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Analysis of Students' Computational Thinking Ability in Solving Contextual Problems

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Abstract

This study aims to examine students' computational thinking skills in solving contextual problems in the matter of a system of two-variable linear equations. This type of research uses descriptive qualitative approach. The subjects used in this study were 25 class VIII students of State Middle School in the 2022/2023 academic year on SPLDV material (System of Two-Variable Linear Equations). Data collection techniques and instruments in this study were written tests and interviews. Data analysis was carried out by first classifying the data, then presenting the data and ending by concluding the results of computational thinking indicators. The results showed that the percentage of students' computational thinking aspects, namely the decomposition aspect, was 70.30% in the good category, pattern recognition 58.63% sufficient category, abstraction 58.30% sufficient category, and thinking algorithm 50.47% sufficient category. So that students' computational thinking skills are included in the sufficient category. Meanwhile, based on the categorization of high-level students they have done well. However, there were several steps that were missed and not written down in the answer sheets, such as the decomposition and pattern recognition aspects which were not carried out properly. For the medium category, all stages of computational thinking have been carried out very well starting from decomposition, pattern recognition, abstraction, and thinking algorithms. For the low category, this category has not been able to carry out the stages of computational thinking properly.

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INTRODUCTION

Mathematics is one of the compulsory subjects in Indonesia, especially from the elementary school level to the senior high school level(Masfingatin and Maharani 2019). Mathematics is a science that everyone needs to learn and understand because it has an important role in everyday life(Susanti and Taufik 2021).Jolles et al. (2016)stated that mathematics has an important domain in the development of academic skills, but compared to other skills such as reading, interventions in mathematics have received little attention.

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One of the reasons for the lack of maximum learning outcomes in mathematics is a lack of attention to mathematics. Another cause is that students still view mathematics as a difficult and boring subject, therefore many students do not like this subject.(Utari, Wardana, and Damayani 2019;Pardimin and Widodo 2016). Other conditions show that it is often found that students at the secondary level still have an inaccurate mindset, even a little critical thinking, and a lack of ability to become a problem solver.(Mulhamah and Putrawangsa 2016).

In studying mathematics there are many abilities that can help students understand mathematics, one of these abilities is the ability to think computationally(Lockwood and Mooney 2017). Computational thinking means the process of solving problems using coherent and systematic reasoning which is familiar to use in the computer field, but it is also important for students to develop their abilities in mathematics or other fields.(Lee et al. 2014). In the 21st century the ability to think computationally is very important for students to have, because in the ability to think computationally it is not only emphasized on the focus of problem solving, but is more focused on how to solve a problem.(Masfingatin and Maharani 2019).

It is common that problem solving questions are presented in the form of story questions that are contextual or related to the real life of students(Anggraeni and Herdiman 2018)**.**This is also in accordance with the statement(Jayanti, Irawan, and Irawati 2018)that contextual problems are mathematical problems related to students' daily lives. Contextual problems are problems related to the daily lives of students which include the surrounding environment so that they can be understood and observed directly by students(Febriyanti and Irawan 2017;Rizky 2018). The mathematical contextual problem is a mathematical problem that connects many different contexts in order to be able to imagine the problem or to be able to present real situations that have been experienced by students.(Rizki 2018). Mathematics has many branches of material that can be studied. One branch of the material that is familiar with everyday life is the System of Two Variable Linear Equations (SPLDV) material. The material is able to provide simple problems that are closely related to everyday life (Achir, Usodo, and Retiawan 2017).

The results of research conducted by Susanti and Taufik (2021) , which examined the computational thinking skills of government science students in solving statistical problems, showed that all indicators of computational thinking had been carried out, starting from Decomposition, Pattern recognition, Abstraction, and Algorithm design. The highest percentage carried out by students is in the Algorithm Design indicator, with a value of 84%, while the lowest percentage is in the Decomposition indicator, with a value of 65.5%. The mistakes often occur because students are not used to solving problems in a structured way. In research Nuraisa et al. (2019) , which examined high school level students on linear programming material, it was stated that students solving problems could only reach the decomposition and pattern recognition stages. Students still cannot evaluate the results of their work correctly. The Algorithmic Design indicator is also less coherent because, at the Abstraction indicator stage, students still need to finish working on it.

