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Analysis of Student Computational Thinking in Solving Social Statistics Problems

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ABSTRACT

This study aims to see students' computational thinking in solving social statistics questions and to find out why students experience their mistakes. This type of research uses a descriptive qualitative approach. The subjects used in this study were Governmental Science students taking the Social Statistics course. Data collection techniques were carried out by observation and tests. The instruments used in this study were the observation sheet and the test question sheet. The data analysis is carried out by reducing the data first, then presenting the data, and ending by concluding the results of the computational thinking indicator. The results showed that all aspects of computational thinking have been carried out by students, starting from Decomposition, Pattern Recognition, Abstraction, and Algorithm design. Students get the highest percentage on the computational thinking indicator, namely algorithm design with 84% and the lowest on decomposition with 65.5%. The cause of errors, in general, is because students are not used to completing in a structured manner. Students are accustomed to solving problems by directly substituting values into the formula without first writing down what is known and looking for what is needed in the questions first.

INTRODUCTION

As a basic science, mathematics has developed in terms of theory and application, it can be widely used in all areas of life(Gazali, 2016). That is the reason why mathematics is a science that must be studied and known by everyone. The success of students in understanding mathematics becomes a benchmark for whether or not to achieve mathematics learning and can take advantage of this understanding to solve other mathematical problems. Therefore, a suitable learning strategy can help students learn. Teaching is an art that helps students learn (Rahman & Dkk, 2011).

Learning mathematics that is meaningful and interesting is said to help students in learning. This makes students interested and happy to learn all fields of mathematics. So that there is no assumption that mathematics is the most difficult subject. This also happens in the field of statistics. Statistics is a branch of science in mathematics that studies how to plan, collect, analyze, and interpret data (Ulpah, 2009). Statistics are usually in the form of story questions in which data is presented in this question. The existence of such questions requires students to be able to think and reason so that they can apply or use rules or settlement steps in statistics to find the answer. In addition to training students 'mathematical and analytical thinking processes, problems in statistics are useful for training students' calculation skills (Gokce et al., 2017). Mastering the concept of material, understanding language, modeling mathematics, doing calculations, and determining the final answer according to the questions, are the abilities students must have to solve statistical questions (Nafi'an, 2011). Statistics have an important role in learning mathematics when students are faced with problems related to their daily lives (Ulpah, 2009). Statistics also has many benefits, one of which is for the development of students' thinking processes, because solving these problems requires understanding and reasoning(Syarifah, 2017). Students are said to have understood the problem, it can be seen from how to read questions, interpret sentences, and understand questions. After understanding the questions, students easily determine operations and perform calculations according to the formula given so that in the end they get the correct answer (Syarifah, 2017).

Solving problems in mathematics does not only require the ability to count but requires the ability to reason so that students can find out the meaning of the problem (Kusumawardani et al., 2018). Students are required to be able to understand the problems to be solved, be able to model them into mathematical language, and be able to relate the material to the problems they have faced.

Many theories in learning or in understanding mathematical concepts can be used to assist students in learning(Lockwood & Mooney, 2018). One of them is by training students to always use computational thinking theory in learning. Computational thinking is a pattern used in breaking or analyzing parts of a computer into 4 patterns, namely Decomposition, Pattern Recognition, Abstraction, and Algorithm Design (Swaid, 2015). Apart from computers and technology, this pattern also be used as a pattern to analyze the extent to which students solve problems in mathematics or find out at what stage students often make mistakes. Based on these 4 stages, it can be mapped again what the elements are in it. So that it can make it easier to analyze or find out where the difficulty is.
Previous research conducted by (Città et al., 2019) on the effects of mental rotation on computational thinking stated that there is a positive correlation between computational thinking skills and mental rotation abilities, which means that computational thinking patterns can be used in learning. (Durak & Saritepeci, 2018) also researched Computational Thinking, in which the results showed that a person's computational thinking is also determined by the supporting variables, for example, the style of thinking and attitudes towards learning activities. Subsequent research also explains that curriculum development and game systems inappropriate learning can also develop someone's Computational Thinking (Kong & Li, 2016).

