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Exploring Student Algebraic Thinking to Solve TIMSS Problems in Terms of Accommodator Learning Styles

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ABSTRACT

This study aims to explore students' algebraic thinking skills in solving Trends International Mathematics and Science Study (TIMSS) problems in terms of accommodator learning styles. The research design used is a case study with a qualitative analysis approach. The results showed that accommodating subjects were able to meet the indicators of algebraic thinking, namely generalization, abstraction, analytical thinking, dynamic thinking, and modeling. However, the lack of accuracy in performing calculation operations causes the answers obtained by the subject to be less precise on abstraction, analytical thinking, and dynamic thinking problems. The characteristics of subjects with accommodator learning styles who are more likely to use intuition in solving problems influence students' ability to solve problems related to algebraic thinking.

1. Introduction

Algebraic thinking is the process of reasoning algebraic symbols on the relationship between a quantity and something unknown and is related to abstraction and the development of variable concepts (Amerom, 2002). Algebraic thinking can also be interpreted as the ability to form conclusions in general, change or modify, and understand thoroughly the concept and solve algebra problems involving numbers or symbols with the aim of making it easier for students to learn algebra at school (Kieran, 2004). Carraher et al., (2006) describes algebraic thinking as a system of thinking that involves numbers and high-level reasoning skills to form conclusions aimed at creating relationships between algebraic concepts and algebraic problems. Based on some of these

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understandings, it can be concluded that algebraic thinking is a process of reasoning algebraic symbols, thinking involving numbers and the ability to form conclusions. Therefore, algebraic thinking is a thinking process that involves reasoning algebraic symbols or numbers to form conclusions in general, changing or modifying those aimed at solving algebraic problems.

Several experts have investigated the components associated with algebraic thinking. Lew (2004) states that the components of algebraic thinking include generalization, abstraction, analytical thinking, dynamic thinking, modeling and organizing. At the generalization stage, students are expected to be able to explain patterns or formulate general symbols. Then, at the abstraction stage, students are expected to be able to analyze mathematical objects and relationships based on generalizations. At the stage of analytical thinking, students are expected to solve problems to determine unknown quantities. Furthermore, at the dynamic thinking stage, students are expected to be able to manipulate mathematical objects. At the modeling stage, students are expected to represent problems in the form of mathematical models. Then, at the organizing stage, students are expected to be able to use logical strategies to solve algebra problems. Kieran (2004) and Istikomah et al., (2020) states that algebraic thinking has three components that students must have: generational, transformational and global meta-level. Generational can be defined as an algebraic object expressed in an equation. Transformation can be defined as a change in the form of an expression or equation based on rules. Then, the global meta-level is an ability that involves algebra in solving a problem related to algebra or not. In this study, researchers used the formulation of the components of algebraic thinking according to Lew (2004) to investigate students' algebraic thinking skills. Formulation of the components of algebraic thinking from Lew (2004) more details making it easier for researchers to reveal students' algebraic thinking skills.

Patton and Santos (2012) states that algebraic thinking is a thinking ability that requires students to be able to operate a quantity that in reality is unknown. In this case, algebraic thinking can encourage students to think logically to solve algebra problems in learning mathematics and everyday life problems. Nurhayati et al., (2017) states that algebraic thinking is a logical way of thinking that is needed in learning mathematics to solve problems related to algebra. Then, algebraic thinking is an indispensable ability for students to explore solving mathematical problems involving algebraic concepts such as geometric transformation materials, matrices, linear equations and inequalities, linear programs, algebra (Hardianti et al., 2020). Algebraic thinking is also related to the ability to think critically which is one of the indispensable thinking skills in the 21st century which requires every student to have skills in the learning process such as 4C skills namely Communication, Critical Thinking, Collaboration, and Creativity (Mutohhari et al., 2021). Through educators, 4C skills can be used to prepare learners who are responsive and able to face global competition (PeranginAngin et al., 2021). By having the ability to think algebraically, students are trained to think critically, creatively, reason and think abstractly, so that students are able to become problem solvers reliably.

