

## HOTS-oriented mathematical problem-solving ability reviewed from the students' learning styles

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### ABSTRACT

This research aims to analyze the students' mathematical problem-solving abilities in solving higher order thinking skills (HOTS) oriented mathematics problems in algebra material, particularly reviewed from their learning styles. This research used a qualitative descriptive method. The subjects of this research consisted of 6 students of Class VIII Science 4 at MTs Negeri 1 Surakarta. Data collection techniques consist of questionnaires, tests, and interviews. Data analysis techniques consist of data presentation, data reduction, and conclusion. The results of this research are the mathematical problem-solving abilities of Class VIII Science 4 students based on the visual learning style type which is the same as the auditory learning style in solving problems on linear equation system in two variable material, namely being able to carry out up to the fourth stage of Polya (understanding problems, planning, solving problems, and looking back at the process). Meanwhile, the mathematical problem-solving abilities of Class VIII Science 4 students are based on the kinesthetic learning style, namely implementing up to the third stage of Polya (understanding the problem, planning, and solving the problem).

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## Introduction

Mathematics is a science obtained by reasoning using terms that are defined carefully, clearly and accurately, represented by symbols or symbols and have meaning and can be used in solving problems related to numbers (Telaumbanua, 2020). Mathematics is a branch of science taught at all levels of education starting from kindergarten to college. Mathematics is a field of science in the form of a tool for thinking, communicating, a tool for solving problems in various practical problems, and has branches including arithmetic, algebra, geometry and analysis (Telaumbanua, 2020). Algebra also plays an important role for achievement in other mathematical domains such as analytical geometry, calculus, and statistics (Ghifari et al., 2021). Mathematics learning aims to ensure students have problem solving abilities which include the ability to build and complete mathematical models, understand problems and explain the solutions obtained, including solving everyday problems.

Problem-solving is a skill or potential that students have in solving problems and applying them in everyday life to find solutions to problems related to their learning activities, including solving mathematics problems (Yuaidah et al., 2022; Ardiawan, 2023). Problem solving abilities are very important for students to have because they can minimize mistakes when solving problems (Yuwono et al., 2018; Rahmawati et al., 2022). Students are trained not only to understand, but also to solve existing problems. Students could solve mathematical problems if they can understand, determine the right strategy, then apply it (Fauziah & Kurniasih, 2022).

According to Polya (1985) there are four indicators of solving a problem that must be carried out, including: (1) Understanding the problem, which is the first step taken when students want to solve a problem. (2) Planning a Solution, activities that can be carried out are, students write down plans that will be used to solve the problem. (3) Implementing the Plan, implementing the completion plan will be easier if the plan made is correct. (4) Re-examine the process and results obtained. Problem solving ability in mathematics is one of the higher order thinking skills (HOTS) activities. Students' ability to solve problems on different mathematics problems also make them have different higher-level thinking abilities (Manik & Ngurah, 2020; Mauleto, 2019).

HOTS has a concept in forming students' abilities independently, not only focusing on educational goals that have been set, including critical, creative, innovative thinking and being able to solve problems (Sriyanti et al., 2022; Febryana et al., 2023). If the same HOTS problem is given to different people, the solution will produce different answers. Higher Order Thinking Skills consist of three levels, namely Analyzing (C4), Evaluating (C5), and Creating (C6) (Irawati, 2018). If a student has reached the three levels above, then he can be classified as having the ability to think at a high level. Therefore, higher order thinking abilities (HOTS) need to be improved. This can be developed in the presentation of HOTS type mathematics questions taught in schools.

One of the factors that influences the level of students' problem-solving abilities is learning style. The work process or students' learning styles in solving problems are different, students have various learning styles. (Partington et al., 2021) states that learning style is an approach that explains how individuals learn or the way each person uses to concentrate on the process and master difficult and new information through different perceptions. Students who study with their dominant learning style when taking tests will achieve better grades than those who study in a way that is not in line with their learning style (Syawahid & Putrawangsa, 2017). Learning style includes how a person chooses to learn and how they think when facing learning tasks (Falah & Fatimah, 2019). In this research, the type of learning style is "In general, we use sensory preferences based on visual, auditory and kinesthetic" (Anggraini et al., 2021). Students who learn using a visual learning style tend to learn through the sense of the eye, students who use an auditory learning style tend to learn through the sense of hearing, while kinesthetic students tend to learn through movement & touch (Arfi et al., 2022).

In mathematics learning carried out in schools currently there are still many students who have low problem-solving abilities. In learning, students often experience difficulties and are unable to solve mathematical problems. Students have difficulty solving questions that are classified as problems. If the teacher gives students problems in the form of problem solving, most students cannot solve the questions, students appear confused in understanding the questions. Therefore, researchers want to try to conduct research related to students' problem-solving abilities in terms of each student's learning style and mathematical abilities in solving HOTS questions regarding two-variable linear equation systems. Students have the opportunity to find out to what extent their abilities are in solving problems. This research can provide experience in solving mathematics problems that can measure high-level thinking abilities.

## Method

To determine students' abilities in solving HOTS-type questions in terms of learning style, researchers made in-depth observations of what students did and wrote. This research was carried out using a qualitative approach with descriptive research type. The subjects in this research were class VIII Science 4 MTs Negeri Surakarta 1, totaling 28 students.

The instruments used were a learning style questionnaire, a test of mathematical problem-solving abilities, and interviews which had been validated by a team of experts. The questionnaire distribution aims to find out students' learning styles, contains questions that can provide information about students' learning styles and only provides answers according to their choices. The learning styles questionnaire instrument in this research was adopted from the learning styles questionnaire developed by O'Brien (1985). The learning style questionnaire consists of 30 statements with 10 statements referring to the visual learning style, 10 statements referring to the auditory learning style, and 10 statements referring to the kinesthetic learning style.

After obtaining student learning style data, 6 students were then selected as research subjects consisting of 2 students with a visual learning style (S1 and S2) with high and low mathematical abilities, 2 students with an auditory learning style (S3 and S4) with high mathematical abilities and low, and 2 students with kinesthetic learning styles (S5 and S6) with high and low mathematics abilities. The mathematical problem-solving ability test aims to determine the level of students' abilities in solving mathematical problems in student work, in the form of orders to work on HOTS type description questions with SPLDV material. The questions on mathematical problem-solving abilities in this study consisted of 3 questions. Question number 1 is a HOTS level C4 question, question number 2 is a HOTS level C5 question and question number 3 is a HOTS level C6 question. Interviews are used to find out and obtain information about the causes of student errors from the test results that have been analyzed.

The interview subjects were 6 students selected according to their learning styles and mistakes. The researcher's data was analyzed using a descriptive qualitative approach which aims to describe how students' abilities solve HOTS type questions in terms of their learning style. The analysis carried out by researchers used the opinion of Miles and Huberman (2014) which included the stages of data reduction, data presentation, and drawing conclusions.

## Results and discussion

### Mathematical problem-solving abilities based on visual learning style

S1 is a student with visual learning style, worked on three given problems. The specimen of S1's work on problem number 1 is available in Figure 1. Based on Figure 1, it shows that S1 is able to write down the elements that are known and asked about, S1 can model the problem into variables  $x$  and  $y$ . The solution is also precise and correct by using the substitution method so that you can write the conclusion correctly and precisely. S1 carried out the re-checking stage accurately and correctly. It is supported by the results of interview with S1 subject as follows.

- Researcher (R) : What information did you get after reading the question?  
 S1 : Comparison of the age 5 years ago and Fiqri's age 4 years in the future is equal to Erwanda's age minus 3 years and find the sum of their age.  
 R : What steps must be taken to solve the problem?  
 S1 : The first is to create an example of variables  $x$  and  $y$  then determine equations 1 and 2. Then solve it by substitution.  
 R : Try to explain the problem-solving process that you did on that question.