So that to develop computational thinking, appropriate learning techniques or strategies are needed. One of them is to use a variety of learning models or methods and can also use or get used to the application of questions or exercises in the form of story questions and allow reasoning first (Hossain, 2015). Based on the background description, the formulation taken in this study is the Computational Thinking Analysis of Students in Solving Social Statistics Problems and what are the causes. The purpose of this study was to see how students' computational thinking in solving social statistics questions and to find out what causes students to have difficulty solving these statistical questions.

METHOD

This type of research uses a descriptive qualitative approach. The subjects used in this study were Governmental Science students taking the Social Statistics course. The research procedure carried out, namely starting from research planning which includes library research activities, preparation of research instruments, and student conditioning. Next is the implementation of actions that include the provision of teaching material and explanations related to the material to be studied, then giving examples of questions and discussion, and finally learning about exercises that are by the learning material. The third procedure is analysis, where at this analysis stage it is carried out according to the Milles and Huberman method, the analysis begins with data reduction activities or selecting answers according to the computational thinking category, then presenting the data presented in the form of a table and drawing conclusions for all indicators of computational thinking.

Data collection techniques used to collect compliance data were observation and tests. Observations were made to find out how students solve Social Statistics questions with Computational Thinking. for the test data using a written test and in the form of essay questions. The test is used to see the results of student work which are then analyzed. Analysis of the data used in this study is to examine the results of student work which is then adjusted to indicators in Computational Thinking. Then the results are described supported by the findings during the observation. The following is an indicator of computational thinking which is used as a reference as a data analysis chart:

Table 1. Indicator of Computational Thinking

No	Aspect	Indicator
1	Decomposition	a. Read information and problems that arise
		b. Make information simpler
		c. Convert from a word to a symbol or example
		d. Determine the formula
2	Pattern Recognition	a. Determining what issues arise (asked)
		b. Determining the Pattern / possibility
3	Abstraction	a. Focus on Important Information.
		b. Develop a problem-solving plan
4	Algorithm Design	a. Solve problems in accordance with the steps that have been made / arranged.
		b. Make a Conclusion

RESULTS AND DISCUSSION

This research was conducted on Governmental Science students who were taking social statistics courses and consisted of 44 students. The data from this research were obtained after giving questions to students. Then the data is reduced or sorted according to the student Computational Thinking indicator and the percentage is calculated per indicator of students who work according to these indicators. Based on the results of the analysis, it is obtained data that

Table 2. Average Student Understanding Results based on Computational Thinking Indicators

No	Aspect	Indicator	Average
1	Decomposition	a. Read information and problems that arise	48%
		b. Make information simpler	65%

		c. Convert from a word to a symbol or example	66%
		d. Determine the formula	83%
		Rata-rata Aspek Decompotition	65,5%
2	Pattern Recognition	a. Determining what issues arise (asked)	63%
		b. Determining the Pattern / possibility	75%
		Rata-rata Aspek Patern Recognition	69 %
3	Abstraction	a. Focus on Important Information.	80%
		b. Develop a problem-solving plan	65%
		Rata-rata Aspek Astraction	72,5 %
4	Algorithm Design	a. Solve problems in accordance with the steps that have been made / arranged.	83%
		b. Make a Conclusion	85%
		Rata-rata Aspek Algorithm Design	84%

Based on the table above, it can be seen that the Computational thinking aspect for Decomposition gets an average of 65.5%, the Pattern Recognition aspect with an average of 69%, the Abstraction aspect with an average of 72.5%, and the last is for the Algorithm Design aspect. with an average of 84%. The lowest average is in the Decomposition aspect and the highest average is in the Algorithm Design aspect. The average is obtained from how many students can complete the exercise questions according to the indicators of each aspect. The explanation for each indicator is as follows:

1. Decomposition
   a. Read information and problems that arise

      Reading information about the problems that arise get a percentage of 48%, the lowest percentage among other indicators. Following the results of observations, the problem that occurs in the indicator reading information from the problems that arise is because students do not understand what the meaning of the concept in the problem is, what students understand is about what material. This is also because students are accustomed to working on questions by the examples given by the lecturers so that when the questions are changed the structure students will experience difficulties and confusion.

   b. Make information simpler

      This indicator gets a percentage of 65%. On this indicator, students write down the information that has been obtained but it is more down to the points. What was originally a long sentence or in the form of paragraphs became only a few words. So that the problems asked in the questions become better understood. By looking at what is known, students know what is meant in the question, so that their understanding is limited to what is being asked, not yet in a deeper understanding of the question.

   c. Changing from words to symbols or examples

      Changing from words to symbols or examples is the most important part of solving math problems. In this case, the problem which is usually a description must be described in a mathematical form that can be solved under the concepts in the material. The percentage for this indicator is 66%. Some students did not write down the mathematical model or form of this indicator. What happens is that students solve problems directly without writing down the mathematical model.