Students' algebraic thinking ability in solving problems is influenced by several factors, one of which is learning style. One learning style that involves student experience is Kolb's learning style. Kolb and Kolb (2005) classifies four types of learning styles which include accommodator, assimilator, diverger and

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converter learning styles. Gooden et al., (2009) explained that the accommodator type of learning style is a combination of Concrete Experience (CE) and Active Experiment (AE), namely the ability to engage in new experiences, depend on others for information, and easily act according to intuition. Then, Pratiwi et al., (2011) revealing the type of assimilator learning style is a combination of Abstract Conceptualization (AC) and Reflective Observation (RO), namely the ability to create various theoretical models, inductive reasoning, and combine various information that has been obtained. Next, Richmond and Cummings (2005) explained that the divergent type of learning style combines the ability of Concrete Experience (CE) and Reflective Observation (RO), which is to view concrete situations through various perspectives, imaginative and have a good ability to process information into alternative ideas. As for Daimaturrohmatin and Rufiana (2019) states that the type of converter learning style is a combination of Abstract Conceptualization (AC) and Active Experimentation (AE), namely the tendency to be able to make decisions and solve problems efficiently and can find practical from an idea or idea.

Research on algebraic thinking has been done before by several researchers. Indraswari et al., (2018) researching the algebraic reasoning ability of high school students in solving algebra problems based on learning styles shows that on generalization indicators students with visual and kinesthetic learning styles determine the general rules of equations used to solve problems using algebraic symbols. While students with auditorial learning styles use a sentence. Then, Azahra and Masriyah (2022) the study of high school students' algebraic thinking skills in solving algebraic problems in terms of visual, auditory and kinesthetic learning styles showed that the three learning style subjects performed six algebraic thinking indicators from the stages of generalization, abstraction, analytical thinking, dynamic thinking, modeling and organization. Students with visual and kinesthetic learning styles determine the general rules of equations used to solve problems using algebraic symbols. While students with auditorial learning styles express explanations verbally (words).

Next, Amri and Arsid (2022) the research on the creative thinking ability of high school students in terms of learning styles in algebra material shows that students with visual learning styles are at the third level of creative thinking ability because they can meet the indicators of fluency and flexibility. This also occurs in students with kinesthetic learning styles but there is a lack of accuracy. While students with auditorial learning styles are at the first level of creative thinking ability because they are only able to meet the fluency indicator. Harti and Agoestanto (2019) examining the algebraic thinking skills of high school students in terms of critical thinking skills in problem-based learning showed that students' critical thinking and algebraic thinking skills in problem-based learning reached minimal criteria. Students belonging to the high critical thinking group have high global generational and meta-level abilities, while medium to high transformational abilities. Then, students in the middle critical thinking group have generational, transformational and meta-level global abilities tend to be moderate. Furthermore, students belonging to the low critical thinking group have low generational and transformational abilities, while global meta-level abilities are low to moderate.

The studies that have been done do not appear to examine the relationship between Kolb's learning style and students' algebraic thinking skills. In other

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words, there has been no research that discusses specifically about students' algebraic thinking skills in solving math problems in terms of Kolb's learning style. Based on this description, the research question that arises is how students' algebraic thinking skills in solving mathematical problems are viewed from the accommodator learning style. Therefore, this study aims to reveal students' algebraic thinking skills in solving mathematical problems in terms of accommodator learning styles. The results of this study are useful for teachers to design learning strategies and problems that can develop students' algebraic thinking skills in accordance with accommodator learning styles.

2. Method

The research design used is a case study with a qualitative approach. This study involved 64 grade VIII students in one of the private junior high schools in Surakarta, Central Java, Indonesia. The instruments used in this study were algebraic thinking test questions, KLSI questionnaires, and interview guidelines. The components or indicators of algebraic thinking to be analyzed consist of 5 components, namely generalization, abstraction, analytical thinking, dynamic thinking and modeling. Researchers compiled ten questions adopted from the TIMSS questions for grade VIII (Provasnik, 2013). Each component of algebraic thinking according to (Lew, 2004) are represented by two questions. Before being used, the questions were first validated by 3 mathematics learning experts. Based on the validation results, the researcher set eight questions by eliminating 1 question in the generalization and dynamic thinking components. Next, researchers conducted a test of questions on 20 students who were not research subjects. Based on the results of the trial, researchers made improvements to the problems used for data collection. Then, to classify students' learning styles, researchers used the KLSI instrument (Kolb and Kolb, 2005). Furthermore, to uncover students' algebraic thought processes in depth, researchers used interview guidelines. Before use, interview guidelines are first validated by expert validators.