<p>1) Diket: Perbandingan umur Fiqri dan Erwanda 5 tahun lalu 4:5          Umur Fiqri 4 tahun yang akan datang = umur Erwanda 5 tahun yang akan datang          Ditanya: Berapa jumlah umur Fiqri dan Erwanda?          Jawab:          Misal: <math>x</math> = umur Fiqri  <math>y</math> = umur Erwanda          Perbandingan umur Fiqri dan Erwanda 5 tahun lalu 4:5  <math>\frac{x-5}{y-5} = \frac{4}{5}</math>  <math>5(x-5) = 4(y-5)</math>  <math>5x - 25 = 4y - 20</math>  <math>5x - 4y = 25 - 20</math>  <math>5x - 4y = 5</math> ..... (Pers. 1)          Umur Fiqri 4 tahun yang akan datang = umur Erwanda 5 tahun yang akan datang  <math>\frac{4+x}{5+y} = \frac{4}{5}</math>  <math>4+x = \frac{4}{5}(5+y)</math>  <math>4+x = 4 + \frac{4}{5}y</math>  <math>x = \frac{4}{5}y</math> ..... (Pers. 2)          Substitusi Pers. 2 ke Pers. 1  <math>5(\frac{4}{5}y) - 4y = 5</math>  <math>4y - 4y = 5</math>  <math>0 = 5</math>  <math>y = 20</math>          Substitusi nilai <math>y = 20</math> ke Persamaan 2  <math>x = \frac{4}{5}y</math>  <math>x = \frac{4}{5}(20)</math>  <math>x = 16</math></p>	<p>Jadi, umur Fiqri 16 tahun sedangkan umur Erwanda 20 tahun.          Jumlah umur Fiqri dan Erwanda adalah 16 + 20 = 36 tahun.          Menentukan kembali:          Nilai <math>x = 16</math> tahun          Nilai <math>y = 20</math> tahun          Persamaan 1: <math>5x - 4y = 5</math>          Persamaan 2: <math>x = \frac{4}{5}y</math>          Substitusi nilai <math>x</math> ke Pers. 1  <math>5(\frac{4}{5}y) - 4y = 5</math>  <math>4y - 4y = 5</math>  <math>0 = 5</math>  <math>y = 20</math>          Substitusi nilai <math>y = 20</math> ke Pers. 2  <math>x = \frac{4}{5}y</math>  <math>x = \frac{4}{5}(20)</math>  <math>x = 16</math>          Kesimpulan: Nilai <math>x</math> dan <math>y</math> dimasukkan ke Persamaan 1 dan Persamaan 2 menghasilkan jawaban yang benar.</p>
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Figure 1. S1's answer to question number 1

- S1 : Initially, make the example that  $x$  is Fiqri's age,  $y$  is Erwanda's age. Making equations 1 and 2 from what is known by cross multiplication, we get equation 1 and equation 2. Then substitute equation 2 into equation 1 and get the result  $y = 20$ . Substituting  $y = 20$  into equation 2 gets the result  $x = 17$ . So, Fiqri's age is 17 years, Erwanda is 20 years old, adding up to 37 years.
- R : How do I ensure that the answer obtained is the correct solution?
- S1 : I checked again by entering the  $x$  and  $y$  values into equations 1 and 2 and the answer was the same as at the beginning.

From the interview above, it can be concluded that S1 subjects are able to fulfill the four indicators of mathematical problem-solving ability in question number 1. S1 subjects are able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems, being able to plan problem solving and resolving problems, and being able to recheck the process and the results obtained.

Upon working on the question number 2, S1 perform the answer in Figure 2.

<p>2) Diketahui: Jumlah sepeda motor dan mobil di tempat parkir 98 unit          Total roda sepeda motor dan mobil = 260 buah          Ditanya: Menentukan pers. 1 dan pers. 2 yang benar?          Jawab:          Misal: <math>r</math> = jumlah sepeda motor  <math>s</math> = jumlah mobil          Total: Sepeda motor + mobil = 98 unit          Total: roda sepeda motor + mobil = 260 buah  <math>r + s = 98</math> ..... (Persamaan 1)  <math>2r + 4s = 260</math> ..... (Persamaan 2)          Eliminasi Pers. 1 dan Pers. 2  <math>r + s = 98</math> x 1  <math>2r + 4s = 260</math> x (-1)  <math>9r + 4s = 392</math>  <math>2r + 4s = 260</math>  <math>7r = 132</math>  <math>r = 18</math>          Substitusi nilai <math>r = 18</math> ke Persamaan 1  <math>r + s = 98</math>  <math>18 + s = 98</math>  <math>s = 98 - 18</math>  <math>s = 80</math>          Jadi, di tempat parkir ada 18 unit sepeda motor dan 80 unit mobil.          Untuk total sepeda motor dan mobil = 18 + 80 = 98 unit maka pernyataan yang benar adalah B dan C.</p>	<p>Menentukan kembali:          Nilai <math>r = 18</math>          Nilai <math>s = 80</math>          Persamaan 1: <math>r + s = 98</math>          Persamaan 2: <math>2r + 4s = 260</math>          Substitusi nilai <math>s</math> ke Persamaan 1  <math>r + s = 98</math>  <math>18 + s = 98</math>  <math>s = 98 - 18</math>  <math>s = 80</math>          Substitusi nilai <math>s</math> ke Persamaan 2  <math>2r + 4s = 260</math>  <math>2r + 4(80) = 260</math>  <math>2r + 320 = 260</math>  <math>2r = 260 - 320</math>  <math>2r = -60</math>  <math>r = -30</math>          Kesimpulan: Nilai <math>r</math> dan <math>s</math> dimasukkan ke Persamaan 1 dan 2 menghasilkan jawaban yang benar.</p>
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Figure 2. S1's answer to question number 2

Based on Figure 2, it shows that S1 is able to write down the elements that are known and asked about, S1 can model the problem into variables  $r$  and  $s$ . The solution is also precise and correct using mixed methods so that you can write conclusions correctly and precisely. S1 carried

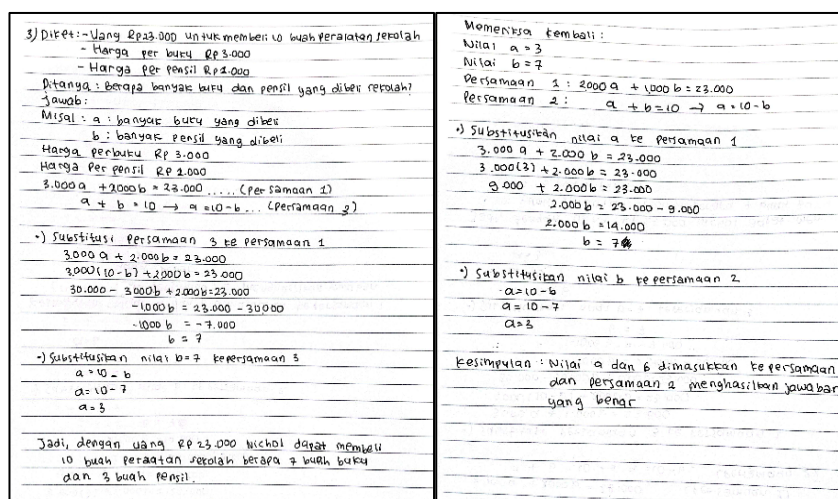


out the re-checking stage accurately and correctly. This is supported by the results of interviews. The following is an excerpt from the S1 subject interview.

- R : What information did you get after reading the question?  
 S1 : A total of 98 motorbikes and cars and 260 wheels. Then you are asked to prove which statement is true.  
 R : What steps must be taken to solve the problem?  
 S1 : Make variable examples and continue to determine equations 1 and 2.  
 Continue to solve them by elimination and substitution.  
 R : Try to explain the problem-solving process that you did on that question.  
 S1 : Determine the example  $r$  = many motorbikes and  $s$  = many cars. "Continue to look for equations 1 and 2, by eliminating it you get  $r = 66$ , then by substituting you get  $s = 32$ . So, in the parking lot there are 66 motorbikes and there are 32 cars, the difference is 34. So, the statements B and C are correct.  
 R : How do I ensure that the answer obtained is the correct solution?  
 S1 : Enter the values of  $r$  and  $s$  into equations 1 and 2 and the answer is the same as my answer above.

Thus, it can be concluded that S1 subjects are able to fulfill the four indicators of mathematical problem-solving ability in question number 2. S1 subjects are able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems, being able to plan problem solving and solving problems, and being able to re-examine the process and results obtained.

Upon working on the question number 3, S1 perform the answer in Figure 3.



3) Diket: - Uang Rp23.000 untuk membeli 10 buah peralatan sekolah  
 - Harga per buku Rp3.000  
 - Harga per pensil Rp2.000  
 Ditanya: Berapa banyak buku dan pensil yang dibeli?  
 Jawab:  
 Misal: a : banyak buku yang dibeli  
 b : banyak pensil yang dibeli  
 Harga per buku Rp3.000  
 Harga per pensil Rp2.000  
 $3.000a + 2.000b = 23.000$  ..... (Persamaan 1)  
 $a + b = 10$  ..... (Persamaan 2)  
 \*) Substitusi persamaan 2 ke persamaan 1  
 $3.000a + 2.000b = 23.000$   
 $3.000(10 - b) + 2.000b = 23.000$   
 $30.000 - 3.000b + 2.000b = 23.000$   
 $-1.000b = 23.000 - 30.000$   
 $-1.000b = -7.000$   
 $b = 7$   
 \*) Substitusi nilai  $b = 7$  ke persamaan 2  
 $a + b = 10$   
 $a + 7 = 10$   
 $a = 10 - 7$   
 $a = 3$   
 Jadi, dengan uang Rp23.000 Nichol dapat membeli 10 buah peralatan sekolah berupa 3 buku dan 7 buah pensil.

