

Problem Solving Ability According to Polya on System of Linear Equations in Two Variables Based on Student Learning Styles

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Abstract. *The ability to solve mathematical problems can be said to be still low. Learning style is one of the factors that affect it. The purpose of the research conducted is to describe mathematical problem-solving skills based on learning styles. This research uses a type of research in the form of qualitative descriptive research. The subjects used were 3 students of class VIII with each having a different learning style. The selection of subjects for as many as three students in this study was on purposive sampling. This study used instruments in the form of questionnaires, tests, and interviews. The techniques used when analyzing data are to carry out the stages of data reduction, data presentation, and drawing conclusions. Checking the validity of the data using triangulation techniques. Troubleshooting using Polya steps. This study shows several results as follows: (1) subjects who have a visual learning style are able to understand problems, devise a plan, carry out the plan, and looking back, (2) subjects who have an auditory learning style are able to understand problems, devise a plan, carry out the plan, and looking back, and (3) subjects who have a kinesthetic learning style do not understand the problem, devise a plan, carry out the plans, and do not looking back.*

Keywords: *Learning style, problem solving, polya, two-variable linear equation system*

Introduction

Mathematics is one of the lessons that everyone must understand. Mathematics is a basic science from elementary to high school, which has an essential role in everyday life (Khatimah et al., 2017). According to (Zain et al., 2016), by learning mathematics, students are expected to be capable to handle difficulties in their face, both problems in mathematics lessons and problems related to daily life. Depdiknas (Riau & Junaedi, 2016) sees the use of mathematics as tracing patterns and correlations, creativity that involves imagination, intuition, and discovery, problem-solving with mathematics, and the use of mathematics as a vehicle for communication. Therefore, thinking problem-solving, students need guidance from a teacher who helps develop problem-solving skills, both in solving mathematical problems and solving problems in a real-world context. The teacher spearheads guiding the learning process to have a significant role (Setyaningsih et al., 2019).

According to National Council of Teachers of Mathematics (NCTM, 2000) posits that problem-solving is applying the knowledge possessed through the previous learning process to a new and different atmosphere. In addition, students' must meet five levels of mathematical proficiency, according to the NCTM including the capacities for problem-solving, understanding and proof, communication, connections, and representation.

Problem-solving is one of the main aspects of the mathematics curriculum that is applied in Indonesia and throughout the world (Rahayuningsih et al., 2021). Problem-solving is a strategy to realize expectations by the correct procedures, able to overcome difficult questions by directing all the abilities they have so that it requires enabling students to think critically, creatively, and efficiently (Febriyanti & Irawan, 2017). Since problem-solving can have a positive effect on students' creativity and comprehension, it focuses the tactics and processes used by students' to solve problems rather than merely the outcomes. Students' must process problem-solving skills in order to solve mathematical difficulties. Finding the best answer to an issue is a sign of a student's capacity to solve challenges (Isnaini et al., 2016).

The mathematics problem-solving skills of Indonesian students are still comparatively weak. This is evident from the consistently low average mathematics score on the National Examination, which ranges from basic education levels to upper secondary education levels. The TIMSS and PISA scores likewise show a low aptitude for math problem-solving. Indonesian Students rarely face and solve problems with characteristics the TIMSS or PISA (Murtiyasa et al., 2019). With a score of 397, Indonesia placed 44th out of 49 nations according to the 2015 TIMSS findings. The score obtained by Indonesia is below the average international score of 500 (Mullis et al., 2016). TIMSS resulted in 2019, no Indonesian students were participating in the 2019 TIMSS survey (Mullis et al., 2020). With a score of 386, Indonesia is ranked 73rd out of 79 nations in the 2018 PISA rankings (OECD, 2019). Data shows how Indonesia's score is still below the average, and Indonesia's position from year to year is not much different. Therefore, teachers must be capable of understand students' mathematical problem-solving skills to develop their mathematical problem-solving abilities by their abilities. Solving mathematical problems requires an appropriate strategy so a problem can be solved correctly. Steps to resolve the issue have been suggested by certain specialists. One of them, in the words of (Polya, 2004), takes four phases to solve problems: comprehending the issue, coming up with a strategy, putting the plan into action, and reflecting back.

The material of the system of linear equations in two variables is one of the materials that can test a person's aptitude for mathematics problem-solving. In class VIII of junior high school, one of the subjects taught is the system of linear equations in two variables (Kemendikbud, 2018). The system of linear equations in two variables is important for students to master because this material is used to understand other mathematical concepts, including determining the coordinates of the two-line intersecting points, determining the line equation, and determining the constants in an equation (Islamiyah et al., 2018). This information is frequently presented as a story problem, a mathematics issue that is provided in the form of phrases, and a problem that is relevant

to everyday life (Asni et al., 2021). The steps in solving story problems with Polya's stages are considered simple and can easily be understood by students (Pradana & Murtiyasa, 2020).

