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Analysis of Computational Thinking Ability of High School Students in Solving Statistics Problems

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ABSTRACT

This research is motivated by the importance of computational thinking skills in 21st century learning. This research aims to describe the computational thinking skills of high school students in solving problems on statistics material. This research is a descriptive research with qualitative approach. The subject of the research was class X students of SMA Negeri 7 Pekanbaru, Pekanbaru City as many as 25 students. The data collection technique was done by test and interview. The analysis of students' computational thinking ability is seen through the indicators of computational thinking. The results of the analysis showed that high ability students on decomposition indicators (95.83%) were in the excellent category, on pattern recognition indicators (79.17%) abstraction (79.17%) were in the good category, and on algorithm thinking indicators (66.67%) were in the sufficient category. Medium ability students on decomposition indicators (72.22%) and pattern recognition (63.89%) are in the good category, on abstraction indicators (58.33%) in the sufficient category, and on algorithm thinking indicators (33.33%) are in the low category. Low ability students in the decomposition indicator (55%) are in the sufficient category, low category for the pattern recognition indicator (22.5%) and very low category for the abstraction indicator (17.5%) and thinking algorithm (7.5%).

Keywords: computational thinking; statistics

INTRODUCTION

The world is facing the industrial era 4.0 with its various challenges and opportunities, in the industrial era 4.0 it is necessary to develop 21st century skills such as problem solving skills (Runisah, 2021). The thinking ability used in one of the efforts to develop problem solving skills is computational thinking. Computational thinking skills popularized by Jeanette Wing are built on the principles of computational processes carried out either by humans or machines, but computational thinking in problem solving does not mean that it requires involving computers but humans must also have computer-like abilities, namely computational thinking (Angraini et al., 2023). Some experts state that computational thinking skills can be integrated and stimulated through mathematics subjects at school because it stimulates students' thinking skills by presenting mathematical problems that will be the process of students' knowledge construction (Cahdriyana & Richardo, 2020; Maharani et al., 2019). Mathematics and computational thinking have a complementary relationship. Mathematics plays a role in overcoming challenges and understanding concepts in computational thinking, while computational thinking in mathematics learning will explain mathematical concepts that are considered complicated into a simpler mathematical form. The integration of computational thinking in mathematics learning has enormous

benefits in the development of education (Reichert et al., 2020). Computational thinking is not just a technical ability to program computers, but a systematic and logical way of thinking to solve complex problems. This skill is particularly relevant in today's digital age, where technology increasingly dominates various aspects of life. Computational thinking is a modern way to overcome difficulties in learning mathematics (Tang et al., 2020).

The Program for International Student Assessment (PISA) in 2021 has added computational thinking to mathematics learning (Kusaka, 2021). Indonesia's Minister of Education, Culture, Research and Technology has also incorporated computational thinking into the education curriculum (Apriani et al., 2021). Computational thinking has a role in solving mathematical problems, because problem solving requires a process, with computational thinking that applies students to think abstractly, algorithmically, and logically, as well as solving complex problems in accordance with the indicators of computational thinking, to see students' computational thinking ability, there needs to be an indicator of computational thinking ability. Indicators of computational thinking according to Bocconi (Ariesandi et al., 2021), namely: (a) decomposing complex problems into simpler ones (decomposition), (b) from the problems that have been decomposed to then identify patterns that appear (Pattern recognition) (c) perform abstraction to get generalizations. used in solving problems (abstraction), (d) step-by-step solutions developed to solve problems (algorithmic thinking).

Statistics is a compulsory material that must be learned by high school students, and statistics is an important content of mathematics subjects in various countries (Ramelan & Wijaya, 2019). Statistics is one of the materials to solve problems that require more detailed analysis, so that computational thinking processes can be used. Research conducted (Munthe et al., 2023) found that students have difficulty in solving problems in statistics problems so that there is a need to increase, In accordance with that, research Setiani et al (2020) states that in solving problem solving in statistics material, students experience difficulties, as well as the results of the 2022 Program for International Student Assessment (PISA) study for the mathematics category, Indonesia's average score fell 13 points to 366, from the score in the previous edition of 379 (Schleicher, 2023).

Based on this description, this research aims to describe students' computational thinking ability in the learning process on statistics material. The results are expected to provide information as an inspiring preliminary study for teachers in developing students' computational thinking skills through mathematics learning.