Based on the explanation above, the researchers raised this problem because the results of pre-research conducted during the internship and interviews with

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several students were that students still needed clarification in understanding and accepting the SPLDV material taught by the teacher. Hence, it took much work for students to solve the mathematical problems. Several factors have influenced students' learning outcomes that could have been more optimal, including learning carried out online during the pandemic. What makes it different from previous research is that it focuses on describing the results of the analysis of students' computational thinking skills in solving contextual problems in systems of two-variable linear equations (SPLDV) at State Middle School 2 Batu. The formulation of the problem discussed in this study is how students' computational thinking skills are used in solving contextual problems. This study aims to examine students' computational thinking skills in solving contextual problems in the material of a system of two-variable linear equations. In this study, there are benefits that students can describe plans for solving contextual problems properly and correctly through computational thinking skills.

RESEARCH METHOD

This type of research is descriptive qualitative. This study describes students' computational thinking abilities in solving contextual problems. The subjects in this study were 25 students in class VIII (eight) of SMP Negeri 2 Kota Batu in the 2022/2023 academic year. Subjects were taken based on the grades of the mathematics subject which were then categorized into 3 sections, each section containing 6 students based on high, medium and low SPLDV material test scores. Then from each category 2 representatives were taken to conduct interviews with the aim of ascertaining the answers of students in answering the results of the written test.

Data collection techniques used by researchers to measure computational thinking skills are written tests and interviews. The written test here is used to see students' ability to answer contextual questions. The written test used in this research is a matter of description on the contextual-based two-variable system of linear equations subject. The interviews in this study were conducted in a semi-structured manner in which the questions were structured but could change according to the respondents' answers. The purpose of using interviews here is to obtain data regarding the reasons that strengthen the results of students' answers.

There are three data analysis techniques in this study, namely data classification, data presentation, and drawing conclusions. The interviews in this study were conducted in a semi-structured manner in which the questions were structured but could change according to the respondents' answers. The purpose of using interviews here is to obtain data regarding the reasons that strengthen the results of students' answers. There are three data analysis techniques in this study, namely data classification, data presentation, and drawing conclusions. The interviews in this study were conducted in a semi-structured manner in which the questions were structured but could change according to the respondents' answers. The purpose of using interviews here is to obtain data regarding the reasons that strengthen the results of students' answers. There are three data analysis techniques in this study, namely data classification, data presentation, and drawing conclusions.

The formula for the average percentage of written test scores is as follows.

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$$\hat{x} = \frac{sum\ of\ score}{total\ score}\ x\ 100\%$$

The criteria for evaluating students' computational thinking skills are as follows:

Tabel 1. Computational thinking ability assessment criteria

Score	**Category**
81% - 100%	Very Good
61% - 80%	Good
41% - 60%	Enough
31% - 40%	Not good
<30%	Very Less Good

RESULTS AND DISCUSSION

Based on the analysis of the data obtained, the average data is grouped according to computational thinking indicators as follows.

Table 2 Percentage Results for Computational Thinking Indicators

Aspect	Indicator	
Decomposition	Carefully read the information and issues that arise	76.64%
	Sorting information into simpler parts	63.96%
	Average Decomposition	70.30%
Pattern Recognition	Recognize patterns for doing something similar	58.63%
Abstraction	Focus on important parts or information	54.64%
	Create and develop a problem solving plan	61.96%
	Average Abstraction	58.30%
Algorithm thinking	Solve the problem according to the procedure that has been made	53.96%
	Draw conclusions	46.98%
	Average Thinking Algorithm	50.47%

Based on the table above, the results obtained from the percentage of data for each aspect are 70.30% decomposition in the good category, pattern recognition 58.63% in the sufficient category, 58.30% abstraction in the sufficient category, and 50.47% thinking algorithm in the sufficient category. The average is obtained from the results of the assessment answered by students in the written test on the material system of two-variable linear equations. The following is a description of the results of the written test for each aspect based on computational thinking indicators.

1) Decomposition

Figure 1, Figure 2 anda Figure 3 is the result of the subject's work on the given task.

