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Student's Computational Thinking Ability in Solving Trigonometry Problems in the Review of Self-Regulated Learning

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Abstract: This research is motivated by the habits we often encounter in learning, especially in mathematics. Each student has different computational thinking abilities. Computational thinking ability is a thinking ability that supports problem-solving solutions. Computational thinking components include decomposition, pattern recognition, abstraction, and algorithm design. This research aims to: 1) Describe the computational thinking abilities of students with high self-regulated learning in solving trigonometry problems, 2) Describe the computational thinking abilities of students with moderate self-regulated learning in solving trigonometry problems, 3) Describe the computational thinking abilities of students with low self-regulated learning in solving trigonometry problems. This research used a qualitative approach with a case study type of research. This research was conducted at SMKN 2 Tulungagung which was attended by all students of class XI TKRO 3, totaling 32 students. Of the 32 students, 6 students will be selected as subjects who are classified based on the level of self-regulated learning. Data collection techniques used are observation, tests, interviews, and documentation. Data analysis techniques were carried out through the stages of data collection, data presentation, and conclusion. The results of this research indicate that: 1) students with high self-regulated learning can fulfill 3-4 indicators of computational thinking skills in solving trigonometry problems, 2) students with moderate self-regulated learning can fulfill 2-3 indicators of computational thinking skills in solving trigonometry problems, 3) and students with low self-regulated learning can fulfill 0-1 indicators of computational thinking skills in solving trigonometry problems.

Keywords: Computational thinking; Problem-solving; Self-regulated learning; Trigonometry

Introduction

Mathematics has such an important role, it would be impossible for a person to live in the 20th century without making use of mathematics (Shadiq, 2014). Almost all aspects of daily life use mathematical concepts such as trade, technology, economics, some sciences, and so on. The role of mathematics in everyday life, apart from mastering several aspects of life, is also intended to develop thinking skills through learning mathematics (Santoso, 2018).

Learning mathematics is one of the educational tools that can develop students' intellect and thinking skills (Septiani et al., 2018). While solving problems, students carry out a thinking process to answer the problems found (Maryono, 2020). Therefore, the ability to think becomes one of the determinants of achieving goals in learning mathematics, such as critical thinking, higher-order thinking, computational thinking, logical thinking, creative thinking, analytical, and reflective.

One of the thinking skills that support the process of learning mathematics, especially solving mathematical problems is computational thinking ability. Computational thinking is very important because the essence of computational thinking is to form a frame of mind for students who can solve problems by forming effective and efficient solutions based on the knowledge and information that has been obtained

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(Cahdriyana et al., 2020). Computational thinking includes cognitive skills that enable us to identify patterns, solve complex problems into simpler ones, organize and create sets of solutions and build representations through simulations. Computational thinking can enhance problem-solving skills and is a key attribute for success in the 21st century (Danindra, 2020). Computational Thinking is that way of solving problems, using computational methods normally used by technology such as algorithms (Maraza-Quispe et al., 2021). Computational thinking is a skill in the learning process that supports students in determining a solution to solve a problem. Computational thinking is an essential aspect of learning mathematics because it can form effective and efficient solutions in solving mathematical problems (Setiana, 2018).

Problem-solving ability is an important aspect of learning mathematics (Agustina et al., 2020). The importance of problem-solving skills in learning mathematics will affect learning outcomes (Badrulaini, 2018). If students have good problem-solving skills, they will get good and satisfying learning outcomes. This is in line with the objectives of learning mathematics as stated in the National Council of Teacher Mathematics (NCTM), namely learning mathematics can develop the ability to: (1) solve problems; (2) reasoning and proof; (3) communication; (4) connection (5) representation (Santoso, 2018).

The reality of mathematics education in the field is still getting unsatisfactory results. Based on the results of the National Examination at the high school level in 2019, mathematics is the subject with the lowest score, with an average score of 33.47. This shows that the essential aspects of the learning process, namely the thought process, are still being ignored because students have not been able to understand mathematical concepts properly so they get unsatisfactory results (Santoso, 2018). Therefore, computational thinking skills need to be improved considering that low computational thinking ability affects student learning outcomes (Mania, 2021).