In this study, five questions were analyzed consisting of 1 question each on the components of generalization, abstraction, analytical thinking, dynamic thinking and modeling. The questions to be analyzed are presented in Table 1. Generalization problems aim to investigate students' ability to solve problems using number patterns or number series. Abstraction problems aim to investigate students' ability to use symbols related to mathematical concepts and properties. Then, analytical thinking problems aim to reveal students' ability to determine the value of an equation and inequality problem. Furthermore, dynamic thinking problems aim to reveal students' ability to solve problems using direct proportionality. Meanwhile, modeling problems aim to investigate students' ability to represent problems into mathematical models.

Table 1. Examples of Algebraic Thinking Test Questions

No	Question Type	Question
1	Generalization	Several pieces of tiles are arranged into a square shape as follows: The 3 × 3 square shape consists of 8 Gray tiles and 1 Black tile. The 4 × 4 square shape consists of 12 Gray tiles and 4 Black tiles. The table below shows the number of tiles arranged into square shapes of various sizes. Complete the

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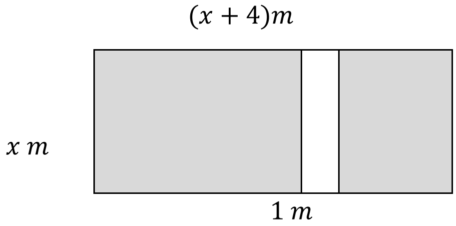
<table>
<tr><th>No</th><th>Question Type</th><th>Question</th></tr>
<tr><td></td><td></td><td>table below to find out the number of tile pieces that make up the square!
<table>
<tr><th>Shape</th><th>Number of Black Tiles</th><th>Number of Gray Tiles</th><th>Total Tiles</th></tr>
<tr><td>3 × 3</td><td>1</td><td>8</td><td>9</td></tr>
<tr><td>4 × 4</td><td>4</td><td>12</td><td>16</td></tr>
<tr><td>5 × 5</td><td>9</td><td>16</td><td>25</td></tr>
<tr><td>6 × 6</td><td>16</td><td></td><td></td></tr>
<tr><td>7 × 7</td><td>25</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>2</td><td>Abstraction</td><td>Take a look at the rectangle image below!


If the width of the unshaded area is 1m, then determine the equation showing the area of the shaded area (m²)!</td></tr>
<tr><td>3</td><td>Analytical Thinking</td><td>Solve the following inequality!
$9x - 6 < 4x + 4$</td></tr>
<tr><td>4</td><td>Dynamic Thinking</td><td>Take a look at the table below!
<table>
<tr><th>Bush Height (cm)</th><th>Shadow Length (cm)</th></tr>
<tr><td>20</td><td>16</td></tr>
<tr><td>40</td><td>32</td></tr>
<tr><td>60</td><td>48</td></tr>
<tr><td>80</td><td>64</td></tr>
</table>
The table above shows the shadow lengths of four bushes of different heights at 10 a.m. If the height of the bush is 50 cm, then determine the length of the shadow of the bush!</td></tr>
<tr><td>5</td><td>Modeling</td><td>The table below shows the temperature at various times of the day!
<table>
<tr><td>Time</td><td>06.00</td><td>09.00</td><td>12.00</td><td>15.00</td><td>18.00</td></tr>
<tr><td>Temperature (°C)</td><td>12</td><td>17</td><td>14</td><td>18</td><td>15</td></tr>
</table>
Draw a graph showing the corresponding information in the table above.</td></tr>
</table>

Furthermore, based on the results of the KLSI questionnaire algebra thinking test to 64 students, recapitulation data was obtained as presented in Table 2.