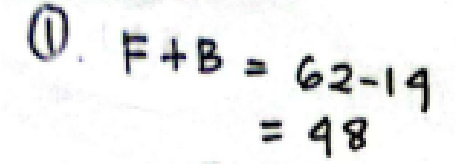

Figure 1. Aspects of Decomposition in High Level Students

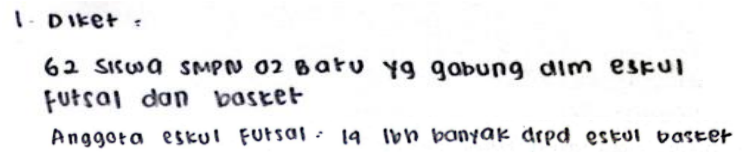

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Figure 2. Aspects of Decomposition in Students with Moderate Levels

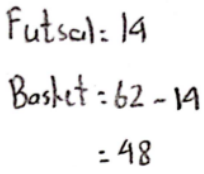

Figure 3. Aspects of Decomposition in Students with Low Levels

Based on Figure 1, 2 and 3, then it can be known that:

a. Carefully read the information and issues that arise

In this indicator as a whole students get an average percentage of 76.64% which can be categorized as good. The problem that is often experienced by students is that they do not understand what is intended from the information that appears in the questions so that it is often found that some students write down inaccurate information. For students with high and moderate levels in this indicator there is not much difference. Students in the high and medium categories need 2-4 times to be able to understand the problems that arise, while students in the low category need more than 4 times to understand the meaning of the problems that arise. This happens because students in the low category have not fully mastered the subject matter of mathematics.

b. Sorting information into simpler parts

In the indicator of sorting information into simpler parts, the percentage obtained is an average of 63.96%, which means it is included in the good category. Students with a high level tend not to write down the information obtained on the answer sheet, because they are able to remember and already understand what is meant in the problem, so they only write down the last steps to find the answer. They also think this way can save time in the process. Whereas for students with moderate levels, on average, they write down all the information in the problem completely, because this will make it easier for them to solve the problems they face.

2) Pattern Recognition

a. Recognize patterns for doing something similar

In the indicator of identifying patterns for doing something similar, students determine the problems that arise in questions based on what they have read and understood at the decomposition stage. At this stage students enter the information obtained in the previous stage into the general formula of the SPLDV material, such as substituting or eliminating to get the answer. Students in the high category are able to recognize patterns of processing steps, the type of material being tested and what is asked in the questions. However, this made it impossible to write a complete answer on the answer sheet. Whereas for the medium category, they have to recall the material being taught, and write down the answers in full to be able to recognize patterns of work at this stage of the indicator. For low indicators, they haven't reached

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this stage because they haven't been able to find a pattern to proceed to the next stage, and the previous indicators haven't been resolved either.

3) Abstraction
Figure 4 anda 5 is the result of the subject's work on the given task.

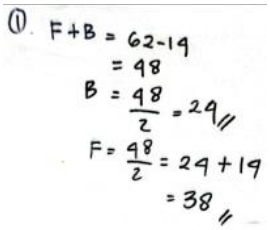

Figure 4. Aspects of Abstraction in High Level Students

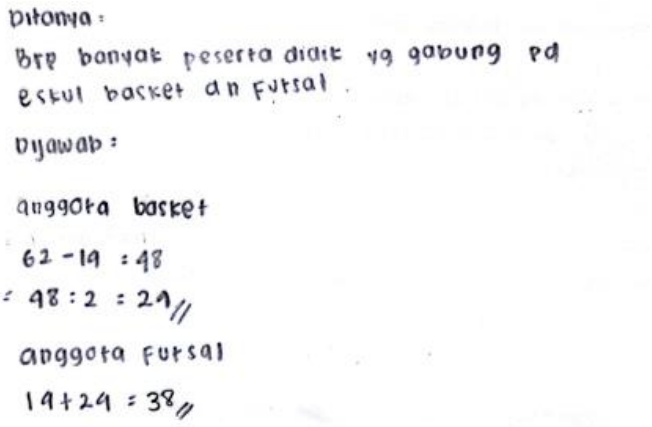

Figure 5. Aspects of Abstraction in Students with Moderate Levels

Based on Figure 4 and 5, then it can be known that:

a. Focus on important parts or information
In this indicator students focus on important parts or information such as focusing on what has been written at the (asked) stage. Students in the high category are able to do this indicator well. Sometimes they don't write down the steps completely and coherently because it's already been done in their brains. For medium category students, they are able to carry out this indicator properly and coherently, because they are more careful and thorough in writing answers. Whereas for the low category, they did not write it down to this stage because the work on the previous stage had not been completed.

b. Create and develop a problem solving plan
Students who have finished determining the pattern in the previous indicator (pattern recognition), then they describe the formulation that has been made to get the results of the answers. Students in the high category have a tendency not to write coherently and completely on the answer sheet, because some of the steps developed have been carried out in their brains. So they are more focused on the results of the answers. While students in the moderate category write their answers in full on the answer sheet. For the low category, they have not been able to make and formulate steps to solve the problem due to

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weaknesses in mathematical abilities, especially in numerical calculations and the work on the previous stage has not been completed.