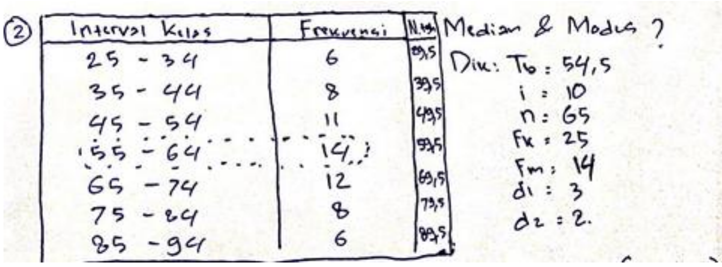

Figure 1. The activity changes from words to examples

From Figure 1, it can be seen that students write a mathematical model or form of the given problem. For example, in the picture, the students write the bottom edge of the class, the interval, the amount of data, the mode class frequency, the mode class frequency, and the frequency before and after the mode class.

d. Specifies the formula

Students determine what formulas will be used to solve the problems faced in accordance with the rules of mathematics/material taught / requirements on the questions. This indicator gets a percentage of 83%. Students write the formula that will be used to solve the problem.

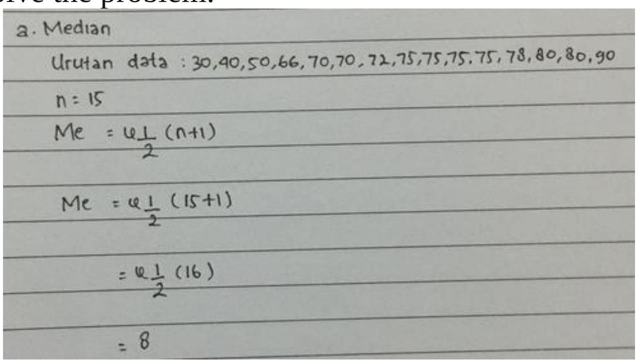

Figure 2. Activities of writing formulas In

Figure 2 above, it is known that students write down the formula of the median that will be used to solve the problem in advance. Then the students solve the questions according to what is known in the questions. This indicator is mostly used by students because solving these questions will be easier if the formula used to solve the questions is completed first

2. Patern Recognition

a. Determine what problems arise (asked)

In pattern recognition for this indicator students determine the problems that arise in the questions according to what students have read and understood at the decomposition stage. For example in this indicator is to write down what is asked in the question. This indicator gets a percentage of 63%. Many students do not write down what is asked in the questions implicitly, but students directly write down the solution to the problem.

b. Determining the Pattern/possibility

Students enter existing information into a format/formula that was prepared previously at the decomposition stage. This indicator is mostly done by students, which is 75%. Examples of student activity results for this indicator are:

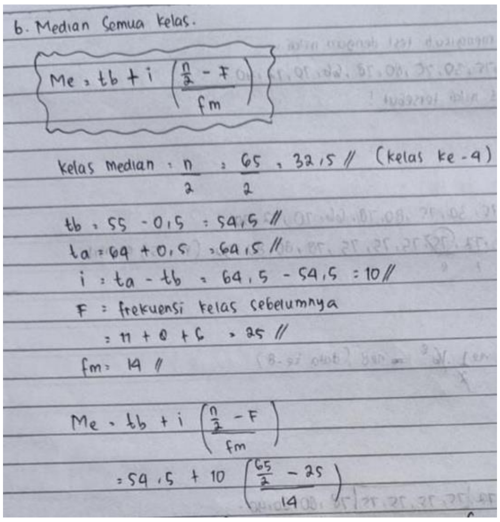

Figure 3. Activities Determining patterns or possibilities

In Figure 3 above, it can be seen that before solving the problem by using the median formula, the student first looks for the value of all the variables in the problem-solving formula. From finding the lower edge to finding the frequency of the median class. So that by finding the value of each variable first, it will be easier to substitute it in the problem.