Table 2. Recapitulation of Student Learning Styles

No	Learning Style	Number of Students
1	Accommodator	32
2	Assimilators	6
3	Diverger	7
4	Converters	19

Based on the data in Table 2, most subjects have accommodator learning style characteristics. Therefore, in this paper the researcher focuses on the

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analysis of subjects who have an accommodator learning style. Researchers selected 2 subjects in the accommodator learning style category with the criteria of having relatively similar algebraic thinking test scores. To facilitate data analysis, both subjects were assigned S1 and S2 codes.

Data analysis is carried out by first conducting document analysis, namely analysis of students' answers in solving algebraic thinking test questions. The focus of the analysis is on the steps of solving the problem and the strategy used to solve the problem. In document analysis, researchers use assessment rubrics as presented in Table 3.

Table 3. Assessment Rubric

No	Judging Criteria	Score
1	Incorrect solution steps or unable to answer the question	0
2	The solution step is partially correct and the answer is incorrect.	1
3	Correct solution steps but incorrect answers.	2
4	Solution steps and answers are correct	3

Furthermore, researchers conducted interviews to reveal more deeply the steps and strategies of solving students in solving algebraic thinking test questions. The interview is intended to validate the student's answers in the document i.e. the student's answer sheet.

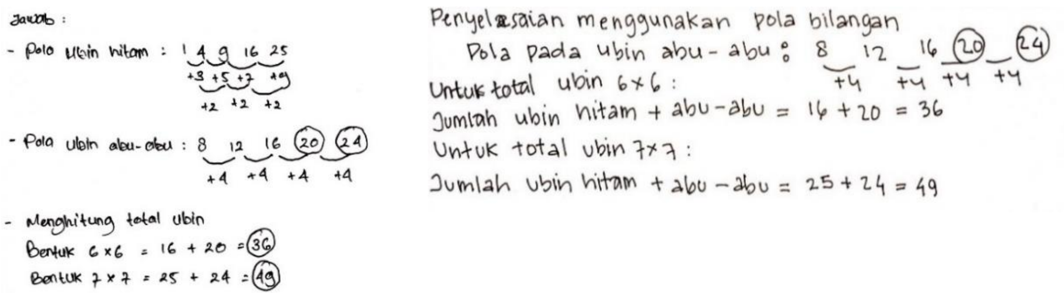
3. Results and Discussion

3.1 Results

The following are presented the results of document analysis and interviews of both subjects with accommodator learning styles in solving generalization problems, abstractions, analytical thinking, dynamic thinking, and modeling.

3.1.1 Analysis Question Number 1

Question number 1 is used to investigate students' generalization ability, which is a process that aims to find a pattern or shape in a given set of objects. Based on the test results, S1 and S2 subjects can solve questions using the right solving steps and get the right answers as well. The subject's answer in solving question number 1 is presented in the picture below.



(a) (b)

Figure 1. Answer to question number 1: (a) S1, (b) S2

Based on Figure 1, S1 and S2 solve the generalization problem in almost the same way. S1 first determines the difference in black tile patterns on each square shape, which is 3, 5, 7, and 9. Then, S1 determines the difference between gray

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tiles on 3 x 3, 4 x 4, and 5 x 5 square shapes which is 4. Based on the pattern obtained, S1 can determine the number of gray tiles for 6 x 6 and 7 x 7 square shapes i.e. 20 and 24. Next, S1 determines the total tiles in a square shape whose value is still unknown, namely 6 x 6 and 7 x 7 by adding black tiles and gray tiles, which are 36 and 49 tiles. The same is done by S2 by first determining the difference in gray tiles on 3 x 3, 4 x 4, and 5 x 5 shape squares to determine the number of gray tiles on 6 x 6 and 7 x 7 square shapes. Then S2 determines the total tiles by summing the sum of the number of black tiles and gray tiles on the corresponding square shape. The understanding of the two subjects related to generalization is supported by the results of the researchers' interviews with S1 and S2.

Researchers : How can you find the number pattern on the number of gray tiles and the total tiles?

S1 : I created a number pattern on the black tiles first. The numbers 1 to 4 have a difference of 3, from 4 to 9 have a difference of 5, and so on. Furthermore, the first number pattern does not yet have the same difference, so I made another number pattern from the number 3 to 5 which has a difference of 2, 5 to 7 has the same difference of 2 and so on.