Momenya kembali:  
 Nilai  $a = 3$   
 Nilai  $b = 7$   
 Persamaan 1 :  $3.000a + 2.000b = 23.000$   
 Persamaan 2 :  $a + b = 10 \rightarrow a = 10 - b$   
 \*) Substitusi nilai  $a$  ke persamaan 1  
 $3.000a + 2.000b = 23.000$   
 $3.000(3) + 2.000b = 23.000$   
 $9.000 + 2.000b = 23.000$   
 $2.000b = 23.000 - 9.000$   
 $2.000b = 14.000$   
 $b = 7$   
 \*) Substitusi nilai  $b$  ke persamaan 2  
 $a + b = 10$   
 $a + 7 = 10$   
 $a = 10 - 7$   
 $a = 3$   
 Kesimpulan: Nilai  $a$  dan  $b$  dimasukkan ke persamaan 1 dan persamaan 2 menghasilkan jawaban yang benar.

Figure 3. S1's answer to question number 3

Based on Figure 3, it shows that S1 is able to write down the elements that are known and asked about, S1 can model the problem into variables  $a$  and  $b$ . The solution is also precise and correct using mixed methods so that you can write conclusions correctly and precisely. S1 carried out the re-checking stage accurately and correctly. The following is an excerpt of the S1 interview.

- R : What information did you get after reading the question?  
 S1 : Nichol's money is 23 thousand to buy 10 school equipment and the price per book is 3 thousand and the price per pencil is 2 thousand.

- R : What steps must be taken to solve the problem?
- S1 : Determine the equations a and b, continue to determine equations 1 and 2. Continue to solve by substitution.
- R : Try to explain the problem-solving process that you did on that question.
- S1 : Determine the example a = number of books purchased and b = number of pencils purchased. Continue looking for equations 1 and 2 from the problem, substituting the result is  $b = 7$ , then substituting b to get  $a = 3$ . So, Nichol bought 3 books and 7 pencils.
- R : How do I ensure that the answer obtained is the correct solution?
- S1 : Input the values a and b into equations 1 and 2 and the answer is the same.

So, it can be concluded that S1 subjects are able to fulfill the four indicators of mathematical problem-solving ability in question number 3. S1 subjects are able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems, being able to plan problem solving and solving problems, and being able to re-examine the process and results obtained.

Now, let's take a look at the work of S2, as presented in Figure 4.

1) Diket : Perbandingan umur Fiqri dan Ervanda 5 tahun yang lalu adalah 4:5, empat tahun yang akan datang umur Fiqri sama dengan umur Ervanda dikurangi 3 tahun.

Ditanya : Jumlah umur mereka berdua ?

Jawab :

Misal :  $E$  = Umur Fiqri  
 $F$  = Umur Ervanda

5 tahun yang lalu  
 $E = 4$   
 $F = 5$   
 $4E = 5F$   
 $4E - 5F = 5$  .... (Persamaan 1)

4 tahun yang akan datang  
 $4 + E = (F + 4) - 3$   
 $4 + E = F + 1$   
 $E = F + 1 - 4$   
 $E = F - 3$  .... (Persamaan 2)

Eliminasi pers 1 dan pers 2  
 $4E - 5F = 5$   $\times 1$   $4E - 5F = 5$   
 $E - F = -3$   $\times 4$   $4E - 4F = -12$   
 $-F = 17$   
 $F = -17$

$4E - 5F = 5$   
 $4E - 5(-17) = 5$   
 $4E + 85 = 5$   
 $4E = 5 - 85$   
 $4E = -80$   
 $E = -20$

Jadi, jumlah umur mereka berdua  $21 + 17 = 38$  tahun

Figure 4. S2's answer to question number 1

Based on Figure 4, it shows that S2 is able to write down the elements that are known and asked about, S2 can make the problem example into variables E and F. The solution is not precise so that the conclusion is also not written correctly. Subject S2 did not carry out the re-examination stage. The following is an excerpt from the S2 subject interview.

- R : What information did you get after reading the question?
- S2 : The ratio of Fiqri and Ervanda's ages 5 years ago was 4: 5, in four years Fiqri's age will be the same as Ervanda's age minus 3 years and then how old will they be?
- R : What steps must be taken to solve the problem?
- S2 : For example, looking for equations 1 and 2, continue looking for the values of E and F by elimination and substitution.
- R : Try to explain the problem-solving process that you did on that question.

- S2 : Initially, let  $E = \text{Fiqri's age}$  and  $F = \text{Ervanda's age}$ , then look for equations 1 and 2 from what is known in the question, then eliminate and substitute to get the results  $E = -21$  and  $F = -17$ .  
So, the sum of their ages is  $-38$ .
- R : After doing the work, you didn't check your answer again?
- S2 : I don't have time, Sis, I'm afraid there won't be enough time to do the next question.  
But I'm also confused about why the age result is  $(-)$ .
- R : Yes, the steps in the process are wrong, the part to find equation 1 should be cross-multiplied.
- S2 : Oh, I forgot.

So, it can be concluded that S2 was only able to fulfill 2 indicators of mathematical problem-solving ability in question number 1. Master's subjects are able to fulfill indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem solutions.

a) Diket : Tempat parkir dapat menampung sepeda motor dan mobil sebanyak 98 unit. jumlah roda seluruhnya ada 260 buah.  
 Ditanya: Pernyataan berikut manakah yang benar?  
 jawab :  
 Misal :  $x = \text{Sepeda motor}$   
 $y = \text{mobil}$   
 $x + y = 98 \dots\dots (1)$   
 $2x + 4y = 260 \dots\dots (2)$   
 Eliminasi: Pers (1) dan (2).  
 $x + y = 98$   
 $2x + 4y = 260$  |  $\times 2$  |  $2x + 2y = 196$   
 $2x + 4y = 260$  |  $\times 1$  |  $2x + 4y = 260$   
 $-2y = -64$   
 $y = 32$   
 $x + y = 98$   
 $x + 32 = 98$   
 $x = 98 - 32$   
 $x = 66$   
 Jadi, terdapat 66 sepeda motor dan 32 mobil.  
 Sejenis sepeda motor dan mobil adalah  $66 + 32 = 98$  unit

Figure 5. S2's answer to question number 2

Based on Figure 5, it shows that S2 is able to write down the elements that are known and asked about, subject S2 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of  $x$  and  $y$  variables. The solution is also precise and correct using mixed methods so that you can write conclusions correctly and precisely. Subject S2 did not carry out the re-examination stage. The following is an excerpt from the S2 subject interview.

- R : What information did you get after reading the question?
- S2 : The parking lot can accommodate 98 motorbikes and cars. There are a total of 260 wheels. Asked which of the following motor statements is true?
- R : What steps must be taken to solve the problem?
- S2 : For example  $x$  and  $y$ , look for equations 1 and 2, then eliminate and substitute to find the values for  $x$  and  $y$ .
- R : Try to explain the problem-solving process that you did on that question.
- S2 : Initially, let  $x = \text{motorbike}$  and  $y = \text{car}$ , then look for equations 1 and 2 from what is known in the question, then eliminate and substitute to get the results  $y = 32$  and  $x = 66$ . So there are 66 motorbikes and 32 cars, the difference motorbikes and cars are 34 units.
- R : After doing the work, you didn't check your answers again?
- S2 : I have no time.

So, it can be concluded that the S2 subject is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 2. The S2 subject is able to fulfill the indicators of

mathematical problem-solving ability, namely being able to understand problems and being able to plan problem solving and solving problems.

3) Diket: Nichol mempunyai uang sebesar Rp23.000  
 Uang tersebut akan dihabiskan untuk membeli  
 10 buah peralatan sekolah. Ia membeli buku  
 dengan harga Rp3.000/buku dan pensil  
 dengan harga Rp2.000/pensil.  
 Ditanya: Berapa banyak buku dan banyak pensil  
 yang dibeli Nichol?

Jawab  
 Misal :  $a$  = buku  
 $b$  = pensil

$$3.000a + 2.000b = 23.000 \quad (1)$$

$$a + b = 10 \quad (2)$$

Eliminasi pers (1) dan (2)

$$\begin{array}{r} 3.000a + 2.000b = 23.000 \quad \times 1 \\ a + b = 10 \quad \times 2.000 \\ \hline 3.000a + 2.000b = 23.000 \\ 2.000a + 2.000b = 20.000 - \\ \hline 1.000a = 3.000 \\ a = 3 \end{array}$$

$$a + b = 10$$

$$3 + b = 10$$

$$b = 10 - 3$$

$$b = 7$$

Jadi, Nichol membeli 3 buku dan 7 pensil

Figure 6. S2's answer to question number 3

Based on Figure 6, it shows that S2 is able to write down the elements that are known and asked about, subject S2 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of variables  $a$  and  $b$ . The solution is also precise and correct using mixed methods so that you can write conclusions correctly and precisely. Subject S2 did not carry out the re-examination stage. The following is an excerpt from the S2 subject interview.