3. Abstraction
   a. Focus on Important Information.
   This indicator states that students focus on important information that has been arranged in patterns/possibilities at the Pattern Recognition stage. 80% of students do this activity. Examples of activities can also be seen in Figure 3, where students solve questions by looking for the median value by substituting what has been written or searched for at the Pattern recognition stage for indicators of writing patterns or possibilities. So that after all the values of the variables in the formula are searched, they are substituted and resolved.
   b. Develop a problem-solving plan
   Students determine steps to solve problems that students encounter in questions. This indicator gets a percentage of 65%. Examples of student activity in this indicator are:

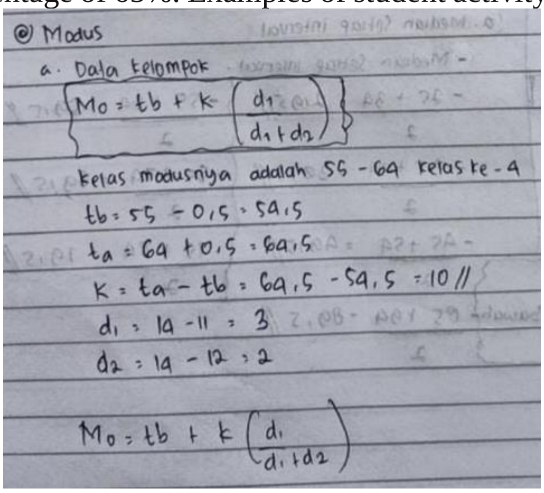

Figure 4. Problem-solving plan activities

In Figure 4. It can be seen that students write a plan for solving the problem starting from writing the formula first, then looking for the values of all the variables in the formula to solving the problem. In this way, students can determine what plans will be used in solving the questions or there is already a picture of what will be done to solve the questions.

4. Algorithm Design
   a. Solve problems by the steps that have been made/compiled

      This indicator gets a percentage of 85%. Students solve problems using steps that have been arranged in the abstraction stage. So that with the complete steps that have been prepared, students only need to continue by substituting all the values of the existing variables into the formula. Then proceed with calculations by the algebraic calculation procedures that students already understand. Examples of student activity in this indicator are:

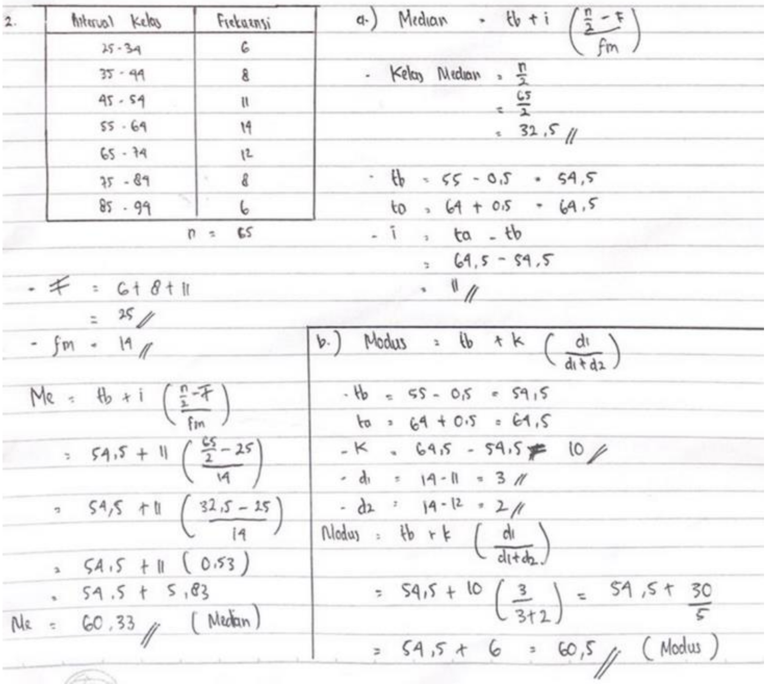

Figure 5. Problem-solving activities

      Figure 5. The above shows that the student solved the problem by first writing the formula and looking for all the values of the variables in the formula, then the student substituted all the values and calculated the median value and their mode. So that the student can determine the median and mode value of the group data in the questions presented.

   b. Making Conclusions

      From the results that have been obtained on the indicator of problem-solving, then a conclusion is made as the final result or final problem-solving. This indicator gets a percentage of 84%. Example :