S2 : The number of gray tiles in the first column is 8, then I compare it with the second column, which is 12 and has a difference of 4, then in column 3, which is 16, which has a difference of 4, so I already know the difference is 4, so column 4 I fill in with 16 + 4 and the result is 20, then use the same method in column 5, which is 20 + 4, the result is 24.

Researchers : What about gray tile patterns and tile totals?

S1 : I figured out the difference myself. From 8 to 12 has a difference of 4, then 12 to 16 also has a difference of 4, and so on. So that the values 20 and 24 are obtained. Then, for the total tiles are summed only from the black and gray tiles. 16 + 20 the result is 36.

S2 : I sum it up to find the total 6 x 6 tiles with the number of black and gray tiles, so 16 +20 = 36, then for the total 7 x 7 tiles which is 25+24 = 49.

Based on the interview results, S1 and S2 can explain the solution steps to determine the number of gray tiles and the total tiles that are still unknown in 6 x 6 and 7 x 7 square shapes using the number pattern in the previous square shape. Thus, it can be concluded that both subjects are able to satisfy the indicator of algebraic thinking on the generalization component, that is, being able to use number patterns to generalize the next pattern. Then, both subjects solve the problem using a way that the subject understands himself and does not refer to a specific formula. This corresponds to the characteristics of the subject's accommodating learning style that tends to use one's own experience or understanding in solving problems.

3.1.2 Analysis Question Number 2

Question number 2 is used to investigate students' abstraction abilities, namely

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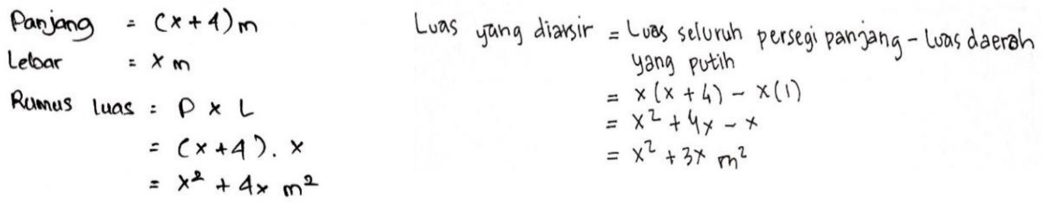
the process of abstracting mathematical objects and relationships between mathematical objects. Based on the test results, S1 has not been able to solve the problem using the right solving steps and has not been able to get the right answer either. Conversely, S2 is able to solve problems using the right solving steps and get the right answers as well. The answers of the two subjects in solving question number 2 are presented in Figure 2.



(a) (b)

Figure 2. Number question answer 2: (a) S1, (b) S2

Based on Figure 2, S1 and S2 solve abstraction problems in almost the same way. S1 first writes the formula of the area of the rectangle. Next, S1 substitutes the length and width values into the rectangular area formula so that the rectangular area $x^2 + 4x$ m^2 is obtained. However, S1 made the mistake of not paying attention to the area of the area that was not shaded to calculate the area of the shaded area. The same strategy is also carried out by S2 to solve question number 2. S2 writes that the shaded area can be found using a formula in the form of subtraction from the area of the entire rectangle minus the area that is not shaded. Then, S2 determines the area of the shaded area, namely the area of the rectangular area, which is x (x + 4) minus the area of the unshaded area which is x so that $x^2 + 3x$ is obtained. The understanding of the two subjects related to solving abstraction problems is presented in the following interview results.

Researchers	: How do you find the area of shaded area?
S1	: I think the length (x + 4) m and width x m can be multiplied according to the rectangular formula whose result is $x^2 + 4x$ m^2.
S2	: I use the rectangular formula, so to find the shaded area can use the formula of the area of the entire rectangle subtracted by the area of the unshaded area. The length of the first is x + 4. The width of the first is x. Then, the length of the second is x and the width of the second is 1 m. Next, substitute it in the rectangular formula. The calculation is x (x) becomes x^2 plus x (4) becomes 4x and subtracts x (1) to x. So the result is $x^2 + 3x$ m^2.
Researchers	: What about non-shaded areas?
S1	: I don't count.