There are four categories of mathematical problem solving ability, namely good categories if students are able to write down information completely, clearly, and accurately, use specific procedures and are able to explain the solution, looking back the problem-solving steps carefully and conclude correctly, categories are sufficient if the learner is capable of accurately record what is known and what is asked, using formulas and procedures that are not correct or miscalculated, examine each step but do not explain the steps entirely so as to produce incorrect conclusions, the category is less if the learner is able to accurately record the information that has been known and requested, using less related strategies, the formulas used do not lead to solutions, looking steps but are wrong and conclusions are wrong, categories are severely lacking if the learner is unable to explain the information contained in the problem, does not use appropriate strategies, is irrelevant and unable to provide explanations, does not examine the procedure or steps of solving the problem so that the conclusions obtained are wrong (Nur & Palobo, 2018).

One of the factors influencing the categories of good, sufficient, lacking, and severely lacking problem-solving abilities of Students is the learning style (Richardo et al., 2014). Ilmiyah and Masriyah (Kepa, 2019) assert that each learner can efficiently acquire, learn, and process knowledge in their own unique way according to their learning style. As for other opinions, according to (Mubarik, 2013), learning style is the style chosen by students in receiving information or knowledge in the learning process. According to (Setyadi et al., 2020), learning style is one of the variables concerned with the way students understand the lesson, especially mathematics. Each student's learning style is certainly different because the absorption of students' brains cannot be the same. Teachers must consider this in teaching mathematics because a learning style that students already have will affect learning activities in the classroom.

Learning styles can be divided into three categories, namely visual styles of learning, auditory styles of learning, and kinesthetic styles of learning, according to DePorter and Hernacki (Argarini, 2018). Students with a visual style of learning rely on their skills to use their sense of sight throughout the latter phase because this learning style is one that depends on observation (Argarini, 2018). According to Wahyuni (Khoirunnisa & Soro, 2021), the auditory style generally utilizes the sense of hearing to facilitate learning, get information quickly when having discussions, and listen to what the teacher conveys orally or with voice intermediaries. Kinesthetic learning is a type of learning where children like utilizing their limbs to study and enjoy engaging in physical sports such as running, jumping, and so forth (Argarini, 2018).

As evidenced by the findings of earlier studies, such as those by (Imamuddin et al., 2019), people with a visual style of learning are able to comprehend difficulties extremely well, prepare

solutions very well, solve problems very effectively, and look back quite poorly. Subjects with an auditory learning style comprehend the problem extremely well, organize the solution well, carry it out adequately, and evaluate it inadequately. Kinesthetic Students comprehend problems relatively well, organize solutions effectively, resolve issues less effectively, and reflect on solutions quite poorly. Other research was also conducted by (Anggraini & Hendroanto, 2021) determined that students who learned best visually could comprehend problems, make plans, carry them out, and avoid looking back. Subjects with an auditory learning style are able to comprehend problems but are less adept at planning and resolving them, they also do not look back. The subject can comprehend difficulties and formulate plans, but they are less likely to be carried through and they do not look back when they learn in a kinesthetic way.

This study examines how well people can handle mathematical problems according to Polya's steps based on learning styles. The researcher conducted research in one of the junior high schools in Surakarta with the material of a system of linear equations in two variables. It can see through solving problems according to Polya, which arises from the results of students' answers that can see as the step of devising and implementing plans. Meanwhile, the measure that has not to see is understanding the problem and looking back. Students with auditory and visual learning preferences can use the Polya steps to solve issues, but kinesthetic students' haven't been successful in using them.

Based on the description above, the formulation of the problem is obtained, namely how the mathematical problem-solving ability of class VIII students in one of the junior high schools in Surakarta is based on learning styles. There are three types of learning styles that are applied: visual, auditory, and kinesthetic. This research describes how learning affects class VIII students in one of the junior high schools in Surakarta's capacity to solve mathematical issues.

Method

This research was conducted in a qualitative descriptive manner at Surakarta Special Program Batik Junior High School with the research subject of class VIII B totaling 19 students. The subject in this was a study taken by three students based on the type of learning style, where one student represented every kind of learning style. Each learning style gives a symbol: the KAW symbol for visual modes of learning, the BAK symbol for auditory modes of learning, and the AWA symbol for kinesthetic modes of learning. The selection of subjects for as many as three students in this study was purposive sampling based on students in class VIII. Some following criteria were taken into account when selecting this topic: 1) students have visual modes of learning, auditory modes of learning, or kinesthetic modes of learning obtained from the results of the learning style questionnaire; 2) the test results for problem-solving aptitude employing the

complete Polya steps when working on the problem-solving test questions, and 3) Students have obtained material on a set of linear equations with two variable.

The signs of each stage of the problem-solving skill utilized by students in solving particular problems show the student's capacity to comprehend problems, formulate plans, execute strategies, and reflect back on problem-solving. Polya's indicators of problem-solving are shown in Table 1.