RESEARCH METHODS

The research method used is descriptive qualitative research method. This research was conducted in the Pekanbaru city area, the subjects in this study were class X students of SMA Negeri 7 Pekanbaru in the 2023/2024 school year as many as 25 students. Data collection techniques used in this study were tests and interviews. The instrument used is a problem solving on Statistics material. The research procedures used are conducting preliminary activities, compiling tests and interview guidelines, collecting data and drawing conclusions.

There are several stages in this research. First, giving problem solving to the subjects and asking them to solve the problems. The second stage is to analyze the computational

thinking indicators that appear in the subject's problem solving results. The test results of students' computational thinking ability were analyzed based on aspects of computational thinking, namely decomposition, pattern recognition, abstraction, and thinking algorithms. Scoring was done on students' answers for each item, while the scoring criteria used was a modified rubric score from Ida Farida. (Windari, 2023) namely: each indicator of decomposition, pattern recognition, abstraction, and thinking algorithms will get a score of 4 if students are able to write answers in detail and accurately, score 3 if students write answers correctly but there are still shortcomings, score 2 if students can write answers but still an error was found, a score of 1 if the student wrote an answer but it was wrong, and a score of 0 if he did not write down the answer. The score is then converted into a score on a scale of 0-100. The percentage value of computational thinking ability is categorized according to the table of categories of students' mathematical computational thinking ability adopted from (Lestari & Annizar, 2020), which can be seen in Table 1.

Table 1. Categories of Students' Mathematical Computational Thinking Ability Level

Student scores	Assessment Category
66,7-100	High Ability
33,4-66,6	Medium Ability
0-33,3	Low Ability

Source: Lestari & Annizar, 2020

The third stage, to support qualitative analysis, interviews were conducted with 3 randomly selected students representing each category of computing ability.

RESULT AND DISCUSSION

The data in this research are answers from test results and student interview results. The results of the test data show that students are grouped into 3 categories, namely students with high computing ability, moderate computing ability, and low computing ability which are seen based on computational thinking processes in accordance with computational thinking indicators, namely: (1) decomposition; (2) pattern recognition; (3) abstraction; (4) thinking algorithm. The following data obtained from the test results are presented in Table 2.

Table 2. Computational thinking test result data

	Range	minimum	maximum	Mean
Subject	75	12,5	87,5	50

Data on the distribution of students' computational thinking ability results in the high, medium and low categories can be seen in table 3.

Table 3. Grouping of Students' Mathematical Computational Thinking Abilities

Category	Frekuensi	Percentage
High Ability	6	24%
Medium Ability	9	36%
Low Ability	10	40%

From the mathematical ability categories from table 3, 1 student was taken for each category for interviews. The results of the analysis of student answers based on high, medium

and low ability categories for each indicator of computational thinking ability are detailed in Table 4.

Table 4. Percentage of High, Medium and Low Ability Categories

Indicator	High Ability	Medium Ability	Low Ability
Decomposition	95,83%	72,22%	55%
Pattern recognition	79,17%	63,89%	22,5%
Abstraction	79,17%	58,33%	17,5%
Algorithm Thinking	66,67%	33,33%	7,5%

The percentage results of computational thinking ability are then described per indicator of computational ability, qualifications based on adaptations from Arikunto (Azizah et al., 2022) can be seen in table 5

Table 5. Qualification Percentage Computational Thinking Ability

No	Percentage	Criteria
1	81% - 100%	Very good
2	61% - 80,99%	Well
3	41% - 60,99%	Enough
4	21% - 40,99%	Low
5	0% - 20,99%	Very low

In more detail, researchers will describe the results of students' answers in solving statistics questions based on high, medium and low ability categories for each indicator of computational thinking ability. This description aims to be able to see the differences in computational thinking processes for each student's abilities.

The Computational Thinking Process of High-Ability Students

Based on the answer sheet, students with high ability levels have a success rate on each indicator as in the table below.

Table 6. Percentage High Ability Category

Indicator	Decomposition	Pattern recognition	Abstraction	Algorithm Thinking
Percentage	95,83%	79,17%	79,17%	66,67%

In general, students with high abilities are capable of decomposition indicators, namely describing the information contained in the problem, but students are still a little hampered by algorithmic thinking indicators. The following is one of the students' answers