Based on the results of the interview, both subjects can explain how to determine the solution of the problem. However, the steps to solve the S1 problem are still not right because they do not calculate the area that is not shaded. While S2 is able to utilize the area of the area that is not shaded to determine the area of the shaded area. Thus, both subjects have fulfilled the indicators of algebraic thinking in the abstraction component, namely being able to abstract mathematical objects and relationships between mathematical objects.

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However, the lack of accuracy of S1 that does not take into account the area that is not shaded causes the answers obtained to be less precise.

3.1.3 Analysis Question Number 3

Question number 3 is used to investigate students' ability to think analytically, which is to apply inverse operations in solving problems. Based on the test results, S1 subjects can solve questions using the right solving steps and get the right answers as well. Meanwhile, S2 subjects can solve questions using the right question solving steps but the answers obtained are not correct. The subject's answer in solving question number 3 is presented in Figure 3.

(a) (b)

Figure 3. Answer to question number 3: (a) S1, (b) S2

Based on Figure 3, S1 and S2 use different solving steps to solve problem number 3 related to analytical thinking. S1 solves the problem by collecting terms containing variables in the left field and terms containing constants in the right field. S1 uses an inverse operation, where the 4x term on the right segment is moved to the left segment so that the sign changes to -4x. Then, the constant -6 in the left segment is performed inverse operation to +6 in the right segment. Using algebraic manipulations obtained values x < 2. Meanwhile, S2 uses the completion step by collecting all the tribes on the left segment. However, S2 made the mistake of changing the +6 sign to -6 even though no inverse operation was performed. This results in improper completion of S2. The understanding of the two subjects related to the steps to solve question number 3 is presented in the results of the researcher's interview with S1 and S2.

Researchers : What do you do to solve the inequality problem??

S1 : I moved the variable number x in the left field. Then, a number that is not variable in the right field. Furthermore, 9x minus 4x is 5x, then 6 plus 4 is 10. Then, to find the value of x I divide the number 10 divided by 5, 5 I move it on the right segment so that the result of x is 2 or x less than 2.

S2 : I moved 4x +4 to the left segment so that the right segment is less than 0 and easy to calculate. So 9x is subtracted by 4x which is 5x, while -6 is subtracted by 4 which is -10. Next I moved -10 on the right segment to 10. Then I move the number 5 to the right segment or 10 minus 5, the result is 5. So the value of x is less than 5.

Based on the results of the interview, S1 and S2 can explain the solution steps to obtain x value from a form of inequality. S1 explains that solving a form of inequality can be done by grouping terms that contain variables and constants in the same field so that calculation operations can be carried out. Meanwhile, S2

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moves all tribes in the right segment to the left segment with the aim that the left segment is 0 so that it is easier to solve. However, S2 is less careful by changing the constant sign so that the solution obtained is not right. Thus, both subjects already meet the indicator of algebraic thinking on the component of analytical thinking that is, understanding the use of inverse operations to solve problems. The lack of accuracy of S2 in the calculation operation causes the answers obtained to be less precise.

3.1.4 Analysis of Question Number 4

Question number 4 is used to investigate students' ability to think dynamically, namely students' ability to solve problems using comparisons. Based on the test results, S1 can solve the problem using the right solving steps and get the right answer as well. In contrast, S2 is unable to solve the problem. The answer S1 in solving question number 4 is presented in Figure 4.

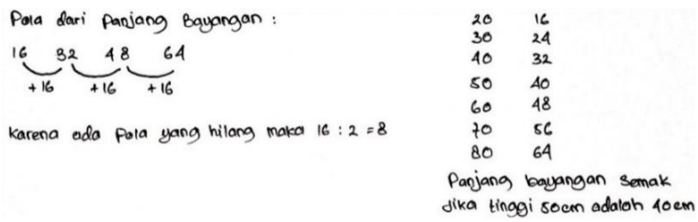

Figure 4. Answer S1 question number 4

Based on Figure 4, S1 solves the problem using a number pattern that relates the height of a bush to the length of its shadow. S1 is able to identify the difference in shadow length from the height of the bush presented in the table, which is 16. Because the bush height in the problem has a difference of 20, S1 uses the concept of comparison to determine the height of the shadow when it is known that the bush height is 50 cm. S1 divides the difference in shadow height by 16 by 2 so that 8 is obtained. Then S1 concludes that if the bush height difference is 10, the shadow height difference is 8. Based on the identification results, S1 constructs a number pattern that relates the height of the bush if the difference is 10 and the height of the shadow. S1 found that if the height of the bush is 50 cm long, the shadow is 40 cm. S1's understanding regarding solving question number 4 is presented in the following interview excerpts.