Table 1. Polya's indicators for problem solving

Polya Step	Indicators
Understanding the Problem	When Students are given questions, they comprehend the answer.
Formulating a Plan	Students' can determine the methods utilized to find a solution.
Executing the Plan	Students can use the planned method to address the issue.
Looking Back	Students' can double-check the answers in solving the questions to ensure are obtain the solutions.

(According to Alacaci in (Argarini, 2018))

Tests of problem-solving abilities, personal interviews, and questionnaires about learning styles are the methods used to collect data. The learning style questionnaire aims to group Students into visual modes of learning, auditory modes of learning, and kinesthetic modes of learning. Each student's learning style is undoubtedly different; by submitting statements that lead to each student's modes of learning, researchers can determine the student's learning styles. Modes of learning questionnaires must give before students do written test questions. The written test aims to determine students' problem-solving ability in solving issues with a system of linear equations in two variables according to the Polya steps. After completing the learning style questionnaire, the Students must give this test. This test is for all students of class VIII B of SMP Batik Special Program Surakarta. The interview aims to find data that strengthens the outcomes of the assessment of the exam for issue-solving aptitude according to Polya and collect information on learning preferences and the reasons why some students struggle to pass the problem-solving test. The interview by analyzing the data obtained when the study was conducted. The conversation in the interview is about how students solve problems using the Polya steps.

This research instrument uses a questionnaire of learning styles and written questions. This questionnaire of student learning styles consists of 30 questions that have been teacher validated by the who teaches mathematics subjects at the Junior High School Batik Special Program in Surakarta and one of the lecturers in Mathematics Education Department at the University of Muhammadiyah Surakarta. Written test questions using two questions from a stem-nuanced mathematics teaching material book (Niam et al., 2020). The test questions take the form of a description that has been teacher-validated by lecturers in in Mathematics Education Department at the University of Muhammadiyah Surakarta and a teacher of mathematics at the Junior High

School Batik Special Program in Surakarta. Table 2 contains questions from the written test materials.

Table 2. Question instruments for problem solving skills test

Test Question Instruments	
1.	Riski is an automotive service tech who works in an automotive repair shop to repair cars and trucks. This job requires Riski to use his ability to combine technical and mechanical skills with new technologies in identifying problems and worn car components. Based on experience, Riski bought a used civic sedan car and intended to modify the car. After checking with Riski, the car requires parts of two new tires and one coil spring purchased by Riski for Rp 1,600,000.00, so the car usually runs. One day, an office employee wanted to service his car because it was not comfortable to drive. The car owned by the office employee is similar to the car that Riski bought. Upon inspection by Riski, it turned out that one tire of his car had run low, and his two coil springs had begun to stretch. Therefore, Riski replaced these two components to make the car comfortable when driving. The office employee incurred a fee of Rp 1,450,000.00 with details of one new tire and two coil springs for Rp 1,400,000.00 plus a service fee of Rp 50,000.00. What is the price for two new tires and two coil springs?
2.	During the mathematics subject of SPLDV class 8A material at MTs 1 Negeri Serang, Mrs. Suci as the teacher explained the SPLDV concept material. At that time, Mrs. Suci asked three people, Ita, Riko, and Ida, to buy pens and notebooks. Mrs. Suci asked Ita to buy three pens and one notebook for Rp 8,500.00. As for Riko, Mrs. Suci told her to buy one pen and three notebooks for Rp 9,500.00. Then for Ida, Mrs. Suci told her to buy two pens and two notebooks. How much did two pens and two notebooks bought by Ida worth?
(Niam et al., 2020)	

The miles and Huberman steps, as well as data reduction, presentation, and conclusion, are data among the data analysis procedures (Sutama, 2019). The triangulation of methods ensures the reliability of the data employed. The triangulation approach is used to ensure that the data gathered is as accurate as possible by comparing the data of the written problem-solving ability test result with the data of each subject's interview results.

Results and Discussion

According to the modes of learning questionnaire's findings, among the study participants, 19 students total, only 16 students took this test, and three other students did not take this test because there was an obstacle. Each student fills out the learning style questionnaire according to the filing instructions listed on the questionnaire. The study style questionnaire was analyzed using the highest scores of the three learning styles. The highest number of scores indicates that each learner predominantly owns the learning style. The data presented in Table 3 was the learning style obtained from questionnaire results.

From Table 3, the results of 10 students with a visual mode of learning, five students with an auditorial mode of learning, and single students with kinesthetic learning preferences were obtained, as for the initials of the bolded respondents as the subject of the study.