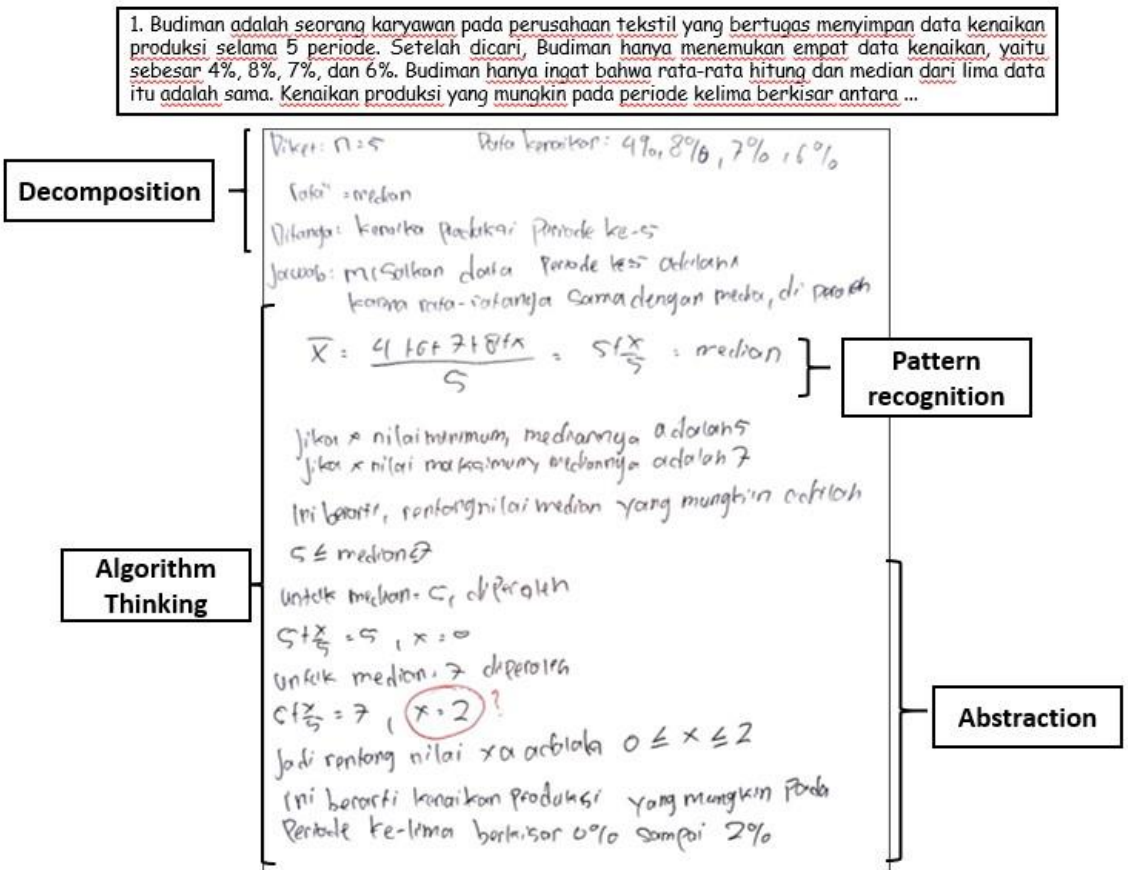

Figure 1. Answer Results of High Ability Students

From Figure 1, it can be seen that students have been able to write down the information contained in the problem, determine what is known and asked about the problem, are able to formulate the general form of the problem given, but at the abstraction and algorithm thinking stage, students make mistakes in writing down the reasons for getting the value x= 0 and x=2 in problem solving, this analysis was then strengthened through an interview with students. The results of the researcher's interviews with students showed that students realized errors during the calculation process and the reasons given by students for being careless and not being careful when carrying out mathematical calculations. Students actually have good calculation skills, but accuracy and precision in the calculation process needs to be improved (Pramesti & Prasetya, 2021).

The Computational Thinking Process of Medium-Ability Students

Based on the answer sheet, students with medium ability levels have a success rate on each indicator as in the Table 7.

Table 7. Percentage of Medium Categories

Indicator	Decomposition	Pattern recognition	Abstraction	Algorithm Thinking
Percentage	72.22%	63.89%	58.33%	33.33%