- R : What information did you get after reading the question?
- S2 : Nichol has 23 thousand, this money will be spent to buy 10 pieces of school equipment. He bought books at a price of 3 thousand per book and pencils at a price of 2 thousand per pencil. How many books and pencils did Nichol buy?
- R : What steps must be taken to solve the problem?
- S2 : For example  $a$  and  $b$ , look for equations 1 and 2, then eliminate and substitute to find the values for  $a$  and  $b$ .
- R : Try to explain the problem-solving process that you did on that question.
- S2 : Initially, let  $a$  = book and  $b$  = pencil, look for equations 1 and 2 from what is known in the question, then eliminate and substitute to get the result  $a = 3$  and  $y = 7$ . So Nichol bought 3 books and 7 pencils.
- R : After doing the work, you didn't check your answers again?
- S2 : No.

So, it can be concluded that the S2 subject is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 3. The S2 subject is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem solving and solving problems.

### Mathematical problem-solving abilities based on auditory learning style

S3 is a subject with auditory learning style, worked on three given problems. The specimen of S3's work on problem number 1 is available in Figure 7.



**Contoh:**  
 $5x - 4y = 5$   
 $5(17) - 4y = 5$   
 $85 - 4y = 5$   
 $-4y = -80$   
 $y = 20$   
 Jadi, sudah benar

**2. Diket:** Jumlah sepeda motor dan mobil 98  
 Total roda seluruhnya = 260  
 Ditanya: Manakah pernyataan yang benar  
 Jawab:  
 Misalkan:  
 $x = \text{Sepeda motor}$   
 $y = \text{Mobil}$   
 $x + y = 98 \rightarrow x = 98 - y \dots (1)$   
 $2x + 4y = 260 \rightarrow x = 130 - 2y \dots (2)$   
 Substitusi:  
 $2x + 4y = 260$   
 $2(98 - y) + 4y = 260$   
 $196 - 2y + 4y = 260$   
 $2y = 260 - 196$   
 $y = 32$   
 Jadi, ada 32 sepeda motor dan 32 mobil dengan  
 seluruh 66 + 32 = 98  
 Maka pernyataan yang benar adalah B dan C

**1. Diket:** Perbandingan umur Fiqri dan Erwanda 5 tahun lalu 4:3  
 - Umur Fiqri 4 tahun yang akan datang = umur Erwanda  
 ditanya: Berapa jumlah umur Fiqri dan Erwanda?  
 Jawab:  
 Misalkan:  
 $x = \text{Fiqri}$   
 $y = \text{Erwanda}$   
 $5 \text{ tahun lalu}$   
 $\frac{x-5}{y-5} = \frac{4}{3}$   
 $3(x-5) = 4(y-5)$   
 $3x - 15 = 4y - 20$   
 $3x - 4y = -5 \dots (1)$   
 $4 \text{ tahun yang akan datang umur Fiqri} = \text{umur Erwanda}$   
 $3 \text{ tahun}$   
 $4(x+3) = 3(y+3)$   
 $4x + 12 = 3y + 9$   
 $4x - 3y = -3 \dots (2)$   
 Substitusi:  
 $5x - 4y = 5$   
 $5(17 - 3) - 4y = 5$   
 $5(14) - 4y = 5$   
 $70 - 4y = 5$   
 $-4y = 5 - 70$   
 $-4y = -65$   
 $y = 16.25$   
 Jadi, jumlah umur mereka berdua adalah 20 + 17 = 37 tahun

Figure 7. S3's answer to question number 1

Based on Figure 7, it shows that S3 is able to write down the elements that are known and asked about, subject S3 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of  $x$  and  $y$  variables. The solution is also precise and correct by using the substitution method so that you can write the conclusion correctly and precisely. S3 carried out the re-checking stage accurately and correctly. The following is an excerpt from the S3 subject interview.

- R : What information did you get after reading the question?  
 S3 : It is known that the age comparison between Fiqri and Erwanda was 5 years ago. Fiqri's age in 4 years will be the same as Erwanda's age minus 3 years. I asked how old they both are.  
 R : What steps must be taken to solve the problem?  
 S3 : The first is to create an example of variables  $x$  and  $y$ , then determine equations 1 and 2. Continue to substitute to find the values of  $x$  and  $y$ .  
 R : Try to explain the problem-solving process that you did on that question.  
 S3 : Make an example where  $x$  is Fiqri,  $y$  is Erwanda. Making equations 1 and 2 from what is known by cross multiplication, we get equation 1 ' $5x - 4y = 5$ ' and equation 2 ' $x = y - 3$ '. Then substitute equation 2 into equation 1 to get the result  $y = 20$ . Substitute the value  $y = 20$  "Going to equation 2, the result is  $x = 17$ . So, Fiqri's age is 17 years, Erwanda's age is 20 years, so the sum of their ages is 37 years.  
 R : How do I ensure that the answer obtained is the correct solution?  
 S3 : I entered the value  $x = 17$  into equation 1 and got the value  $y = 20$  and then entered the value  $y$  into equation 2 and got the value  $x = 17$ . So, the answer is the same.

So, it can be concluded that the S3 subject is able to fulfill the four indicators of mathematical problem-solving ability in question number 1. The S3 subject is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems, being able to plan problem solving and solving problems, and being able to re-examine the process and results.

Figure 8 shows that S3 is able to write down the elements that are known and asked about, subject S3 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of  $x$  and  $y$  variables.

The following is an excerpt from the S3 subject interview.

- R : What information did you get after reading the question?  
 S3 : It is known that there are 98 motorbikes and cars and a total of 260 wheels.  
 Asked which statement is correct?

**2. Dikets: Jumlah sepeda motor dan mobil 98**  
**Totol roda seluruhnya 260**  
**Ditanya: Menentukan pernyataan yang benar**  
**Jawab:**  
**Misalkan:**  
 $x$  = sepeda motor  
 $y$  = mobil  
 $x + y = 98 \rightarrow x = 98 - y \dots (1)$   
 $2x + 4y = 260 \dots (2)$   
**Substitusi**  
 $2x + 4y = 260$   
 $2(98 - y) + 4y = 260$   
 $196 - 2y + 4y = 260$   
 $2y = 260 - 196$   
 $2y = 64$   
 $y = 32$   
**Jadi, ada 66 sepeda motor dan 32 mobil dengan**  
**selisih  $66 - 32 = 34$**   
**Maka pernyataan yang benar adalah B dan C**

**Car kembali:**  
 $x = 98 - y$   
 $2(98 - y) + 4y = 260$   
 $196 - 2y + 4y = 260$   
 $2y = 260 - 196$   
 $2y = 64$   
 $y = 32$   
**Jadi, sudah benar**

**3. Dikets: Liliang Rp 15.000 untuk membeli 10 permen dan 5 pensil**  
**Hanya per buku Rp 3.000**  
**Hanya per pensil Rp 1.000**  
**Ditanya: Banyak buku dan pensil yang dibeli?**  
**Jawab:**  
**Misalkan:**  
 $x$  = buku  
 $y$  = pensil  
 $x + y = 10 \rightarrow x = 10 - y \dots (1)$   
 $3.000x + 1.000y = 15.000 \dots (2)$   
**Substitusi**  
 $3.000x + 1.000y = 15.000$   
 $3.000(10 - y) + 1.000y = 15.000$   
 $30.000 - 3.000y + 1.000y = 15.000$   
 $30.000 - 2.000y = 15.000$   
 $-2.000y = 15.000 - 30.000$   
 $-2.000y = -15.000$   
 $y = 7$   
**Jadi, sudah benar**

Figure 8. S3's answer to question number 2

- R : What steps must be taken to solve the problem?
- S3 : Make an example of variables  $x$  and  $y$ , continue to determine equations 1 and 2. Continue to substitute to find the  $x$  value,  $y$  value, and the difference between the  $x$  and  $y$  values.
- R : Try to explain the problem-solving process that you did on that question.
- S3 : Initially, let's say  $x$  = motorbike and  $y$  = car. Determine equation 1 and equation 2 from the problem. The result of equation 1 is  $x = 98 - y$  and equation 2 is  $2x + 4y = 260$ . Continuing to substitute equation 1 into equation 2, the result is  $y = 32$ . Continuing to substitute the value  $y = 32$  into equation 1, the result is  $x = 66$ . So, there are 66 motorbikes and 32 cars with a difference of  $66 - 32 = 34$ . So the correct statements are B and C.
- R : How do I ensure that the answer obtained is the correct solution?
- S3 : I entered the value  $x = 66$  into equation 2 and got the value  $y = 32$  and then entered the value  $y$  into equation 1 and got the value  $x = 66$ . So, the answer is the same.

So, it can be concluded that the S3 subject is able to fulfill the four indicators of mathematical problem-solving ability in question number 2. The S3 subject is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems, being able to plan problem solving and solving problems, and being able to re-examine the process and results.