Table 3. Learning style questionnaire results

Number	Respondent's Initials	Learning Styles			Conclusion
		Visual	Auditory	Kinesthetic	
1	AWA	8	8	14	Kinesthetic
2	AJ	20	7	3	Visual
3	BAK	4	17	9	Auditory
4	FRL	13	9	8	Visual
5	FDR	6	13	11	Auditory
6	KRM	10	13	7	Auditory
7	KAW	15	6	9	Visual
8	KIN	13	11	6	Visual
9	MNAN	11	14	5	Auditory
10	NKPM	13	10	7	Visual
11	SAZR	14	9	7	Visual
12	SZ	15	6	9	Visual
13	YER	13	10	7	Visual
14	YSP	14	6	10	Visual
15	VCDFM	16	6	8	Visual
16	NAJ	7	13	10	Auditory

Based on the analysis of students' propensity for solving mathematical issues according to Polya steps based on learning styles on the material of the system of linear equations in two variables, the following test results and interviews can see as follows:

1. Data on the results of the mathematical problem-solving ability test according to Polya steps in KAW subjects based on visual learning styles.
 - a. Understanding the Problem

In this step, the subject can write down what is known, ask about the problem, and model mathematical sentences. In understanding the problem, the subject reads the question many times inwardly. The results in understanding the problems in questions number 1 and 2 can be seen in Figure 1. For a description of the answers see Table 4.

1. a. Memahami masalah misal : ban = b pegas = p Diketahui : $2b + 1p = 1.600.000$ ① $1b + 2p = 1.400.000$ ② Ditanya : $2b + 2p = \dots ?$	2. a. Memahami masalah misal : pulpen = p buku = b Diketahui : $3p + 1b = 8.500$ ① $1p + 3b = 9.500$ ② Ditanya : $2p + 2b = \dots ?$
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Figure 1. Understanding problem number 1 and 2

Tabel 4. Description of understanding the problem

Description number 1	Description number 2
Students understand the problem by assuming that <i>tires</i> = b and <i>springs</i> = p . Students write down what is known, namely equation $2b + 1p = 1.600.000$ as the first equation and equation $1b + 2p = 1.400.000$ as the second equation. Students also write down what is asked in the question, namely the $2b + 2p$ equation	Students understand the problem by passing <i>pen</i> = p and <i>book</i> = b . Students write down what is known, namely equation $3p + 1b = 8.500$ as the first equation and equation $1p + 3b = 9.500$ as the second equation. Students also write down what is asked in the question, namely the $2b + 2p$ equation

b. Devising a Plan

In this step, the subject can determine the concept, use all the information on the problem, and plan the problem's solution well in questions 1 and 2. The results in devising plans in questions number 1 and 2 can be seen in Figure 2. For a description of the answers see Table 5.

b. Membuat rencana.	b. Membuat rencana.
Langkah 1: Eliminasi persm	Langkah 1: Eliminasi persm
Langkah 2: Substitusi nilai p	Langkah 2: Substitusi nilai p
Langkah 3: Substitusi nilai p dan b.	Langkah 3: Substitusi nilai p & b

Figure 2. Devising a plan for questions number 1 and 2

Tabel 5. Description of devising a plan

Description number 1	Description number 2
Students devise a plan by writing down the steps, namely:	Students devise a plan by writing down the steps, namely:
1. Eliminating equations	1. Eliminating equations
2. Substitute the p-value obtained in the first step	2. Substitute the p-value obtained in the first step
3. Substitute p-grades and b-grades to answer questions in questions	3. Substitute p-grades and b-grades to answer questions in questions

c. Carrying out the Plan

In this step, the subject can already carry out the plan under the plan written in the step of Devising a Plan. The results in carrying out the plan in questions number 1 and 2 can be seen in Figure 3. For a description of the answers see Table 6.

Tabel 6. Description of carrying out the plan

Description number 1	Description number 2
Students carry out the plan by:	Students carry out the plan by:
1. Students eliminate the b-value of both equations and get a p-value of 400.000	1. Students eliminate the b-value of the two equations and get a p-value of 2.000
2. Students substitute the value $p = 400.000$ to the first equation and get a b-value of 600.000	2. Students substitute the value $p = 2.000$ to the first equation and get a b-value of 2.500
3. Students substitute a $p = 400.000$ and a $b = 600.000$ grade to the equation asked in the question and get a result of 2.000.000	3. Students substitute a $p=2,000$ and a $b=2,500$ grade to the equation asked in the question and get a result of 9.000

C. Melaksanakan rencana.

$2b + 1p = 1.600.000$	$ b1 $	$2b + 1p = 1.600.000$	$ b1 $	$2b + 2p = ?$
$1b + 2p = 1.400.000$	$ b2 $	$-2b + 2p = 2.800.000$	$ b2 $	$(2 \times 600.000) + (2 \times 400.000)$
		$0 \quad -3p = -1.800.000$		$= 2.000.000$
		$-3p = -1.800.000$		
		$p = \frac{-1.800.000}{-3}$		
		$p = 400.000$		
$2b + 1p = 1.600.000$				
$2b + 400.000 = 1.600.000$				
$2b = 1.600.000 - 400.000$				
$b = \frac{1.200.000}{2}$				
$b = 600.000$				