The following is one of the students' answers

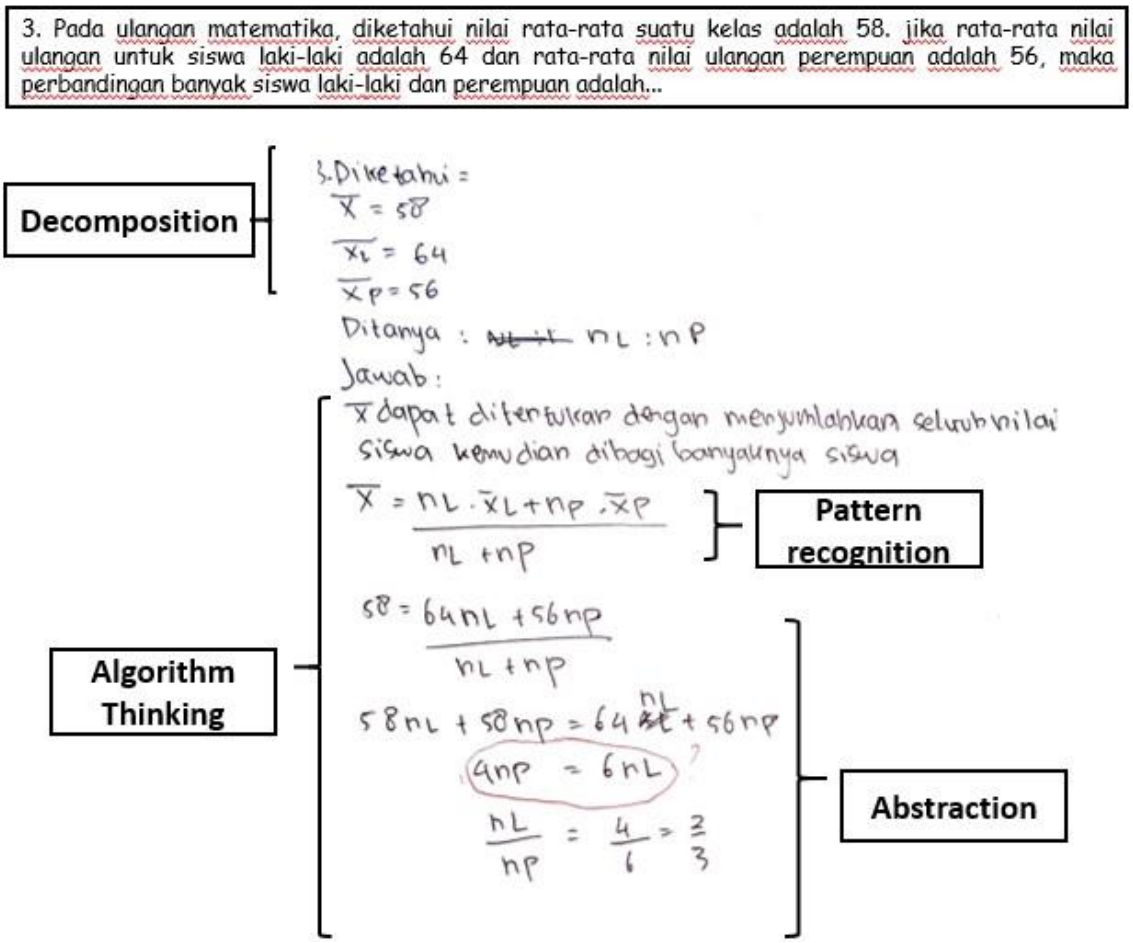

Figure 2. Results of Answers from Students With Medium-Ability

From Figure 2, it can be seen that when answering question number 3, students were able to write down what they knew and asked about the problem and were able to determine the general pattern or form used in the problem, however, at the abstraction stage of the thinking algorithm, students made mistakes in calculating the comparison value for male students. and women, as well as students do not draw conclusions from the answers obtained. The results of interviews with students showed that students made mistakes in calculations because students rushed the mathematical calculation process. In accordance with research (Hidayat & Pujiastuti, 2019) that errors in the calculation process are caused by students being in a hurry and not being careful in the mathematical calculation process.

The Computational Thinking Process of Low-Ability Students

Based on the answer sheet, students with low ability levels have a success rate on each indicator as in the Table 8.

Table 8. Percentage of Medium Categories

Indicator	Decomposition	Pattern recognition	Abstraction	Algorithm Thinking
Percentage	55%	22.5%	17.5%	7.5%