A soft skill that allows computational thinking to be supported is self-regulated learning (Akhidayat et al., 2018). Self-regulated learning is the active process in which students play a major role in mastering their learning process (Anhonysamy et al., 2020). Students who have good self-regulated learning skills tend to have more advantages in the learning process and can monitor, organize, evaluate their learning effectively and efficiently, and students who have high learning independence tend to be better at self-monitoring, monitoring, evaluating and managing learning more effectively. Therefore, the difference in self-regulated learning will certainly affect the use of students' ways of thinking in solving mathematical problems.

Method

Research Methods

The approach used in this study was qualitative. This study analyzed and described data in the form of written and oral results of students' work in solving Trigonometry problems at SMKN 2 Tulungagung. The type of research used a case study. The case studied was in the form of students' computational thinking in solving trigonometry problems based on self-regulated learning. Students were grouped based on high, medium, and low self-regulated learning. In each of these groups, the results of work in solving trigonometry problems will be seen.

Participant

The population of this study was students of class XI TKRO 3 SMKN 2 Tulungagung with a total of 36 students. The sampling technique used a purposive sampling of as many as 6 people, who were selected based on the criteria of high, medium, and low levels of learning independence.

Instrument

There were several instruments used to support the data. These instruments include questionnaires, tests, and interviews. Questionnaires used to determine the level of self-regulated learning (independence of learning) provided by researchers to determine the characteristics of students. The test was in the form of students' work on solving math problems in trigonometry material to determine students' computational thinking skills. Interviews were in the form of questions and answers between researchers and students with high, medium, and low self-regulated learning types who were selected as interview subjects to find out more about the characteristics of computational thinking in solving trigonometry problems.

Data Analysis

Data analysis in qualitative research used when data collection taken place, and after completing data collection within a certain period. The researcher used several stages of data analysis on the Miles and Huberman model: 1) Data reduction, to provide a clear picture and make it easier for researchers to collect data, 2) Data presentation, the researcher presents data in the form of narrative text presented in the form of descriptions, 3) Withdrawal conclusions, carried out by adjusting the test results with the results of interviews so that conclusions can be drawn about students' computational thinking abilities in solving mathematical problems in terms of self-regulated learning.

Result and Discussion

The first stage in this research was filling out the self-regulated learning questionnaire. The questionnaire containing 20 statement items was filled in by the students in approximately 20 minutes. From the results of completing the questionnaire, the scores of each student will be calculated to determine which students have high, medium, and low self-regulated learning. From each of these characteristics, 2 students were taken each as research subjects so the total number was 6 research subjects.

Based on the table 1, shows that out of 32 students, 6 students have high self-regulated learning, 15 students have moderate self-regulated learning abilities, and 11 students have low self-regulated learning abilities. For further selected 6 subjects representing each category of self-regulated learning. 2 subjects with high self-regulated learning, 2 subjects with moderate self-regulated learning, and 2 subjects with low self-regulated learning. The six subjects were selected to take part in interviews as complementary data and to clarify the stages of work carried out by the six subjects based on indicators of computational thinking skills (table 2).

Table 1. Categories of Self-Regulated Learning Based on the Results of Filling Out the Questionnaire

Score	Frequency	Category
76-90	6 students	Height
61-75	15 students	Medium
45-60	11 students	Low

Meanwhile, a summary of students' computational thinking skills from the three levels of self-regulated learning is shown in table 3.

Table 2. Computational Thinking Ability Indicators

Computational Thinking Components	Sub-Indicator
Decomposition	Students can identify information from the problems given. Students can identify questions from the problems given.
Pattern recognition	Students can recognize the same or different patterns or characteristics in solving a given problem to build a solution.
Abstraction	Students can use familiar patterns and eliminate elements that are not needed when carrying out plans to solve problems.
Algorithm planning	Students can design problem-solving solutions that will be used effectively and efficiently. Students can mention the steps used to compile a solution to a given problem.