C. Melaksanakan rencana.

$3p + 1b = 8.500$	$ b3 $	$9p + 3b = 25.500$
$1p + 3b = 9.500$	$ b1 $	$1p + 3b = 9.500$
		$8p + 0 = 16.000$
		$8p = 16.000$
		$p = \frac{16.000}{8}$
		$p = 2.000$
$1p + 3b = 9.500$		
$2.000 + 3b = 9.500$		
$3b = 9.500 - 2.000$		
$3b = 7.500$		
$b = \frac{7.500}{3}$		
$b = 2.500$		

$2p + 2b = ?$

$(2 \times 2.000) + (2 \times 2.500) =$

$4.000 + 5.000 =$

9.000

Figure 3. Carrying out the plan of questions number 1 and 2

d. Looking Back

In this step, the subject can be looking back through proving the results processed at the step of carrying out the plan according to known or unknown elements. The results in looking back at questions number 1 and 2 can be seen in Figure 4. For a description of the answers see Table 7.

d. Memeriksa kembali:

$2b + 1p = 1.600.000$
$(2 \times 600.000) + 400.000 =$
$1.200.000 + 400.000 = 1.600.000$

d. memeriksa kembali:

$3p + 1b = 8.500$
$(3 \times 2.000) + 2.500 =$
$6.000 + 2.500 =$
8.500

Figure 4. Examining questions number 1 and 2

Tabel 7. Description of looking back

Description number 1	Description number 2
Students looking back by substituting the value of $p = 400.000$ and the value of $b = 600.000$ into the first equation and get a result of 1.600.000 just like the equation known in the problem	Students looking back by substituting the value of $p = 2.000$ and the value of $b = 2.500$ into the first equation and get a result of 8.500 just like the equation known in the problem

In addition to the written test results, the following are the results of the KAW subject interview with a visual learning style

- Researchers* : What is known and asked in question number 1 and 2?
KAW : For question number 1, it is necessary to have known tires and springs, namely $2b + 1p = 1,600,000$ as the first equation and $1b + 2p = 1,400,000$ as the second equation. The question is $2b + 2p$. For question number 2, it is known that the pen and the book are then known to be $3p + 1b = 8,500$ as the first equation and $1p + 3b = 9,500$ as the second equation. The question is $2b + 2p$.
Researchers : What are plans made to address the problem?
KAW : I used the elimination and substitution methods for both numbers.
Researchers : Explain the steps to solve it! (explain one of the numbers only)
KAW : I solved number 1. The first and second equations in elimination get $p = 400,000$ and are substituted for one of the equations to get $b = 600,000$. For the price of 2 tires and 2 springs, it is 2,000,000
Researchers : Have you rechecked that your answer is correct?
KAW : Already
Researchers : How to prove that your answer is correct?
KAW : I substituted the results obtained and returned to the question.

Based on the analysis above results, students can conclude that a visual learning style can carry out problem-solving steps according to Polya, namely understanding problems, devising plans, implementing plans, and looking back. Students with a visual learning style can understand the problem well read the problem many times in their hearts write down what is known and ask about the problem, devising a mathematical model. Memorization is the process carried out to understand new information by searching for stored traces of memory (Sosa & Aguilar, 2021). Students with a visual learning style can make plans easily and simply in devising plans. In carrying out the plan, students make calculations correctly and correctly, and students can be looking back by proving the results obtained under known elements. This is in line with the results of the study (Umrana et al., 2019), which states that the mathematical problem-solving ability of students with a visual learning style according to Polya's steps can understand problems, plan problem-solving, carry out problem-solving plans, and looking back on the results of answers. This is in line with research (Al-hamzah & Awalludin, 2021), which states that subjects with a visual learning style can understand, plan, solve, and looking back. According to (Willia et al., 2020) in their research, subjects with a visual learning style could understand problems well, make a solution plan easily and simply so that they can do the solution correctly, and looking back. At the time of the interview, the subject often answers with a short answer. This aligns with the opinion (Sundayana, 2016) that visual learning styles often answer questions with a short answer, yes or no.

2. Data on the results of the mathematical problem-solving ability test according to Polya steps in BAK subjects based on auditory learning styles
 - a. Understanding the Problem

In this step, the subject can write down what is known, ask about the problem, and model mathematical sentences. In understanding the problem, the subject reads the question repeatedly in a reasonably loud voice. The results in understanding the problems in questions number 1 and 2 can be seen in Figure 5. For a description of the answers see Table 8.