**Car kembali:**  
 $x = 98 - y$   
 $2(98 - y) + 4y = 260$   
 $196 - 2y + 4y = 260$   
 $2y = 260 - 196$   
 $2y = 64$   
 $y = 32$   
**Jadi, sudah benar**

**3. Dikets: Liliang Rp 15.000 untuk membeli 10 permen dan 5 pensil**  
**Hanya per buku Rp 3.000**  
**Hanya per pensil Rp 1.000**  
**Ditanya: Banyak buku dan pensil yang dibeli?**  
**Jawab:**  
**Misalkan:**  
 $x$  = buku  
 $y$  = pensil  
 $x + y = 10 \rightarrow x = 10 - y \dots (1)$   
 $3.000x + 1.000y = 15.000 \dots (2)$   
**Substitusi**  
 $3.000x + 1.000y = 15.000$   
 $3.000(10 - y) + 1.000y = 15.000$   
 $30.000 - 3.000y + 1.000y = 15.000$   
 $30.000 - 2.000y = 15.000$   
 $-2.000y = 15.000 - 30.000$   
 $-2.000y = -15.000$   
 $y = 7$   
**Jadi, sudah benar**

Figure 9. S3's answer to question number 3

Based on Figure 9, it shows that S3 is able to write down the elements that are known and asked about, subject S3 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of  $x$  and  $y$  variables. The solution is also precise and correct by using the substitution method so that you can write the conclusion correctly and precisely. S3 carried out the re-checking stage accurately and correctly. The following is an excerpt from the S3 subject interview.

- R : What information did you get after reading the question?
- S3 : It is known that Nichol's money was IDR 23,000.00 to buy 10 school equipment. The price per book is IDR 3,000 and the price per pencil is IDR 2,000. Asked how many books and pencils Nichol bought.
- R : What steps must be taken to solve the problem?
- S3 : Make an example of variables  $x$  and  $y$ , continue to determine equations 1 and 2. Continue to substitute to find the value of  $x$  and the value of  $y$ .
- R : Try to explain the problem-solving process that you did on that question.
- S3 : Make an example of  $x$  = book and  $y$  = pencil. Determine equation 1 and equation 2 from the problem. The result of equation 1 is  $x = 10 - y$  and equation 2 is  $3,000x + 2,000y = 23,000$ . Continue to substitute equation 1 into equation 2, the result is  $y = 7$ . Continuing to substitute the value  $y = 7$  into equation 1, the result is  $x = 3$ . So, the number of books purchased was 3 and the pencils purchased were 7.
- R : How do I ensure that the answer obtained is the correct solution?
- S3 : Inputting the value  $x = 3$  into equation 2 results in the value  $y = 7$ . Then entering the value  $y$  into equation 1 results in the value  $x = 3$ . So, the answer is the same.

So, it can be concluded that the S3 subject is able to fulfill the four indicators of mathematical problem-solving ability in question number 3. The S3 subject could fulfill the indicators of mathematical problem-solving ability, namely to understand problems, to plan problem solving and solving problems, and to re-examine the process and results obtained.

1. Diket : - Perbandingan umur Fitri dan Erwanda 4 tahun lalu 4:5  
 - Umur Fitri 4 tahun yang akan datang sama dengan umur Erwanda dikurangi 3 tahun  
 Ditanya : Berapa jumlah umur mereka berdua?  
 Jawab :  
 Misal :  $x$  : Fitri  
 $y$  : Erwanda  
 $x-4$   
 $y-4$   
 $\frac{x-4}{4} = \frac{y-4}{5}$   
 $4x - 16 = 4y - 16$   
 $4x - 4y = 0$   
 $x - y = 0$  ... (1)  
 $x - 4 = y - 4 - 3$   
 $x - y = -3$  ... (2)  
 Substitusi pers (2) ke pers (1)  
 $4x - 4y = 0$   
 $4(x - y) = 0$   
 $4x - 4y = 0$   
 $4x - 4y = 0$   
 $4x - 4y = 0$   
 $8y = 33$

Figure 10. S4's answer to question number 1

Based on Figure 10, it shows that S4 is able to write down the elements that are known and asked about, subject S4 can make the problem example into a variable, but it is not quite right because the subject is unable to understand writing examples of  $x$  and  $y$  variables. The solution is not precise and there is no conclusion. Subject S4 did not carry out the re-examination stage. The following is an excerpt from the interview with subject S4.

- R : What information did you get after reading the question?
- S4 : It is known that the ratio between Fitri and Erwanda's ages 5 years ago was 4: 5, in four years Fitri's age will be the same as Erwanda's age minus 3 years and then how old will they be?
- R : What steps must be taken to solve the problem?
- S4 : Looking for equations 1 and 2, continue looking for  $x$  and  $y$  values with substitution.
- R : Try to explain the problem-solving process that you did on that question.
- S4 : Initially, let's say  $x$  = Fitri and  $y$  = Erwanda, then look for equations 1 and 2 from what is known

in the question, then substitute equation 2 into equation 1, but I've only gotten here, because the problem is  $9y = 33$  if you continue then the value of  $y$  will be coma, it looks like there's something wrong with the process, I'm going to redo it, I'm afraid I'm running out of time.

R : Yes, the steps in the process were wrong at the beginning, from the section on finding the equation 1, it should have been multiplied by a cross.

S4 : Yes, sis, that's why the results didn't meet, I saw that my friends were different too, that's why I passed it first because the time was running out.

So, it can be concluded that subject S4 is only able to fulfill 2 indicators of mathematical problem-solving ability in question number 1. Subject S4 is able to fulfill indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem solutions.

2. Diket: Jumlah sepeda motor dan mobil = 98 unit  
Roda seluruhnya = 260 buah  
Ditanya: Per  
Jawab: :  
Misal:  $x$  : Sepeda motor  
 $y$  : mobil  
 $x + y = 98$   $\times 2$   $2x + 2y = 196$   
 $2x + 4y = 260$   $\times 1$   $2x + 4y = 260$   
 $2y = 64$   
 $y = 32$   
Substitusi  
 $x + y = 98$   
 $y + 32 = 98$   
 $x = 66$   
Banyak sepeda motor = 66  
Banyak mobil = 32  
Selisih =  $66 - 32$   
 $= 34$

**Figure 11.** S4's answer to question number 2

Based on Figure 11, it shows that S4 is able to write down the elements that are known and asked about, subject S4 can make the problem example into a variable, but it is not quite right because the subject is unable to understand writing examples of  $x$  and  $y$  variables. The solution is correct using the substitution method and there is a conclusion. Subject S4 did not carry out the re-examination stage. The following is an excerpt from the interview with subject S4.

R : What information did you get after reading the question?

S4 : It is known that the number of motorbikes and cars is 98 units and the total number of wheels is 260 units, does this continue to prove the correct statement?

R : What steps must be taken to solve the problem?

S4 : Make an example, continue to look for  $x$  and  $y$  values by substituting equations 1 and 2.

R : Try to explain the problem-solving process that you did on that question.

S4 : Make the example  $x$  = motorbike and  $y$  = car, get equation 1 ' $x + y = 98$ ' and equation 2 ' $2x + 4y = 260$ ' from what is known in the question, then eliminate equation 1 and equation 2 to get the value  $y = 32$ , then substituting the  $y$  value into equation 1, the result is  $x = 66$ . So the number of motorbikes = 66, cars = 32, and the difference = 34.

R : After doing the work, you didn't check your answer again?

S4 : No time.

So, it can be concluded that subject S4 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 3. Subject S4 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem solving and solve problems.

3. Diket : Uang Rp 23.000 untuk membeli 10 peralatan sekolah  
 Harga per buku Rp 3.000  
 Harga per pensil Rp 2.000  
 Ditanya : Berapa banyak buku dan banyak pensil yang dibeli Nichol

Jawab :

Misal :  $x$  = Buku  
 $y$  = Pensil

$$x + y = 10 \rightarrow y = 10 - x \dots (1)$$

$$3000x + 2000y = 23.000$$

substitusi

$$3000x + 2000y = 23.000$$

$$3000(10 - x) + 2000y = 23.000$$

$$30.000 - 1000x + 2000y = 23.000$$

$$-1000x + 2000y = 23.000 - 30.000$$

$$-1000x + 2000y = -7.000$$

$$y = 7$$

$$x = 10 - y$$

$$x = 10 - 7$$

$$x = 3$$

Nichol membeli 3 buku dan 7 pensil

Figure 12. S4's answer to question number 3

Based on Figure 12, it shows that S4 is able to write down the elements that are known and asked about, subject S4 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of  $x$  and  $y$  variables. The solution is correct and the conclusion is also correct. Subject S4 did not carry out the re-examination stage. The following is an excerpt from the interview with subject S4.

- R : What information did you get after reading the question?
- S4 : Nichol has 23 thousand to buy 10 school equipment. The price per book is 3 thousand and the price per pencil is 2 thousand. Then asked how many books and pencils Nichol bought?
- R : What steps must be taken to solve the problem?"
- S4 : Make an example of  $x$  and  $y$ , look for equations 1 and 2, continue to look for  $x$  and  $y$  values with substitution.
- R : Try to explain the problem-solving process that you did on that question.
- S4 : For example,  $x$  = book and  $y$  = pencil, we get equation 1 ' $x = 10 - y$ ' and equation 2 ' $3,000x + 2,000y = 23,000$ ' from what is known in the question, then substitute to get the values  $x = 3$  and  $y = 7$ . So, Nichol bought 3 books and 7 pencils.
- R : After doing the work, you didn't check your answers again?
- S4 : No time.