The following is one of the students' answers which can be seen in Figure 3

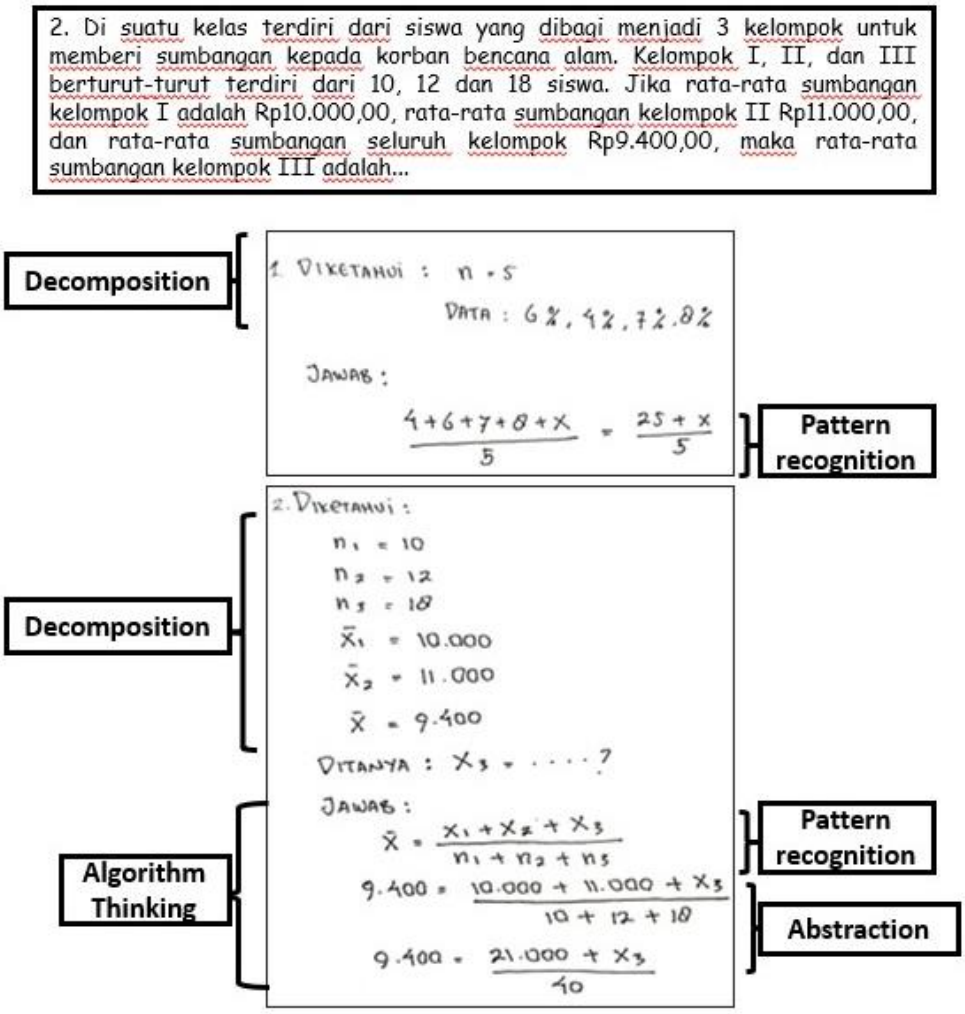

Figure 3. Results of Low-Ability Students' Answers

Figure 3 shows that students have not been able to complete the calculation process for question number 1. Students only write what they know in the question without writing down what is asked, and in discussing the question students do not write down the abstraction and thinking algorithm for the problem. In question number 2 the students were able to produce what they knew and asked, but at the problem solving stage the students made a mistake in determining the general form of work so that the results obtained were wrong. The results of interviews with students revealed that students were not able to carry out mathematical calculations because they were confused in solving problems. Low ability students are only able to answer questions up to number 2. Students did not write any answers to question number 3 on the answer sheet, in line with research conducted by Amalia (2017) that one of the mistakes students made in solving questions was being confused in determining the steps in solving the questions and running out of time to complete the questions.

CONCLUSION

Based on the description of the results and analysis of students' computational thinking in solving statistical problems, it can be concluded that high ability students got the highest percentage, namely decomposition with 95.83% and the lowest was algorithmic thinking with 66.67%, medium ability students got the highest percentage of decomposition with 72. 22% and the lowest in algorithmic thinking with 33.33%, low ability students got the highest percentage, namely decomposition with 55% and the lowest in algorithmic thinking with 7.5%.

The mistake made by students in the decomposition indicator is that they lack detail in describing the information they know and are asked about in the question. In the pattern recognition indicator, students are wrong in determining the pattern or formula in working on the questions. Low ability students cannot carry out the abstraction process well on abstraction indicators. In the algorithmic thinking indicator, students are careless and less careful in solving mathematical problems. The results of this research show that students' computational thinking abilities are still low, these results can be used as input for teachers to design learning that is appropriate to the stages of students' computational thinking processes.

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