1. a). memahami masalah	2. a). memahami masalah
misal = ban = b	misal = pulpen = p
pegas = p	buku = b
diket = $2b + 1p = 1.600.000 \dots (1)$	diket = $3p + 1b = 8.500 \dots (1)$
$1b + 2p = 1.400.000 \dots (2)$	$1p + 3b = 9.500 \dots (2)$
ditanya = $2b + 2p = \dots ?$	ditanya = $2p + 2b = \dots ?$

Figure 5. Understanding problem number 1 and 2

Tabel 8. Description of understanding the problem

Description number 1	Description number 2
Students understand the problem by assuming that <i>tires</i> = <i>b</i> and <i>springs</i> = <i>p</i> . Students write down what is known, namely equation $2b + 1p = 1.600.000$ as the first equation and equation $1b + 2p = 1.400.000$ as the second equation. Students also write down what is asked in the question, namely the $2b + 2p$ equation	Students understand the problem by passing <i>pen</i> = <i>p</i> and <i>book</i> = <i>b</i> . Students write down what is known, namely equation $3p + 1b = 8.500$ as the first equation and equation $1p + 3b = 9.500$ as the second equation. Students also write down what is asked in the question, namely the $2b + 2p$ equation

b. Devising a Plan

In this step, the subject can determine the concept, use all the information on the problem, and plan the problem's solution well in questions 1 and 2. The results in devising plans in questions number 1 and 2 can be seen in Figure 6. For a description of the answers see Table 9.

b. Membuat rencana penyelesaian	b. langkah membuat rencana
Langkah 1: eliminasi persamaan (2) * (1)	langkah 1. Eliminasi persm (1) * (2)
Langkah 2: substitusi nilai p	— 11 — 2: Substitusi nilai p
Langkah 3: Substitusi nilai p & b	— 11 — 3: Substitusi nilai p & b

Figure 6. Devising a plan for questions number 1 and 2

Tabel 9. Description of devising a plan

Description number 1	Description number 2
Students devise a plan by writing down the steps, namely:	Students devise a plan by writing down the steps, namely:
1. Eliminating the first equation and the second equation	1. Eliminating the first equation and the second equation
2. Substitute the p-value obtained in the first step	2. Substitute the p-value obtained in the first step
3. Substitute p-grades and b-grades to answer questions in questions	3. Substitute p-grades and b-grades to answer questions in questions

c. Carrying out the Plan

In this step, the subject can already carry out the plan under the plan written on the step of making a plan. The results of implementing the plan in questions number 1 and 2 can be seen in Figure 7. For a description of the answers see Table 10.

c. Melaksanakan rencana penyelesaian

$$\begin{array}{l|l} 2b + 1p = 1.600.000 & b_1 \\ 1b + 2p = 1.400.000 & b_2 \end{array} \quad \begin{array}{l} 2b + 1p = 1.600.000 \\ 2b + 1p = 2.800.000 \\ \hline 0 + -3 = -1.200.000 \\ -3p = -1.200.000 \\ p = \frac{-1.200.000}{-3} \\ p = 400.000 \end{array}$$

$2b + 1p = 1.600.000$
 $2b + 400.000 = 1.600.000$
 $2b = 1.600.000 - 400.000 = 1.200.000$
 $b = \frac{1.200.000}{2} = 600.000$

$2b + 2p = ?$
 $(2 \times 600.000) + (2 \times 400.000)$
 $= 2.000.000$

c. Melaksanakan rencana

$$\begin{array}{l|l} 3p + 1b = 8.500 & b_2 \\ 1p + 3b = 9.500 & b_1 \end{array} \quad \begin{array}{l} 3p + 1b = 8.500 \\ 1p + 3b = 9.500 \\ \hline 8p + 0 = 16.000 \\ 8p = 16.000 \\ p = \frac{16.000}{8} \\ p = 2.000 \end{array}$$

$1p + 3b = 9.500$
 $2000 + 3b = 9.500$
 $3b = 9.500 - 2000$
 $3b = 7.500$
 $b = \frac{7.500}{3} = 2.500$

$2p + 2b = ?$
 $(2 \times 2000) + (2 \times 2500) :$
 $= 4000 + 5000$
 $= 9.000$

Figure 7. Carrying out the plan of questions number 1 and 2

Tabel 10. Description of carrying out the plan

Description number 1	Description number 2
Students carry out the plan by:	Students carry out the plan by:
1. Students eliminate the b-value of both equations and get a p-value of 400.000	1. Students eliminate the b-value of the two equations and get a p-value of 2.000
2. Students substitute the value $p = 400.000$ to the first equation and get a b-value of 600.000	2. Students substitute the value $p = 2.000$ to the first equation and get a b-value of 2.500
3. Students substitute a $p = 400.000$ and a $b = 600.000$ grade to the equation asked in the question and get a result of 2.000.000	3. Students substitute a $p = 2.000$ and a $b = 2.500$ grade to the equation asked in the question and get a result of 9.000

d. Looking Back

In this step, the subject can be looking back through proving the results processed at the step of carrying out the plan according to known or unknown elements. The results in looking back at questions number 1 and 2 can be seen in Figure 8. For a description of the answers see Table 11.