So, it can be concluded that subject S4 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 3. Subject S4 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem-solving and solve problems.

### Mathematical problem-solving abilities based on kinesthetic learning style

S5 is a subject with kinesthetic learning style, worked on three given problems. The specimen of S5's work on problem number 1 is available in Figure 13.

Based on Figure 13, it shows that S5 is able to write down the elements that are known and asked about, subject S5 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of  $x$  and  $y$  variables. The solution is correct and the conclusion is also correct. Subject S5 carried out the checking stage again but it was not correct.



Dik: - Perbandingan umur 5 tahun lalu 4:5  
- umur Fiqri 4 tahun yang akan datang = umur Ervanda di kurangi 3 tahun  
Ditanya: Berapa jumlah umur mereka berdua?

Jawab:  
Misal:  
x : Fiqri  
y : Ervanda  
 $\frac{x-5}{5} = \frac{y-5}{4}$   
 $\frac{x-5}{5} = \frac{y-5}{4}$   
 $(x-5) \cdot 4 = (y-5) \cdot 5$   
 $5x - 25 = 4y - 20$   
 $5x - 4y = 25 - 20$   
 $5x - 4y = 5$  ..... (1)  
 $4 + x = (y - 3) - 3$   
 $4 + x = y - 6$   
 $x = y - 6 - 4$   
 $x = y - 10$  ..... (2)  
Masukkan Pers. (2) ke Pers. (1)  
 $5x - 4y = 5$   
 $5(y - 10) - 4y = 5$   
 $5y - 50 - 4y = 5$   
 $y - 50 = 5$   
 $y = 5 + 50$   
 $y = 55$   
Masukkan nilai  $y = 55$  ke Pers. (2)  
 $x = y - 10$   
 $x = 55 - 10$   
 $x = 45$   
Jadi jumlah umur mereka berdua adalah  $45 + 55 = 100$  tahun  
Maka jawaban kembali: umur Fiqri : 45 tahun  
- umur Ervanda : 55 tahun  
Total umur mereka berdua :  $45 + 55 = 100$  tahun

Figure 13. S5's answer to question number 1

The following is an excerpt from the interview with subject S5.

- R : What information did you get after reading the question?
- S5 : The ratio of age 5 years ago is 4:5 and Fiqri's age 4 years from now = Ervanda's age minus 3 years. Then ask how old the two of them are?
- R : What steps must be taken to solve the problem?
- S5 : The first step is to write down what is known and what is asked, continue to create variable examples, continue to look for equations 1 and 2, continue to look for x and y values.
- R : Try to explain the problem-solving process that you did on that question.
- S5 : For example:  $x = \text{Fiqri}$  and  $y = \text{Ervanda}$
- |   |   |
|---|---|
| $\begin{array}{rcl} x - 5 & 4 & \text{(cross multiplication)} \\ : y - 5 & 5 & \\ (x - 5) 5 = (y - 5) 4 & & \\ 5x - 25 = 4y - 20 & & \\ 5x - 4y = 25 - 20 & & \\ 5x - 4y = 5 & \dots\dots\dots & \text{(equation 1)} \end{array}$ | $\begin{array}{rcl} 4 + x & = & (4 + y) - 3 \\ 4 + x & = & y + 1 \\ x & = & y + 1 - 4 \\ x & = & y - 3 \dots\dots\dots \text{(equation 2)} \end{array}$ |
|---|---|
- Continue substituting equation 2 into equation 1
- $$\begin{array}{l} 5x - 4y = 5 \\ 5(y - 3) - 4y = 5 \\ 5y - 15 - 4y = 5 \\ y = 5 + 15 \\ y = 20 \end{array}$$
- Substitute the value  $y = 20$  into equation 2
- $$\begin{array}{l} x = y - 3 \\ x = 20 - 3 \\ x = 17 \end{array}$$
- So, the sum of their ages is  $17 + 20 = 37$  years.
- R : How do I ensure that the answer obtained is the correct solution?
- S5 : The results show that Fiqri's age is 17 years and Ervanda's age is 20 years, so their total age =  $17 + 20 = 37$  years, right?
- R : That's not the correct way to double check, sir, so you should double check the x and y values by inserting them into one of equations 1 and 2, try repeating it.

$$\begin{array}{lcl}
 \text{S5} : & 5x - 4y = 5 & \\
 & 5(17) - 4y = 5 & \\
 & 85 - 4y = 5 & \\
 & -4y = 5 - 85 & \\
 & -4y = -80 & \\
 & y = 20 &
 \end{array}
 \quad \left| \quad \begin{array}{l}
 x = y - 3 \\
 x = 20 - 3 \\
 x = 17
 \end{array}
 \right.$$

So, it has been proven that the answer is correct

Is that correct?

R : Yes, that's correct, so every time you check it again it's like that.

So, it can be concluded that subject S5 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 1. Subject S5 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem solving and solve problems.

2. Diket : - jumlah motor + mobil : 98 unit  
 - Roda seluruhnya : 260 buah  
 Ditanya : Persamaan yang benar?  
 Jawab :  
 Misal : m : Sepeda motor  
 n : Mobil  
 $m + n = 98$  ..... (1)  
 $2m + 4n = 260$  ..... (2)  
 Eliminasi  
 $m + n = 98$      $\times 2$      $2m + 2n = 196$   
 $2m + 4n = 260$      $\times 1$      $2m + 4n = 260$   
 $\quad \quad \quad -2n = -64$   
 $\quad \quad \quad n = 32$   
 Masukkan nilai n ke pers (1)  
 $m + n = 98$   
 $m + 32 = 98$   
 $m = 98 - 32$   
 $m = 66$   
 Jadi terdapat 66 sepeda motor dan 32 mobil dengan  
 selisih  $66 - 32 = 34$   
 maka pernyataan yang benar adalah B dan C  
 memeriksa kembali :  
 Dengan di ketahui jumlah sepeda motor dan mobil  
 sebanyak 98 unit serta jumlah roda seluruhnya adalah  
 260 buah, di dapatkan hasil jumlah sepeda motor ada  
 66 dan mobil ada 32 dengan selisih 34 buah

Figure 14. S5's answer to question number 2

Based on Figure 14, it shows that S5 is able to write down the elements that are known and asked about, subject S5 can make the problem example into a variable, but it is not quite right because the subject is unable to understand writing the example of variables m and n. The solution is correct and the conclusion is also correct. Subject S5 carried out the checking stage again but it was not correct. The following is an excerpt from the interview with subject S5.

R : What information did you get after reading the question?

S5 : Number of motorbikes and cars = 98 units and total number of wheels = 260 units.  
 Keep asking the right questions?

R : What steps must be taken to solve the problem?

S5 : Write down what you know and ask, keep making examples of m and n, keep looking for equations 1 and 2, keep looking for the values of m and n.

R : Try to explain the problem-solving process that you did on that question.

S5 : Determine the example m = motorbike and n = car

$$m + n = 98 \dots\dots\dots (1)$$

$$2m + 4n = 260 \dots\dots\dots (2)$$

Elimination

$$\begin{array}{lcl}
 m + n = 98 & \times 2 & 2m + 2n = 196 \\
 2m + 4n = 260 & \times 1 & 2m + 4n = 260
 \end{array}$$

$$-2n = -64$$

$$n = 32$$

Enter the value of n into equation 1

$$m + n = 98$$

$$m + 32 = 98$$

$$m = 98 - 32$$

$$m = 66$$

So, there are 66 motorbikes and 32 cars with a difference of  $66 - 32 = 34$ .

So, the correct statements are B and C.

R : How do I ensure that the answer obtained is the correct solution?

S5 : It seems I was wrong again, sis, I used method like number 1.

R : Yes, this is wrong again, try doing it again using the same method as number 1.

S5 :  $2m + 4n = 260$

$$2(66) + 4n = 260$$

$$132 + 4n = 260$$

$$4n = 260 - 132$$

$$4n = 128$$

$$n = 32$$

$$m + n = 98$$

$$m + 32 = 98$$

$$m = 66$$

So, it has been proven that the answer is correct. This is it.

So, it can be concluded that subject S5 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 2. Subject S5 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem-solving and solve problems.

Based on Figure 15, it shows that S5 is able to write down the elements that are known and asked about, subject S5 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of x and y variables. The solution is correct and the conclusion is also correct. Subject S5 carried out the checking stage again but it was not correct. The following is an excerpt from the interview with subject S5.

