are differences between the three. Students with good categories can answer correctly but do not complete the Gauss-Jordan elimination steps. Students with sufficient categories do not complete the Gauss-Jordan elimination steps and get the wrong results. In the less category, students make mistakes in calculations and results. Finally, students with very less categories get a score of 0 because they do not do calculations, only write the matrix, and are still wrong (Hadi & Radiyatul, 2014).

The fourth aspect is to re-check the procedure and the results of the solution. Students with good categories and sufficient categories have carried out the checks but have not completed them, as evidenced by the fact that they have not written the conclusion at the end of the answer. Therefore, both of them get a score of 1. Students with less and very less categories got a score of 0 because they did not re-check. In addition, students also did not write information and conclusions at the end of the answer. (Hadi & Radiyatul, 2014).

The results of this study indicate that students of the Computer Systems study program, Class of 2022, still need to improve their problem-solving skills. These aspects are planning strategies, implementing plans, and evaluating results. One way to improve problem-solving skills is to apply an appropriate learning model or approach. Lecturers can use a realistic approach to learning because it can increase or train problem-solving skills (Domu & Mangelep, 2019; Fannisa et al., 2022; Haryonik & Bhakti, 2018). In addition, Lecturers can also implement the problem-based learning model because this model has been able to improve problem-solving skills (Hidayati & Wagiran, 2020; Rokhmawati et al., 2016; Simanjuntak et al., 2021; Yanto et al., 2021). Another thing that lecturers can do is to apply the problem-based learning model and the realistic approach together. Because, this has also been proven to be able to improve problem-solving skills (Kurniawati et al., 2023).

CONCLUSION

The study showed that Computer Systems study program students have good, sufficient, less, and very less problem-solving ability categories. The percentage for each category is 35.71% good, 28.57% sufficient, 7.15% less, and 28.57% very less. Based on the study results, the conclusion is that the mathematical problem-solving abilities of Computer Systems Study Program students mainly fall under the good categories and sufficient categories. Aspects of problem-solving ability that still need to be improved are planning problem-solving, solving problems according to plan, and re-checking the procedures and results of the solution. Researchers hope that the research results can improve and enhance the quality of learning, especially in courses that require mathematical skills. For further research, a learning model or

approach can be applied, for example, a problem-based learning model with a realistic approach to improve aspects of Polya's problem-solving ability.

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