d. Memeriksa kembali	d. Memeriksa kembali
$2b + 1p = 1.600.000$	$3p + 1b = 8.500$
$(2 \times 600.000) + 400.000 = 1.600.000$	$= (3 \times 2000) + (1 \times 2500)$
	$= 6000 + 2500$
	$= 8500$

Figure 8. Looking back questions number 1 and 2

Tabel 11. Description of looking back

Description number 1	Description number 2
Students looking back by substituting the value of $p = 400.000$ and the value of $b = 600.000$ into the first equation and get a result of 1.600.000 just like the equation known in the problem	Students looking back by substituting the value of $p = 2.000$ and the value of $b = 2.500$ into the first equation and get a result of 8.500 just like the equation known in the problem

In addition to the written test results, the following are the results of BAK subject interviews with auditory learning styles

- Researchers : What is known and asked in question number 1 and 2?
 BAK : For question number 1, the tires and springs must then be known to be $2b + 1p = 1,600,000$ for the first equation and $1b + 2p = 1,400,000$ for the second equation. The question is $2b + 2p$. For question number 2, it is known that the pen and the later-known books are $3p + 1b = 8,500$ for the first equation and $1p + 3b = 9,500$ for the second equation. What asked is $2b + 2p$.
 Researchers : What are plans made to address the problem?
 BAK : I used the elimination and substitution methods for both numbers.
 Researchers : Explain the steps to solve it! (explain one of the numbers only)
 BAK : I solved number 2. The first and second equations in elimination get $p = 2,000$ and are substituted to one of the equations obtained $b = 2,500$. For the price of 2 pens and 2 books, it is 9,000
 Researchers : Have you rechecked that your answer is correct?
 BAK : Already
 Researchers : How to prove that your answer is correct?
 BAK : I substituted the results obtained and returned to the question.

Based on the results of the analysis above, it can be concluded that students with an auditory learning style can carry out problem-solving steps according to Polya, namely understanding problems, devising plans, implementing plans, and looking back. Students with an auditory learning style can understand the problem well read the problem repeatedly in a reasonably loud voice, write down what is known and ask about the problem, and make a mathematical model.

Students with an auditory learning style can make plans easily and simply in devising plans. In carrying out the plan, students make calculations correctly and correctly, occasionally read the questions at a glance by moving their lips, and students can looking back by proving the results obtained under known elements. This is in line with the study's results (Masdy et al., 2021), which states that subjects with an auditory learning style can understand the problem, make a solution plan correctly, execute the problem-solving plan appropriately, and looking back on the final result. In line with research (Argarini, 2018), subjects with an auditory learning style can understand the problem well, make plans correctly, complete plans appropriately, and looking back at the answers already obtained. According to (H. Febriyanti & Pujiastuti, 2020), subjects with an auditory learning style have understood the problem, planned the solution, implemented the plan, and looking back. According to (Wahyuni, 2017) revealed that students who have an auditory learning style have the characteristics of enjoying reading aloud. In line with opinions (Sundayana, 2016) revealed that students who have an auditory learning style have the characteristics of moving their lips and saying writings in books when they are reading. At the time of the interview, the subject can explain the steps from beginning to end. This is in line with the opinion (Sundayana, 2016) that auditory learning styles like talking, discussing, and explaining things at length.

3. Data on the results of the mathematical problem-solving ability test according to Polya steps in AWA subjects based on kinesthetic learning styles.

a. Understanding the Problem

In this step, the subject cannot write down what information is known and is asked about the question. The subject read the question repeatedly, unable to stand still while moving his hand and hitting the pen on the table. Therefore, the subject has understood the problem for quite a long time.

b. Devising a Plan

In this step, the subject can determine the concept and plan the solution to the problem well in questions 1 and 2. The results in devising plans in questions number 1 and 2 can be seen in Figure 9. For a description of the answers see Table 12.

b) Membuat rencana	b) Membuat rencana
Langkah 1 : Eliminasi x	Langkah 1 : Eliminasi x
Langkah 2 : Substitusi nilai y	Langkah 2 : Substitusi nilai y
Langkah 3 : Substitusi nilai x dan y	Langkah 3 : Substitusi x dan y

Figure 9. Devising a plan for questions number 1 and 2

Tabel 12. Description of devising a plan

Description number 1	Description number 2
Students devise a plan by writing down the steps, namely:	Students devise a plan by writing down the steps, namely:
1. Eliminating equations	1. Eliminating equations
2. Substitute the value of x obtained in the first step	2. Substitute the value of x obtained in the first step
3. Substitute the value of x and the value of y to answer the questions in the question	3. Substitute the value of x and the value of y to answer the questions in the question

c. Carrying out the Plan

In this step, the subject could carry out the plan correctly even though he did not write down the information on the question. However, Students make plans simply. The results in carrying out the plan in questions number 1 and 2 can be seen in Figure 10. For a description of the answers see Table 13.