4) Algorithm Thinking
Figure 6 and 7 is the result of the subject's work on the given task.

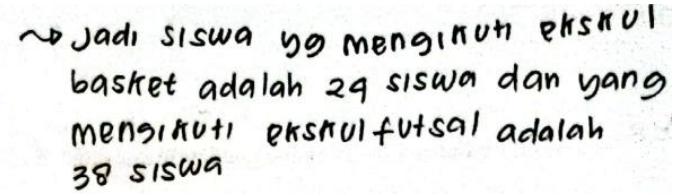

Figure 6. Aspects of Algorithmic Thinking in High Level Students

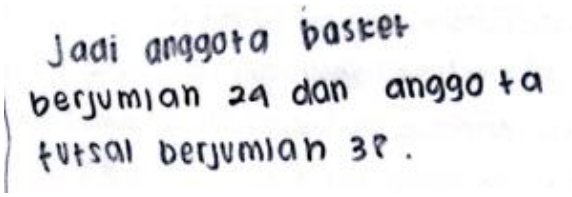

Figure 7. Aspects of Algorithmic Thinking in Medium Level Students

Based on Figure 6 and 7, then it can be known that:

a. Solve the problem according to the procedure that has been made
In this indicator students will solve problems according to procedures that have been made such as starting from what is known, asked, answered to the conclusion stage. Students with a high level tend to be incomplete in carrying out all stages of the indicator due to time efficiency in processing. For medium-level students, many are found to do all the indicators in full because this will make it easier for them in the process of finding answers. While students in the low category have not been able to get the answers correctly because of constraints on their abilities and the lack of enthusiasm of students in the learning process.
b. Draw conclusions
From all the results obtained in the stages of solving previous problems, this indicator makes a conclusion as the final result. For students with high and medium categories, there are no problems when carrying out this stage. As for the low category, there are still many found not to write down the stages of the conclusion because the stages in the previous indicator have not been completed.

Based on the research results above, this research examined students' computational thinking skills in solving contextual problems. Written tests and interviews were given to determine the students' computational thinking skills. The subjects taken were 25 class IX students.

Referring to the computational thinking ability research results above, the percentage results for each aspect are obtained, namely the decomposition aspect of 70.30% in the good category, pattern recognition 58.63% in the enough category, 58.30% abstraction in the enough category, and 50.47% thinking

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algorithm in the enough category. In contrast, research conducted by (Susanti and Taufik 2021) shows that the highest score was achieved by the thinking algorithm aspect with a percentage of 84%, and the lowest was the decomposition aspect of 65.5%. Students in the high category can solve problems accurately and quickly, but several stages of computational thinking still need to be completed. Students in the moderate category can do all stages of computational thinking well.

At the same time, students in the low category have yet to solve problems that arise and have not been able to think computationally ideally. This aligns with research (Kamil, Imami, and Abadi 2021) , which shows that students in the moderate or moderate category can state important information and take steps to resolve and solve problems correctly. Low-category students cannot write down the required information and cannot mention the steps for completion, and the solution obtained is the wrong solution.

CONCLUSION

Aspects of computational thinking of students who received as many as 25 students, namely decomposition aspects 70.30% in the good category, pattern recognition 58.63% in the sufficient category, 58.30% abstraction in the sufficient category, and algorithm thinking 50.47% in the sufficient category. So that students' computational thinking skills are included in the sufficient category. In addition, students' computational thinking abilities measured based on the categorization of students from high, medium, and low are as follows.

1. High category students.
   Students in the high category can perform computational thinking skills well. However, there were several steps that were missed and not written down in the answer sheet, such as the decomposition and pattern recognition aspects. They usually do this because of their fast numeracy skills and some of these stages have already been carried out in their brains, so they don't feel the need to write down these stages in full.
2. Medium category students
   All stages of computational thinking have been carried out very well starting from decomposition, pattern recognition, abstraction, and thinking algorithms. They do this because in this way they are able to solve problems that arise properly and correctly.
3. Low category students

Students in this category have not been able to perform the stages of computational thinking properly. Due to their inability to process the information that appears, they have problems with numerical calculations, and they do not like mathematics.

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