3. Diket : - Uang Rp 23.000 untuk membeli Peralatan Sekolah  
 - harga buku Rp 3.000  
 - harga pensil Rp 2.000  
 Ditanya : banyak buku dan pensil yang dibeli Nichol  
 jawab :  
 misal : a : buku  
 b : pensil  
 $3000a + 2000b = 23000$  ..... (1)  
 Substitusi  
 $3000a + 2000(10 - a) = 23000$   
 $3000a + 20000 - 2000a = 23000$   
 $3000a - 2000a = 23000 - 20000$   
 $1000a = 3000$   
 $a = 3$   
 $a + b = 10$   
 $3 + b = 10$   
 $b = 10 - 3$   
 $b = 7$   
 Jadi, Nichol membeli 3 buku dan 7 pensil  
 Memeriksa kembali :  
 Nichol akan membeli 10 Peralatan Sekolah dengan uang Rp 23.000 tidak boleh kurang atau ada kembalian. Harga buku Rp 3.000 dan harga pensil Rp 2.000. Didapatkan hasil dengan uang Rp 23.000, Nichol dapat membeli 3 buku dan 7 pensil.

Figure 15. S5's answer to question number 3

- R : What information did you get after reading the question?
- S5 : Nichol's money was 23 thousand to buy 10 school equipment and the price per book was 3 thousand and the price per pencil was 2 thousand. Then you ask how many books and pencils you bought?
- R : What steps must be taken to solve the problem?
- S5 : Write what you know and ask, keep making variable examples, keep looking for equations 1 and 2, keep looking for the values of a and b.
- R : Try to explain the problem-solving process that you did on that question
- S5 : Let a = book and b = pencil  
 $a + b = 10 \rightarrow a = 10 - b$  .....(1)  
 $3000a + 2000b = 23.000$ .....(2)  
 Substitution  
 $3000a + 2000b = 23\ 000$   
 $3000(10 - b) + 2000b = 2\ 3000$   
 $30.000 - 3000b + 2000b = 23.000$   
 $30.000 - 1000b = 23.000$   
 $- 1000b = - 7000$   
 $b = 7$   
 $a + b = 10$   
 $a + 7 = 10$   
 $a = 3$
- So, Nichol bought 3 books and 7 pencils.
- R : How do I ensure that the answer obtained is the correct solution?
- S5 : I'll rewrite it again.

So, it can be concluded that subject S5 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 3. Subject S5 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem-solving and solve problems.

1. Diket : Perbandingan umur 5 tahun lalu 4:5  
 - Umur Fiqri 4 tahun yang akan datang : umur  
 Erwanda di Kurangi 3 tahun

Ditanya : Jumlah umur mereka?

Jawab :

K : Fiqri  
 L : Erwanda

$$\begin{aligned} K-5 &= 4 & (K+4) &= (L+4)-3 \\ L-5 &= 5 & K+4 &= L+1 \\ 5(K-5) &= 4(L-5) & K &= L+1-4 \\ 5K-25 &= 4L-20 & K &= L-3 \dots (2) \\ 5K-4L &= 5 \dots (1) \end{aligned}$$

Substitusi

$$\begin{aligned} 5K-4L &= 5 & K &= L-3 \\ 5(L-3)-4L &= 5 & K &= 20-3 \\ 5L-15-4L &= 5 & K &= 17 \\ L &= 20 \end{aligned}$$

Umur Fiqri : 17 th  
 Umur Erwanda : 20 th  
 Total Umur : 17 + 20 = 37 th

**Figure 16.** S6's answer to question number 1

Based on Figure 16, it shows that S6 is able to write down the elements that are known and asked about, subject S6 can make the problem example into a variable, but it is not quite right because the subject is unable to understand when writing examples of x and y variables. The solution is correct and the conclusion is also correct. Subject S6 did not carry out the re-examination stage. The following is an excerpt from the interview with subject S6.

- R : What information did you get after reading the question?
- S6 : The comparison between Fiqri's age 5 years ago and Fiqri's age 4 years in the future is equal to Erwanda's age minus 3 years. Then they asked me to find their ages.
- R : What steps must be taken to solve the problem?
- S6 : Make an example with equations 1 and 2, continue to look for the values of K and L.
- R : Try to explain the problem-solving process that you did on that question.
- S6 : Initially, for example,  $K = \text{Fiqri}$  and  $L = \text{Erwanda}$ , then continue looking for equations 1 and 2. Equation 1 from the ratio of ages 5 years ago  $4:5$  becomes  $K - 5 / L - 5 = 4/5$  multiplied by the cross becomes  $5K - 4L = 5$ . Equation 2 of Fiqri's age in the next 4 years is equal to Erwanda's age minus 3 years to become  $K = L - 3$ . Then substitute the equation to get the value  $L = 20$ , then substitute it to get the value  $K = 17$ . So, Fiqri's age 17 years old and Erwanda 20 years old, so their total age is 37 years old.
- R : After doing the work, you didn't check the answer again?
- S6 : I just reread it from the beginning to the end, sis, I don't know how to write it, check the return.

So, it can be concluded that subject S6 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 1. Subject S6 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem-solving and solve problems.

2. Diket: Jumlah Sepeda motor + mobil = 98  
: Jumlah roda seluruhnya = 260

Ditanya: Pernyataan yang benar?

Jawab:

M : Motor  
n : Mobil  
 $M + n = 98$   
 $2m + 4n = 260$

$2m + 4n = 260$  x1  
 $M + n = 98$  x2  
 $2m + 4n = 260$   
 $2m + 2n = 196$   
 $2n = 64$   
 $n = 32$

$m + n = 98$   
 $m + 32 = 98$   
 $m = 98 - 32$   
 $m = 66$

Sepeda motor = 66  
Mobil = 32  
Selisih =  $66 - 32 = 34$

**Figure 17.** S6's answer to question number 2

Based on Figure 17, it shows that S6 is able to write down the elements that are known and asked about, subject S6 can make the problem example into a variable, but it is not quite right because the subject is unable to understand writing examples of x and y variables. The solution is correct and the conclusion is also correct. Subject S6 did not carry out the re-examination stage. The following is an excerpt from the interview with subject S6.

- R : What information did you get after reading the question?
- S6 : The number of motorbikes and cars is 98 and the total number of wheels is 260. Keep asking which statement is correct.
- R : What steps must be taken to solve the problem?
- S6 : Assuming m and n and equations 1 and 2, continue to find the x and y values with substitution.
- R : Try to explain the problem-solving process that you did on that question.
- S6 : Let's say  $m = \text{motorbike}$  and  $n = \text{car}$ , continue looking for equations 1 and 2.



Equation 1 from the number of motorbikes and cars being 98 becomes  $m + n = 98$ .

Equation 2 from the number of wheels being 260 becomes  $2m + 4n = 260$ .

Continue the equation was substituted into the value  $n = 32$ , then into the value  $m = 66$ .

There are 66 motorbikes and 32 cars with difference of 34. The correct statements are B and C.

R : After doing the work, you didn't check your answers again?

S6 : I only read again.

So it can be concluded that subject S6 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 2. Subject S6 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem-solving and solve problems.

3. Diket : - Rp. 23.000  
- 10 peralatan Sekolah  
- Buku Rp 3.000  
- Pensil Rp 2.000  
Ditanya : Banyak buku dan pensil yang dibeli?  
Jawab :  
 $x + y = 10 \dots (1)$   
 $3000x + 2000y = 23.000 \dots (2)$   
Eliminasi:  
 $x + y = 10 \quad \times 2.000$   
 $3000x + 2000y = 23.000 \quad \times 1$   
 $3000x + 2000y = 20.000$   
 $3000x + 2000y = 23.000$   
 $-1000x = -3.000$   
 $x = 3$   
 $x + y = 10$   
 $3 + y = 10$   
 $y = 10 - 3$   
 $y = 7$   
Buku : 3  
Pensil : 7

**Figure 18.** S6's answer to question number 3

Based on Figure 18, it shows that S6 is able to write down the elements that are known and asked about, subject S6 can make the problem example into a variable, but it is not quite right because the subject is unable to understand writing examples of  $x$  and  $y$  variables. The following is an excerpt from the interview with subject S6.

R : What information did you get after reading the question?

S6 : 23 thousand to buy 10 school equipment. The price per book is 3 thousand and the price per pencil is 2 thousand. Keep asking about how many books and pencils you bought.

R : What steps must be taken to solve the problem?

S6 : Make an example of  $x$  and  $y$  and equations 1 and 2, look for the values of  $x$  and  $y$ .

R : Try to explain the problem-solving process that you did on that question.

S6 : Let  $x$  = books and  $y$  = pencils continue to look for equations 1 and 2. Equation 1 of 10 school equipment purchased in the form of books and pencils becomes  $x + y = 10$ . Equation 2 from money 23,000, the price of books 3,000 and pencils 2,000 becomes  $3,000x + 2,000y = 23,000$ . Then substitute the equation to get the value  $x = 3$ , then substitute it to get the value  $y = 7$ . So, with 23,000 you can buy 3 books and 7 pencils.

R : After doing the work, you didn't check your answers again?

S6 : No, I'll just reread it.