Handwritten work for question 1:

$$\begin{array}{rcl} 2x + y = 1.600.000 & \times 1 & 2x + y = 1.600.000 \quad (1) \\ x + 2y = 1.400.000 & \times 2 & 2x + 4y = 2.800.000 \quad (2) \\ \hline & & 0 - 3y = -1.200.000 \\ & & x = -1.200.000 : -3 \\ & & x = 400.000 \end{array}$$

Substitution:

$$x = 400.000 \text{ Substitusikan ke persm } \rightarrow 1$$

$$2x + y = 1.600.000$$

$$2x = 1.600.000 - 400.000$$

$$2x = 1.200.000$$

$$x = 600.000$$

$$2x + 2y = \dots ?$$

$$(600.000 \times 2) + (400.000 \times 2)$$

$$1.200.000 + 800.000 = 2.000.000$$

Handwritten work for question 2:

$$\begin{array}{rcl} 3x + y = 8.500 & \times 1 & 3x + y = 8.500 \\ x + 3y = 9.500 & \times 3 & 3x + 9y = 28.500 \quad - \\ \hline & & -8y = -20.000 \\ & & y = 2.500 \end{array}$$

Substitution:

$$3x + y = 8.500$$

$$3x + 2.500 = 8.500$$

$$3x = 6.000$$

$$x = 2.000$$

Verification:

$$2x + 2y = (2.000 \times 2) + (2.500 \times 2)$$

$$= 4.000 + 5.000$$

$$= 9.000$$

Figure 10. Carrying out the plan of questions number 1 and 2

Tabel 13. Description of carrying out the plan

Description number 1	Description number 2
Students carry out the plan by:	Students carry out the plan by:
1. Students eliminate the y-value of both equations and get a y-value of 400.000	1. Students eliminate the x-value of both equations and get a y-value of 2.500
2. Students substitute the value $y = 400.000$ to the first equation and get an x-value of 600.000	2. Students substitute the value $y = 2.500$ to the first equation and get an x-value of 2.000
3. Students substitute the value of $y = 400.000$ and the value of $x = 600.000$ to the equation asked in the question and get a result of 2.000.000	3. Students substitute the value of $y = 2.500$ and the value of $x = 2.000$ to the equation asked in the question and get a result of 9.000

d. Looking Back

In this step, the subject cannot be looking back at the results obtained at the step of carrying out the plan because time is not enough.

In addition to the written test results, the following are the results of the interview of AWA subjects with auditory learning styles

- Researchers* : *What is known and asked in question number 1 and 2?*
AWA : *I did not write down what is known and asked in questions number 1 and 2*
- Researchers* : *What are plans made to address the problem?*
AWA : *I used the elimination and substitution methods for both numbers.*
- Researchers* : *Explain the steps to solve it! (explain one of the numbers only)*
AWA : *I solved number 2. The first and second equations in elimination get $p = 2,000$ and are substituted for one of the equations obtained $b = 2,500$. For the price of 2 pens and 2 books, it is 9,000*
- Researchers* : *Have you rechecked that your answer is correct?*
AWA : *I didn't double-check the answer.*
- Researchers* : *Why don't you double-check the answer?*
AWA : *Because the time is not enough.*

Based on the results of the analysis above, it can be concluded that students with kinesthetic learning styles are less able to carry out problem-solving steps according to Polya, namely understanding problems, devising plans, implementing plans, and looking back. Students with a kinesthetic learning style cannot understand the problem well, namely not writing down what is known and asking the question. In devising plans, students with a kinesthetic learning style can also make a simple completion plan. In carrying out the plan, students can do calculations appropriately and correctly, and students are not able to looking back because time is not enough. This is in line with the research (Purwaningsih & Ardani, 2020), which states that male and compassionate subjects with a kinesthetic learning style are incapable of understanding problems, planning solutions, and executing plans well, and are unable to looking back. At the time of the interview, the subject replied slowly and did not want to be silent for a long time. This is in line with the opinion (Sundayana, 2016) that kinesthetic learning styles have the characteristics of speaking slowly, not being able to sit still for a long time, and preferring to do physical activity.

Conclusion

Based on the results of data analysis and discussion, conclusions were obtained, namely as follows: students with a visual learning style can understand problems well, make plans easily and simply so that in carrying out the plan students can do calculations correctly and can looking back. Students with an auditory learning style can understand problems well and make plans

easily and simply so that in carrying out the plan, students can do calculations correctly and can looking back. Students with a kinesthetic learning style are not able to understand problems well, can make a solution plan, can carry out student plans by doing calculations correctly, and looking back students are unable to check the calculations obtained. Students with a visual learning style can solve a problem with the Polya steps. Students with auditory learning styles can also solve a problem with the Polya steps. Students with a kinesthetic learning style have not been able to solve a problem with the Polya steps.

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