

Analysis of students problem solving ability by using polya steps in linear program material

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Abstract. The purpose of this study is to analyze students problem solving ability by using polya steps in linear program material. This was a descriptive study that used a qualitative approach with 103 students of XI grade of science at SMA Negeri 1 Kota Bumi as the subject of the study. The data was collected through the technique of a written test, which consisted of two questions. The result of the research showed that the ability of problem solving in students of XI grade of science at SMA Negeri 1 Kota Bumi were good, which were 17 students or 16,50% was very good at problem solving, 53 students or 51,47% was good enough at problem solving, 28 students or 27,18% was less good at problem solving, and 5 students or 4,85% was goodless at problem solving. The results of each indicator of problem solving ability was the indicator of understanding the problem was 87,86%, indicator of arranging a plan was 45,99%, indicator of carrying out a plan was 39,31%, and indicator of re-check was 34,91%.

1. Introduction

Mathematics has an important role in various aspects of human life. Many problems and activities in life must be solved using mathematics. Therefore it is important for someone to learn mathematics. Recognizing the importance of mastering mathematics, mathematics is a compulsory subject for students at the elementary and secondary education level. In the learning process, mathematics has a role in developing students mathematical thinking ability. One of the mathematical ability that students must have is problem solving ability [1]. Problem solving ability is very important for every student because (1) problem solving is the general goal of teaching mathematics, (2) problem solving which includes methods, procedures, and strategies is the core and main process in the mathematics curriculum, and (3) problem solving is a basic ability in learning mathematics [2].

Problem solving is needed to produce and integrate information about problems through interaction (knowledge acquisition) and to try to solve problems according to the information obtained (knowledge application) [3]. Solving problems requires those who are asked to participate in finding solutions to be able to understand what the problem is itself. Furthermore, problem solvers need to understand how to form generalizations and mathematical representations in such a way as to communicate their understanding and the path to solutions or a series of solutions [4]. There are four indicators of problem solving ability, namely: 1) understanding the problem, 2) arranging a plan, 3) carrying out a plan, and 4) re-check [5]. In this study the researchers analyzed students problem

solving ability based on Polya problem solving ability indicators. Thus, the indicator used to see the students problem solving ability in this study is understanding the problem, arranging a plan, carrying out a plan, and re-check.

Students mathematical problem solving ability in Indonesia are relatively low. This can be seen from the results of the survey Program for International Student Assessment (PISA) in 2015. Indonesia ranked 63 out of 72 participating countries with an average score is 386 for mathematics with an average international score is 490. Factors that caused the low achievement of Indonesian students in PISA is the lack of ability to solve non-routine or high-level problems. The questions tested in PISA consist of 6 levels (lowest level 1 to highest level 6). Whereas students in Indonesia are only familiar with routine questions at levels 1 and 2. Therefore, it can be concluded that the mathematical problem solving ability of Indonesian students are low [6]. The low problem solving ability also occurs in one of the schools in Kota Bumi, North Lampung Regency, namely SMAN 1 Kota Bumi. From the results of interviews with teachers when finished teaching linear program material, information was obtained that students were still having difficulty on carrying out a plan to solve a problem and lack of students thorough examination of the answers obtained.

Linear programs is a mathematical models that is used to solve problems of optimally limited resource allocation. Linear programs involve planning activities to be carried out using linear assumptions of relationships to achieve maximum results. The subject of a linear program presents many problems that are difficult to solve and the form of questions that are not routine. Students sometimes complain about linear program problem solving processes, they consider it quite complicated with problems that are convoluted and require a long time. This shows that students are still difficult to understand and solve the problems related to linear program material [7]. In daily life there are many and various types of problems faced in relation to linear programs, such as in determining maximum profits, not only is the calculation ability needed but problem solving ability must also be possessed by students so that when faced with other problems can overcome them well. In addition, students must also have the ability to translate problems encountered into mathematical models. Therefore, problem solving ability in the material of linear programs must be trained and mastered by students [8].

2. Experimental Method

This research is a descriptive study with a qualitative approach that aims to analyze students problem solving ability using the Polya steps in linear program material. The subjects in this study were students of XI grade of science at SMAN 1 Kota Bumi, amounting to 103 students. In this study the data was collected through a written test in the form of a description consisting of two questions related to linear program material. This test is done by individual students. After the test is carried out, the scores of each student are obtained. These scores are categorized based on the students problem solving ability categories. After determining the category of problem solving ability of students, the next step is to determine the percentage of occurrence indicators of students problem solving ability.

Table 1. Categories of Students Problem Solving Ability [9]

Students Score	Assessment Category
81 – 100	Very Good
61 – 80	Good
41 – 60	Good Enough
21 – 40	Less Good
0 – 20	Goodless

Table 2. Guidance for Students Problem Solving Ability Tests [10]

Indicator	Assessment	Score
Understanding the Problem	Did not mention what was known and what was asked	0
	Mention what is known without mentioning what was asked or vice versa	1
	Mention what is known and what is asked but is not right	2
	Mention what is known and what is asked correctly	3
Arranging a Plan	Not planning a problem solving at all	0
	Planning a solution based on a problem but not right	1
	Plan solutions based on problems correctly	2
Carrying Out a Plan	There are no answers at all	0
	Running the plan by writing down answers but wrong answers or only a small number of correct answers	1
	Running the plan by writing half answers or most correct answers	2
	Running the plan by writing answers completely and correctly	3
Re-Check	Did not write a conclusion	0
	Interpreting the results obtained by making conclusions but not right	1
	Interpret the results obtained by making conclusions appropriately	2

3. Result and Discussion

3.1. Test Results of Students Problem Solving Ability

The data from the test results of students problem solving ability can be seen in Table 3.