Researchers : How do you solve this problem?

S1 : I answer it using trial and error, I try to use the number pattern method. I first saw the number pattern in the length of the shadow of the bush there were numbers 16, 32, 48, 64 so that it had a difference of 16. Then, I divide 16 by 2 because at the height of the bush there is a missing pattern. So if sorted the height of the bush is 20, 30, 40, 50, 60, 70, 80 and the length of the shadow has a difference of 8. So 16 + 8 the result is 24. 24 + 8 the result is 32, and so on.

Based on the results of the interview, S1 can explain how to determine the length of the shadow of the bush if the height of the bush is 50 cm. S1 explains that to solve this problem you can use a number pattern in the length of the

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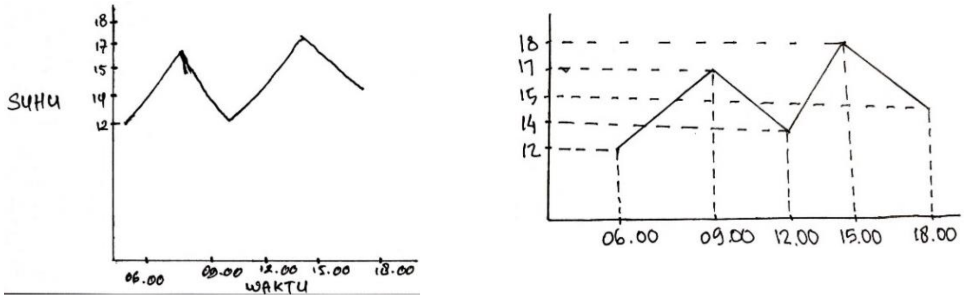
shadow of the bush. The solution of dynamic thinking problem number 4 on the accommodator subject can be seen through the use of direct proportionality to solve the problem. The completion steps that S1 writes are based on the results of trial and error that the subject understands himself. Thus, S1 is able to meet the indicator of algebraic thinking ability in the dynamic thinking component, which is able to use comparisons to solve problems. Subject-solving strategies that use trial and error show the characteristics of the subject, learning styles accommodators who tend to favor experimentation or experimentation in solving problems.

3.1.5 Analysis Question Number 5

Question number 5 is used to investigate students' ability to solve modeling problems, namely the ability to represent complex situations using mathematical expressions, interpret situations with mathematical models, and draw conclusions from a mathematical problem solving. Based on the test results, S1 wrote down the completion steps that were done partially correct and the answers obtained were not correct. Meanwhile, S2 is able to answer using the right completion steps and get the right answer as well. The subject's answer in solving question number 5 is presented in Figure 5.



(a) (b)

Figure 5. Answer to question number 5: (a) S1, (b) S2

Based on Figure 5, S1 and S2 are able to solve modeling problems in relatively the same way. Both subjects drew graphs based on the information available in the problem, which is a graph that states the relationship between time and temperature changes. This shows that both subjects are able to represent mathematical problems in the form of data in the form of tables into graphic forms so that they are easier to understand. The understanding of both subjects related to modeling was also shown in the interview results as follows.

Researchers	: How to make a graph that matches the data in the problem? Then what is the conclusion?
S1	: I draw part of the time on a horizontal line and I determine the line based on the results of asking with friends, namely 06.00, 09.00, 12.00, 15.00, and 18.00. Then, I draw a vertical line that is the temperature part with the numbers 12, 17, 14, 18, and 15. Furthermore, time is connected with the right temperature, for example 06.00 with a temperature of 12° and so on. So the conclusion is that the lowest temperature is at 12° at 06.00 and the highest temperature is 18° at 15.00. But when I draw it doesn't use

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a ruler so the lines connected are not right.