Table 3. Computational Thinking Components of the Three Subjects

Computational Thinking Components	Self-regulated Learning Level		
	High	Medium	Low
Decomposition	The subject writes down and explains the information that is known and asked in the questions correctly	The subject writes down and explains the information that is known and asked in the questions correctly	The subject writes down and explains the information that is known and asked in the questions correctly, but there are questions where subjects with low self-regulated learning are unable to describe the information correctly
Pattern recognition	Subjects can recognize the same or different patterns or characteristics in solving the problem a solution. The subject can build on the knowledge he once knew to solve similar problems	Subjects can recognize the same or different patterns or characteristics in solving a given problem to build a solution. The subject can build on knowledge he has ever recognized to solve similar problems	Subjects are not able to recognize patterns or characteristics that they once knew to develop knowledge so it is difficult to find a suitable strategy
Abstraction	Subjects can use familiar patterns and eliminate unnecessary elements when implementing plans to solve problems Subjects can determine what formulas and strategies are used to solve problems	Subjects can use patterns they recognize and eliminate elements that are not needed when carrying out plans to solve problems Subjects can determine what formulas and strategies are used to solve problems. But there are times when this subject has difficulty in using the concept to be used	The subject was unable to find the appropriate strategy because the subject was limited in describing the information obtained

Computational Thinking Components	Self-regulated Learning Level		
	High	Medium	Low
Algorithm planning	Subjects can design problem-solving solutions that will be used effectively and efficiently The subject can mention the steps used to compile a solution to the given problem.	The subject is unable to design a solution because the subject is unable to use the strategy appropriately.	Students are not able to design solutions with the right solutions so they do not get the appropriate answer conclusions.

Computational Thinking Ability of Students with High Self-regulated Learning

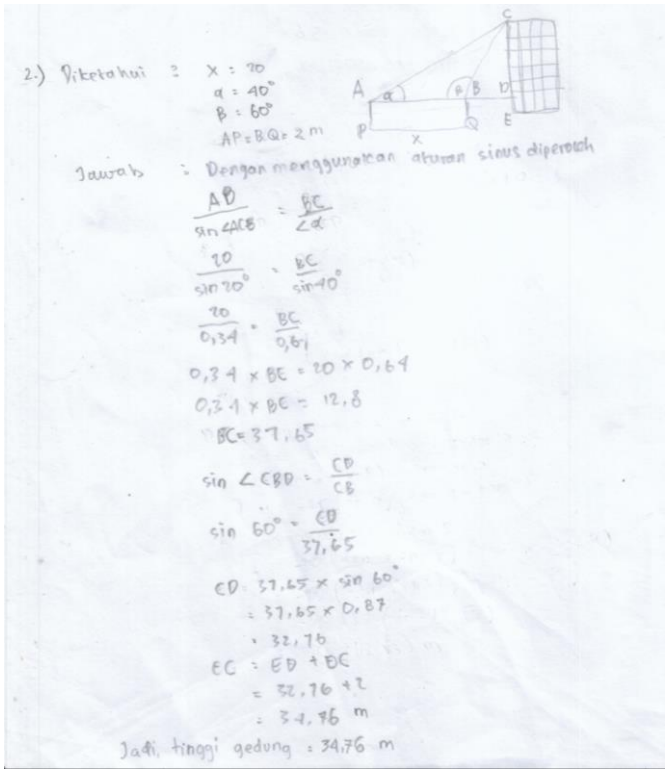

Figure 1. SRL subject test results are high

Based on the figure 1, subjects with high self-regulated learning can identify the information provided in the problem by making an image to make it easier for them to recognize the characteristics of the pattern of problems to be worked on. Students with high self-regulated learning can also identify information that is known in the problem by writing down and mentioning that the question is known that Doni's height is the same as the building's height, the distance between Doni and the building for example in meters, the angle from Doni's place and the angle from the top of the building and mentioning The problem in this problem is to find the height of the building. Computational thinking skills possessed by students with high self-regulated learning can meet decomposition indicators, this is because they set goals and plans before starting work on a learning task (Hong et al., 2021).