Table 3. Test Results of Students Problem Solving Ability

Students Score	Assessment Category	Frequency	Percentage %
81 – 100	Very Good	17	16,50
61 – 80	Good	53	51,47
41 – 60	Good Enough	28	27,18
21 – 40	Less Good	5	4,85
0 – 20	Goodless	0	0
Total		103	100
Students Score Average		66,42	

3.2. The Results of Students Problem Solving Ability Based on Indicators

The data on the results of students problem solving ability based on indicators can be seen in Table 4.

Table 4. The Results of Students Problem Solving Ability Based on Indicators

Indicator	Percentage %
Understanding the Problem	87,86
Arranging a Plan	45,99
Carrying Out a Plan	39,31
Re-Check	34,95

Analysis of problem solving ability can be seen in the question number 1 below.

A bicycle trader wants to buy 2 types of bicycles, 25 mountain bikes and 25 racing bikes. He wants to buy a mountain bike at a price of IDR 1.500.000 per piece and a racing bicycle at a price of IDR 2.000.000 per piece. He planned not to spend more than IDR 42.000.000. If the profit of a mountain

bike is IDR 500.000 and the profit of a racing bicycle is IDR 600.000, then determine the maximum profit received by the trader.


	Sepeda gunung (x)	Sepeda balap (y)	Persediaan
Jenis sepeda	 x	y	25
Modal	1.500.000	2.000.000	42.000.000
Keuntungan	500.000	600.000	?
$f(x,y)$			

Figure 1. Student answer to question number 1

Figure 1 shows that the students are unable to understand the problem given. This can be seen from the inability of students to identify the elements that are known and what is asked in the questions.

1. Diketahui	Sepeda Gunung	Sepeda balap	Pembalap
Unit	x	y	25
Harga	1.500.000 x	2.000.000 y	42.000.000
Untung	500.000 x	600.000 y	F(x,y)

Ditanya : Keuntungan maksimum
Jawab : Banyak Sepeda maksimal 25
(i) $x + y \leq 25$

Budget wangnya yang tersedia 42 juta
 $15x + 20y \leq 420 \Rightarrow$ (ii) $3x + 4y \leq 84$

titik potong (ii) dan (i)
 $3x + 4y = 84$
 $3x + 3y = 75$ -
 $y = 9$
 $x + 9 = 25$
 $x = 25 - 9$
 $x = 16$

Figure 2. Student answer to question number 1

After understanding the problem, students are asked to draw up a plan. Figure 2 shows that the students are not able to plan properly from the problem given. Analysis of other problem solving ability can be seen in the following question number 2. A farmer wants to provide fertilizer containing phosphorus and nitrogen in his paddy plants. The given fertilizer must contain at least 600 grams of phosphorus and 720 grams of nitrogen. Fertilizer I contains 30 grams of phosphorus and 30 grams of nitrogen per pack. Fertilizer II contains 20 grams of phosphorus and 40 grams of nitrogen per pack. Farmers want to mix the two fertilizers. One pack of fertilizer I costs IDR 17.500 and one pack of fertilizer II costs IDR 14.500. Determine the minimum costs that must be incurred by the farmer.

Jwb :

$$30x + 20y \leq 600$$

$$3x + 2y \leq 60 \checkmark$$

$$x \geq 0, y \geq 0$$

$$30x + 40y \leq 720$$

$$3x + 4y \leq 72$$

$$x \geq 0, y \geq 0$$

$$3x + 2y = 60$$

$$3x + 4y = 72$$

$$-2y = -12$$

$$y = 6$$

$$3x + 2(6) = 60$$

$$3x + 12 = 60$$

$$3x = 60 - 12$$

$$3x = 48$$

$$x = 16 \quad (16, 6)$$

Pilihan	$f(x,y) = 17.500x + 14.500y$
0, 18	261.000
20, 0	350.000
16, 6	250.000 + 87.000 (367.000)

Jadi harga minimum \Rightarrow 261.000

Figure 3. Student answers to question number 2

Figure 3 shows that the students are not able to carry out the plan properly even though they have a good understanding of the problem and preparation of plans.

Titik	$17.500 (x)$	+	$14.500 (y)$	
0,30	$17.500 (0)$	+	$14.500 (30)$	435.000
24,0	$17.500 (24)$	+	$14.500 (0)$	420.000
16,6	$17.500 (16)$	+	$14.500 (6)$	385.000 ✓
jadi; Keuntungan minimum : 385.000				

Figure 4. Student answer to question number 2

Figure 4 shows that although the students carry out the plan well, but they do not check the answers obtained.

4. Conclusion

The result of the research showed that the ability of problem solving in students of XI grade of science at SMA Negeri 1 Kota Bumi were good, which were 17 students or 16,50% was very good at problem solving, 53 students or 51,47% was good enough at problem solving, 28 students or 27,18% was less good at problem solving, and 5 students or 4,85% was goodless at problem solving. The results of each indicator of problem solving ability was the indicator of understanding the problem was 87,86%, indicator of arranging a plan was 45,99%, indicator of carrying out a plan was 39,31%, and indicator of re-check was 34,91%.

Based on the results of the analysis it was concluded that the students were still not able to plan, carrying out a plan, and re-check the problem well. Therefore, the teacher in the learning process must plan the learning process that can develop students problem solving ability.

Acknowledgments

Thank you to the students and the teachers for their assistance and participation in this research.

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