So, it can be concluded that subject S6 is only able to fulfill 3 indicators of mathematical problem-solving ability in question number 3. Subject S6 is able to fulfill the indicators of mathematical problem-solving ability, namely being able to understand problems and being able to plan problem-solving and solve problems.

## Discussion

From the results of the analysis, students who have a visual learning style are correct, namely at the stage of understanding the problem, the stage of making a problem-solving plan, the stage of solving the problem, the stage of reviewing the process and results of problem solving. Students wrote answers neatly, clearly and systematically from the information about the questions, including what they knew and what was asked, and checked their answers again, proving that the visual learning style had a good effect on students when understanding the questions. The characteristics of students' visual learning style are that they are neat, orderly and thorough (Febryana et al., 2023).

Next, the results of the analysis of students who have a less than perfect auditory learning style are at the stage of understanding the problem and the stage of solving the problem. However, students were able to explain when interviewed. The characteristic of students' auditory learning style is that they have difficulty writing but are great at speaking (Febryana et al., 2023).

Finally, the results of the analysis of students who have an auditory learning style are less precise, namely at the stage of understanding the problem and checking the answers again. Students who have a kinesthetic learning style find it difficult to remember if forced, using their own way to remember things, including when studying. The desire to do everything is also a characteristic of students with a kinesthetic learning style (Febryana et al., 2023).

The following is a presentation of the research results of the six subjects for each indicator of mathematical problem-solving ability, namely: (1) the stage of understanding the problem, (2) the stage of making a problem-solving plan, (3) the stage of solving the problem, (4) the stage of re-examining the process and results solution to problem.

Subject S1 at the stage of understanding the problem are generally able to understand the problem very well, including: being able to express and write down what they know, being able to present what is being asked. At the stage of making problem solving plans, S1 is able to plan problem solving well. Able to plan steps to solve the problem faced correctly and able to plan the formula that will be used to solve the problem. At the problem-solving stage, S1 is able to carry out all the steps in solving the problem faced according to what has been planned and writing down step by step. S1 subjects can carry out calculations well according to the formulas used, so they are able to make precise and correct conclusions. Subject S1 is able to re-examine the process and results of problem solving obtained. The method used by S1 to re-check the answers obtained is to re-check them by proving the results of the answers using equations 1 and 2. 2.

Subject S2 at the stage of understanding the problem are generally able to understand the problem well, including: being able to express and write down what is known, being able to present what is being asked. At the stage of making problem solving plans, S2 is able to plan problem solving well. Able to plan steps to solve the problem faced correctly and able to plan the formula that will be used to solve the problem. At the stage of solving the problem, S2 was able to carry out all the steps in solving the problem faced according to what had been planned and wrote down step by step, however, S2 was unable to understand how to write examples of  $x$  and  $y$  variables. In problem number 1, in solving the problem, S2 was less able to process the formula used, so he made the wrong conclusion. In questions number 2 and 3, S2 subjects were able to carry out calculations well according to the formula used, so they were able to make precise and correct conclusions. S2 subjects were less able to re-examine the process and results of problem solving obtained. This is supported by S2's statement that S2 is afraid of not being able to solve the questions because there is not enough time.

Subject S3 at the stage of understanding the problem are generally able to understand the problem well, including: being able to express and write down what is known, being able to present what is being asked. At the stage of making problem solving plans, S3 is able to plan problem solving well. Able to plan steps to solve the problem faced correctly and able to plan the formula that will be used to solve the problem. At the stage of solving the problem, S3 was able to carry out all the steps in solving the problem faced according to what had been planned and wrote down step by step, however, S3 was unable to understand how to write the  $x$  and  $y$  variables. S3 subjects can carry out calculations well according to the formulas used, so they are able to make precise and correct conclusions. S3 subjects are able to re-examine the process and results of problem solving obtained. The method used by S3 to re-check the answers obtained is to re-check them by proving the results of the answers using equations 1 and 2.2.

Subject S4 at the stage of understanding the problem is generally able to understand the problem well, including: being able to express and write down what is known, being able to present what is being asked. At the stage of making problem solving plans, S4 is able to plan problem solving well. Able to plan steps to solve the problem faced correctly and able to plan the formula that will be used to solve the problem. At the stage of solving the problem, S4 was able to carry out all the steps in solving the problem faced according to what had been planned and wrote it down step by step, however, S4 was unable to understand how to write the  $x$  and  $y$  variables. In problem number 1, in solving problem S4 was less able to process the formula used, so he could not make a conclusion. In questions number 2 and 3, subject S4 was able to carry out calculations well according to the formula used, so that he was able to make precise and correct conclusions. Subject S4 was less able to re-examine the problem-solving process and results obtained. This is supported in S4's statement that S4 was afraid of not being able to solve the questions because there was not enough time.

Subject S5 at the stage of understanding the problem is generally able to understand the problem well, including: being able to express and write down what is known, being able to present what is being asked. At the stage of planning problem solving, S5 was able to plan problem solving well. Able to plan steps to solve the problem faced correctly and able to plan the formula that will be used to solve the problem. At the stage of solving the problem, S5 was able to carry out all the steps in solving the problem faced according to what had been planned and wrote down step by step, however, S5 was unable to understand how to write examples of  $x$  and  $y$  variables. Subject S5 can carry out calculations well according to the formula used, so that he is able to make precise and correct conclusions. Subject S5 was less able to re-examine the problem-solving process and results obtained. This is supported by S5's statement that the method of re-checking the process and results carried out by S5 was not appropriate.

Subject S6 at the stage of understanding the problem is generally able to understand the problem well, including: being able to express and write down what is known, being able to present what is being asked. At the stage of planning problem solving, S6 is able to plan problem solving well. Able to plan steps to solve the problem faced correctly and able to plan the formula that will be used to solve the problem. At the stage of solving the problem, S6 was able to carry out all the steps in solving the problem faced according to what had been planned and wrote it down step by step, however, S6 was unable to understand how to write the  $x$  and  $y$  variables. Subject S6 can carry out calculations well according to the formula used, so that he is able to make precise and correct conclusions. Subject S6 was less able to re-examine the problem-solving process and results obtained. This is supported in S6's statement that he does not know how to prove the final

results other than by paying attention to the step by step, formulas and calculations that have been carried out. This method does not provide a guarantee that the final results obtained are correct.

The data above shows that the problem-solving abilities of the six subjects have different abilities. One factor that influences differences in problem solving abilities is learning style. According to (Prihastyo et al., 2019) the characteristics of students with a visual learning style are: a) neat and orderly, b) speak quickly, c) pay attention to details, d) remember what they see rather than what they hear, e) prefer to read rather than be read to. According to Purbaningrum (2017), the indicators of auditory learning style are (a) learning by listening, (b) good at oral activities, (c) having sensitivity to music, (d) easily distracted by noise, and (e) weak in learning, visual activity. The characteristics of a kinesthetic learning style are: (a) speaks slowly, (b) is always physically oriented and moves a lot, (c) cannot sit still for a long time, (d) uses a finger as a pointer when reading (Sundayana, 2016; Prihasyto et al., 2019).

It can be concluded that based on markers of problem-solving ability, students with a visual learning style have proficiency in problem solving tasks in the high group. On the other hand, based on indicators of problem-solving skills, those who have a visual learning style and poor problem-solving abilities tend to experience difficulties in problem solving tasks. Based on markers of problem-solving ability, students with an auditory learning style have the ability to complete problem solving tasks in the high group. On the other hand, based on indicators of problem-solving skills, those who have an auditory learning style and poor problem-solving abilities tend to experience difficulties in this area. Based on markers of problem-solving ability, students with a kinesthetic learning style have a high level of proficiency in problem solving tasks. On the other hand, based on markers of problem-solving abilities, students who have a kinesthetic learning style and poor problem-solving abilities show limited problem-solving abilities.

## **Conclusion**

Based on the results of the research described above, it can be concluded that the mathematical problem-solving abilities of class VIII Science 4 students based on the type of visual learning style are the same as the auditory learning style in solving problems on SPLDV material, namely they can carry out up to the fourth stage where visual and auditory students are able to carry out the stage. one, namely understanding the problem, being able to carry out stage two, namely planning to solve the problem, being able to carry out stage three, namely solving the problem, and students being able to carry out stage four, namely reviewing the process and results of the answers obtained. The mathematical problem-solving abilities of class VIII Science 4 students are based on the kinesthetic learning style type, namely they can carry out up to stage 3, where students are able to understand the problem, are able to plan problem solving, and are able to solve problems, and do not carry out the stage of checking the results again. obtained. So, it can be concluded that students' mathematical problem-solving abilities vary and have difficulties in certain parts, therefore it is hoped that teachers will be able to train students in the learning process, carry out more effective learning so that they can improve students' problem-solving abilities (August & Ramlah, 2021).

From the research results and conclusions, teachers are expected to provide mathematics questions which aim to train mathematical problem-solving abilities. So that it can improve students' mathematical problem-solving abilities. And for further research, you can try to dig deeper into the level of students' mathematical problem-solving abilities with different problem contexts or research with different material from different points of view.

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