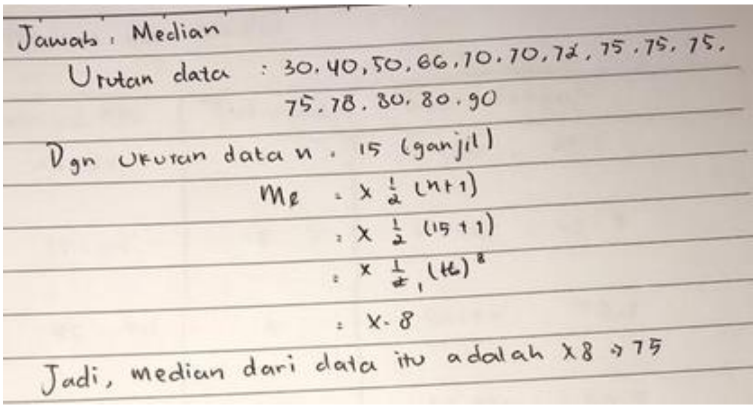

Figure 6. Activities to make conclusions

Figure 6 shows that students write the conclusions of the questions given, namely writing the median of the 8th data is 75. Students in a structured manner write down what the conclusions are in the questions, some write down the results immediately and give a sign for the final result or the conclusion of what the value is looking for.

Based on the research data above, it can be seen that the computational thinking indicator has been done by students. So it can be concluded that computational thinking can be used to see student understanding in solving a problem. In addition, computational thinking is also very important to introduce to students to train students' abilities so that they are more structured and focused on solving math problems or math problems. And not only applicable to teaching computer science only. As research conducted by (Nam, 2011), the elements in computational thinking are also very important to introduce in science learning. The same is the case with research conducted by (Olabe et al., 2019), namely how to solve problems with computational thinking, by first presenting a computational model of thoughts such as when, what, how, and why. So that the computational model will easily map the possible solutions.

CONCLUSION

Based on the description of the results and discussion of the analysis of computational thinking of students in solving statistical problems, it can be concluded that students' computational thinking gets the highest percentage, namely algorithm design with 84% and the lowest in decomposition with 65.5%. The cause of errors, in general, is because students are not used to completing in a structured manner. For example, when solving the mean and median questions, students only substitute directly from the questions, without first writing down the known conditions. Students are accustomed to solving problems by directly substituting values into the formula without first writing down what is known and looking for what is needed in the questions first. The algorithm design aspect gets a high percentage because students basically after writing the formula can immediately calculate the value of what is written in the formula. Meanwhile, decomposition gets a low percentage because students are not used to writing what is known in the questions first.

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Analisis Computational Thinking Mahasiswa Dalam Menyelesaikan Soal Statistika Sosial

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ABSTRAK

Penelitian ini bertujuan untuk melihat computational thinking mahasiswa dalam menyelesaikan soal statistika social serta untuk mengetahui penyebab mahasiswa mengalami kesalahannya. Jenis penelitian ini menggunakan deskriptif dengan pendekatan kualitatif. Subyek yang digunakan dalam penelitian ini adalah mahasiswa Ilmu Pemerintahan yang menempuh mata kuliah Statistika Sosial. Teknik pengumpulan data dilakukan dengan observasi dan tes. Instrument yang digunakan dalam penelitian ini adalah lembar observasi dan lembar soal tes. Analisis dilakukan dengan cara mereduksi data terlebih dahulu, kemudian menyajikan data dan diakhiri dengan menyimpulkan hasil dari indicator computational thinking. Hasil penelitian menunjukkan bahwa semua aspek computational thinking telah dilakukan oleh mahasiswa, mulai dari Decompotition, Patern recognition, Abstraction dan Algorithm design. Mahasiswa mendapatkan persentase tertinggi yaitu pada algorithm design yaitu dengan 84% dan terendah pada decompotition dengan 65,5%. Penyebab kesalahan secara umum adalah karena mahasiswa tidak terbiasa menyelesaikan secara tersetruktur. Mahasiswa terbiasa menyelesaikan soal dengan cara langsung mensubstitusikan nilai ke dalam rumus tanpa terlebih dahulu menuliskan apa saja yang diketahui dan mencari terlebih dahulu apa saja yang dibutuhkan dalam soal.

Kata Kunci: Analisis; Computational thinking; Statistika Sosial

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