Subjects with high self-regulated learning are also able to plan problems by building a solution strategy from examples of images that are made to make it easier to solve problems. The strategy used was to use the sine rule to find the height of the building from the door to the top of the building in the drawings he made. The strategy he had planned was correct because the concepts he had learned could be used properly. This is because subjects with high self-regulated learning can understand the relevance of the information obtained to build solutions and can apply it to solve problems (Makur et al., 2021). The ideas possessed by highly self-regulated learning students can encourage them to find appropriate strategies and find an answer (Imanisa et al., 2019). This fulfills the component of computational thinking, namely pattern recognition.

During the interviews, subjects with high self-regulated learning were able to explain their reasons for using the sine rule, namely that the rule was used because it was to find one of the sides of a triangle where both angles were known. This subject can use the concepts he has acquired to construct a solution appropriately. Subjects with high self-regulated learning set personal learning goals, monitor their progress towards those goals, and reflect on that learning to understand if their strategies used to reach a particular goal were useful (Hong et al., 2021). This fulfills the component of computational thinking, namely pattern recognition. This ability corresponds to a component of computational thinking, namely abstraction.

Based on the results of the tests and interviews above, shows that subjects with high self-regulated learning can understand problems well and have no difficulty in solving problems. Computational thinking skills possessed by highly self-regulated learning students can help them solve problems correctly. Subjects with high self-regulated learning are also able to explain a series of steps in solving problems. This is following the component of computational thinking, namely the design of algorithms. Computational thinking skills need to be continuously trained in mathematics learning (Supiarmo et al., 2021). This is because computational thinking has an important role to support problem-solving in learning mathematics (Danindra et al., 2020).

Computational Thinking Ability of Students with Moderate Self-regulated Learning

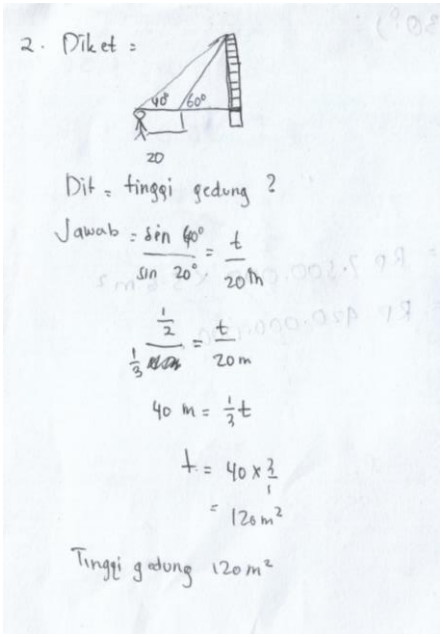

Figure 2. Average SRL subject test results

Subjects who have moderate self-regulated learning can use relationships between ideas in mathematics well (Murti et al., 2019). This is indicated by the subject being able to write down what is known and what is asked in the problem in the form of an image. This is one component of computational thinking, namely decomposition. Decomposition is done so that the problem is easy to understand, solve, develop and evaluate separately (Angeli et al., 2016) Students with moderate self-regulated learning have better problem-solving abilities than students with low self-regulated learning (Murti et al., 2019).

Students with moderate self-regulated learning can plan problems and can recognize the same or different patterns that are used to construct solutions (Supiarmo et al., 2021). It can be seen in the picture above that student with moderate self-regulated learning can mention the sine rule to find strategies from the patterns they find. Recognizing the same or different patterns makes it easier for students with self-regulated learning to solve problems because the information they get will be used as provisions to help them design problem-solving. This is included in the computational thinking component where students can define patterns, solve complex problems into small steps, organize and create a series of steps to provide solutions and build data representations through stimulation (Denning et al., 2019).

Problem-solving errors in students with moderate self-regulated learning are caused by errors and incomplete and systematic completion steps (Supiramo, 2021). This can be seen from the series of answers done by students, namely students with self-regulated learning are limited to the introduction of algorithms. Algorithm recognition is a process of describing systematic steps used to find a solution (Zhang et al., 2019). Students with moderate self-regulated learning have confidence in the answers they get but are doubtful about the results of unusual problems (Rahmadhani et al., 2021).