S2 : I draw the time part on the horizontal line, there are 6:00 a.m., 9:00 a.m., 12:00 p.m., 3:00 p.m., and 6:00 p.m. Then, drawing a vertical line in the temperature section, there are numbers 12, 17, 14, 18, and 15. Next, the time and temperature pairs are connected according to those in the table. At 06.00 the temperature pair is 12°, at 09.00 the temperature pair is 17°, and so on. From the meeting point is drawn from each other to form a graph. In conclusion, in my opinion, the lowest temperature is at 12° hours 06.00, the highest temperature is 18° hours 15.00. Low temperature means cold, High temperature means hot.

Based on the results of the interview and the analysis of the answers to question number 5, it can be concluded that both subjects were able to meet the indicators of algebraic thinking in the modeling component. Both subjects are able to represent the information contained in the problem into another form, namely graphs. Then, both subjects can also make inferences from the graphs that have been compiled.

3.2 Discussion

Accommodator subjects demonstrate the ability to solve algebraic thinking problems related to the components of generalization, abstraction, analytical thinking, dynamic thinking and modeling. In the generalization component, the subject is able to use known number patterns to generalize to unknown patterns. In the abstraction component, the subject is able to abstract mathematical objects and use relationships between mathematical objects to solve problems. Furthermore, in the analytical thinking component, the subject is able to use inverse operations to solve inequality-related problems. In the dynamic thinking component, the subject is able to use comparisons to solve problems. In the modeling component, the subject is able to represent the information contained in the problem into another form, namely graphs. However, the lack of accuracy in performing calculation operations causes the answers obtained by one of the subjects to be less precise on problems related to abstraction, analytical thinking, and dynamic thinking. This is in line with research Winarso and Toheri (2021) which concludes that accommodator subjects sometimes make mistakes in solving mathematical problems. In addition, the results of the study Rahmah et al., (2022) also indicates that the subject accommodator encountered an error in the process of troubleshooting.

The problem-solving steps of both subjects can be attributed to accommodator learning style characteristics that are characteristic of a combination of concrete experiences or feelings and active experiments or real activities. Accommodating subjects tend to discover knowledge through direct experience in the real world and transform their experience in experiments or experiments. This is in line with research Itasari et al., (2021) which states that students with an accommodating learning style in solving a problem will be directly involved in concrete situations and use intuition or feelings more than logic. Then, Sudria et al., (2018) states that subjects with accommodative learning styles in solving problems need more intensive guidance compared to other learning style subjects.

The findings of this study show that students' learning styles have an impact

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on students' ability to solve problems. Every individual has a different learning style. Therefore, differences in student learning styles need to be recognized and facilitated by educators or teachers with different learning strategies. This is necessary so that students with diverse learning styles get learning treatment that is in accordance with the characteristics of their learning styles. The application of learning strategies that are able to facilitate the diversity of student characteristics, such as learning styles, can encourage student success in learning, especially in solving mathematical problems.

4. Conclusions

Accommodating subjects are able to fulfill five components of algebraic thinking, namely generalization, abstraction, analytical thinking, dynamic thinking and modeling. In the generalization component, the subject is able to use known number patterns to generalize to unknown patterns. In the abstraction component, the subject is able to abstract mathematical objects and use relationships between mathematical objects to solve problems. Furthermore, in the analytical thinking component, the subject is able to use inverse operations to solve inequality-related problems. In the dynamic thinking component, the subject is able to use comparisons to solve problems. In the modeling component, the subject is able to represent the information contained in the problem into another form, namely graphs. The lack of accuracy of the subject in the calculation operation causes some of the answers given to be incorrect, especially in problems related to abstraction, analytical thinking, and dynamic thinking. This is influenced by the characteristics of accommodator learning styles that sometimes make mistakes in solving a problem. Accommodating subjects in solving problems tend to use intuition, interest in experiments and real experience, sometimes causing a lack of accuracy in answering questions. Thus, learning style is one of the factors that affect students' ability to solve problems.

Author Contributions

Lutfiyya Fajar Zahiroh: conceptualization, designing research methods, collecting data, analyzing data, conducting discussions, drafting articles. Masduki: conceptualization, formulating the research focus, designing research methods, analyzing data, conducting discussions, revision the article.

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Declaration of Competing Interest

No potential conflicts of interest were reported by the authors.

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