At the stage of solving the problem, students with self-regulated learning are not able to apply the steps they have arranged correctly so the final solution they get is also not quite right. Computational thinking skills are very important in solving problems (Danindra et al., 2020). Students with moderate self-regulated learning need to be improved so they can fulfill their maximum computational thinking skills. Because computational thinking can also be used as an approach to solving problems (Denning et al., 2019).

Computational Thinking Ability of Students with Low Self-regulated Learning

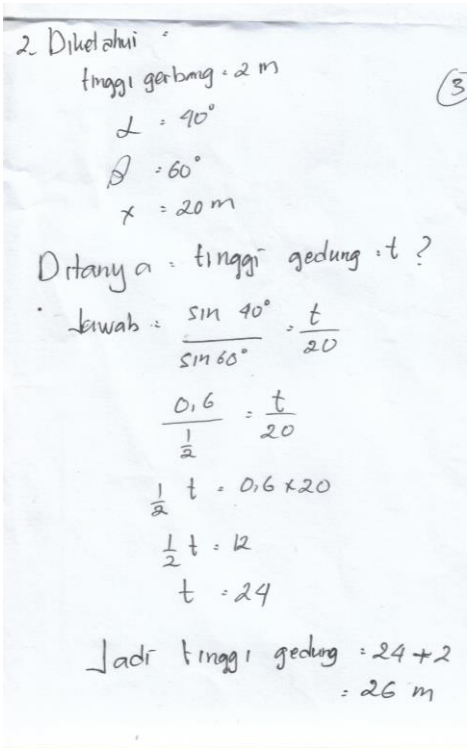

Figure 3. Low SRL subject test results

Subjects with low self-regulated learning were only able to meet the decomposition indicators on the computational thinking component. The answers stated above show that the subject is not perfect in describing information on a given problem. Decomposition is the decomposition or process of changing complex problems into simpler ones (Lee et al., 2018). Students

with low self-regulated learning have problem-solving skills that are no better than students with moderate self-regulated learning (Murti et al., 2019). Problem-solving ability is important in learning mathematics (Rahmadhani et al., 2021).

Subjects with low self-regulated learning are unable to recognize the same or different patterns that are used to construct solutions. The concept used to recognize problems by subjects with low self-regulated learning is not correct, so they experience difficulties in solving problems because the information they obtain cannot be understood properly. This shows that subjects with low self-regulated learning are not able to fulfill the pattern recognition component well in computational thinking skills. Students with low self-regulated learning make many mistakes in solving problems (Hakiki et al., 2022). When students cannot solve problems well, these students have low computational thinking skills (Barcelos et al., 2018).

Students with low self-regulated learning students are in the poor category in carrying out plans because there are mistakes made in carrying out plans that have been designed (Pratiwi et al., 2020). This can be seen in the problem-solving carried out by students with low self-regulated learning where these students cannot compile a solution to the problem given but what is stated is still not correct. This statement shows that students with low self-regulated learning do not meet the indicators of abstraction and algorithmic design in the computational thinking component.

Students with low self-regulated learning do not see difficulties as challenges, so they easily give up to solve problems (Nuraisa et al., 2021). Thus, students with low self-regulatory learning do not reflect independence in their learning process. The independence of student learning needs to be improved because it relates to students' ability to solve problems. The higher the level of self-regulated learning, the better the ability to solve it, and the lower the level of self-regulated learning, the less good the ability to solve the problem (Hakiki et al., 2022).

Conclusion

From the presentation of the data above, it can be seen that the results of research on students' computational thinking skills in solving trigonometry problems in terms of self-regulated learning show that students with high self-regulated learning can fulfill 3-4 indicators of the four indicators of computational thinking skills, namely decomposition, pattern recognition, abstraction, and algorithmic thinking, students with moderate self-regulated learning can fulfill 1-3 indicators of the four indicators of computational thinking ability, namely decomposition, pattern recognition, and abstraction, while students with low self-regulated learning can fulfill 0-1 indicator of the four indicators of computational thinking ability, namely decomposition.

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