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ANALYSIS OF VOCATIONAL HIGH SCHOOL STUDENT METACOGNITIVE CAPABILITIES ON GEOMETRY TOPICS DURING THE COVID-19 PANDEMIC

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Abstract: This study aims to analyze students' metacognitive abilities in terms of metacognitive awareness inventory on geometry topics during the Covid-19 pandemic. The method used in this research is a descriptive qualitative method. The research was conducted at Vocational High School Swadaya Karangnunggal Indonesia in the 2020/2021 academic year. The population in this study was the eleventh-grade student of office automation and governance, totaling 24 students. The questionnaire consists of 35 statement items with five indicators, namely planning (7 items), strategies for managing information (10 items), monitoring of understanding (7 items), improvement strategy (5 items), and evaluation (6 items). The stages in metacognitive ability are planning, monitoring, and evaluating stages. The results showed that students with good metacognitive abilities could carry out all metacognitive stages well, solving problems, planning, monitoring, and evaluating. Students with moderate metacognitive abilities cannot carry out all metacognitive stages in solving problems. They can carry out the planning stage, and some indicators cannot be completed properly. Then at the monitoring stage, they cannot monitor implementation activity to solve the problem because one of the subjects misunderstood the intent of the problem. The other subject experienced a calculation error when solving the problem. While at the evaluation stage, they could not complete all the indicators. Students with low metacognitive abilities cannot carry out all metacognitive stages in solving problems. They can only carry out the planning stage. Some indicators cannot be completed properly. Then they cannot carry out the monitoring and evaluation stages with all indicators.

Keywords: *Metacognitive Ability, Metacognitive Awareness Inventory, Geometry*

INTRODUCTION

The emergence of the Covid-19 outbreak has significantly impacted all aspects of human life, including education. Based on a circular letter from the Minister of Education and Culture regarding school policies during a pandemic states that the learning process is carried out from the home to provide meaningful learning through online or distance learning [1]. But in reality, distance learning has some obstacles. Provision of learning materials by teachers, technology literacy from teachers and students' parents who will guide the child, and the child's economic situation is felt to be an ineffective obstacle in the learning process [2].

In the learning process, metacognitive abilities have become an important issue in education [3]. Mathematics education, in particular, requires metacognitive abilities that play a role in solving obstacles in solving problems [4]. All use metacognitive abilities in problem-solving and planned learning, awareness, and regulation of thought processes [5]. Metacognitive abilities in the learning process receive less attention even though they play an essential role in solving learning problems. According to the results of a 2010 survey and a questionnaire analyzed, 100% of teachers have not empowered their students to use metacognitive abilities intentionally in the learning process in the classroom. It is an indication that teachers have not understood the steps in empowering metacognitive abilities and have not realized their influence on students' learning process. [6].

One of the materials that need to be considered is geometry in the learning process. Geometry material is abstract, requiring relatively high visualization [7]. NCTM recommends that students visualize, describe, and compare geometric shapes

in various positions during geometry learning so that they can understand them [8]. On the other hand, the abstractions developed to explain geometric patterns and relationships make geometry an essential subject and can be applied to various situations [9]. The subject in this research is the distance in shape, which is still included in the geometry topic.

Therefore, it is necessary to conduct research that can analyze students' metacognitive abilities in geometry material during the Covid-19 pandemic. Therefore, we need an inventory that can analyze metacognitive abilities. A metacognitive awareness inventory is considered suitable for measuring the metacognitive ability of adult learners [10]. Meanwhile, you can use metacognitive ability test questions to analyze metacognitive ability. The metacognitive ability test in this study refers to the modified metacognitive ability indicators (taable 1) [11].

Table 1. Metacognitive Ability Indicator Metacognitive

Stage Metacognitive	Ability	Indicator Description Metacognitive Ability Indicator
Planning	Understanding the problem	Determining what is known and asked from the given problem
	Determining the representation and recall of prerequisite materials that can help complete the task	Model the problem in the form of a picture Determine the prerequisite concept used when understanding the problem
	The solution strategy used	Arrange the work steps used to solve the problem
Monitor	Monitor implementation activities problem-solving	Check each step of completion and mark the checklist on the part that has been checked and is considered correct
Evaluating	the repair strategy if there are errors	Repeating some of the steps that have been done or try another way if you find an error
	Evaluate the results obtained	Check the suitability of the answer with what was asked.
	Evaluate the method/strategy used to solve the problem	Use other methods or strategies used to solve the problem

In addition to conducting research during the Covid-19 pandemic, it is necessary to consider the conditions of students, including access gaps/facilities for learning at home. Considering the gap in access/learning facilities of students at the school where the researcher teaches, the application that is considered the most suitable is WhatsApp. Students have mobile phones with limited or relatively low memory capacity, limited quota, and an internet network. In contrast, all students have installed WhatsApp on their cellphones. Given the HP limited or relatively low memory capacity of students, WhatsApp is the most suitable for use in this study because they do not need to install the application again. In addition, WhatsApp groups are seen as an effective distance learning network media for implementing the assignment method in an emergency due to the current coronavirus [12]. But WhatsApp does not support distributing questionnaires. So we need an application that can support the distribution of questionnaires. The most suitable application is Google forms. Google forms can be used to create a survey and questionnaire [13]. Therefore, the researchers chose Google Forms as an application for distributing metacognitive awareness inventory questionnaires.

Several previous studies have examined the analysis of metacognitive abilities in terms of the Metacognitive Awareness Inventory. Researchers examined metacognitive abilities in the Metacognitive Awareness Inventory in biology subjects [10, 23], physics subjects [24], in mathematics [19], primarily material derivative functions and their applications. However, no research has been found on students' metacognitive abilities in the Metacognitive Awareness Inventory on geometry topics. Therefore, it is necessary to conduct research to analyze students' metacognitive abilities in terms of the Metacognitive Awareness Inventory on geometry material during the Covid-19 pandemic.

RESEARCH METHOD

This research was conducted at Vocational High School Swadaya Karangnunggal in the 2020/2021 academic year. The research method used in this research is a descriptive qualitative method. In this study, the researchers tried to describe the research results narratively. The population in this study was class XI Office Automation and Governance (OTKP) 2, amounting to 24 students. The study consisted of 6 students with good metacognitive abilities (2 students), moderate metacognitive abilities (2 students), and low metacognitive abilities (2 students). The technique of taking the subject in this study used a purposive based on the considerations of the teacher. The consideration is that they have studied geometric material with the subject of distance in spatial shapes and the ability of students to express opinions orally and in writing so that they can provide clear information.

The data analysis techniques used are data analysis, namely data reduction, data presentation, and conclusion drawing and verifying. Then the data collection technique in this study is the distribution validated metacognitive awareness inventory [14]: the modified planning (7 items), information management strategies (10 items), monitoring of

understanding (7 items), improvement strategy (5 items), and evaluation (6 items).

The questionnaire uses a scale of 4, with respondents' answers in the form of choices from 4 alternatives, namely 1 (Never), 2 (Rarely), 3 (Often), and 4 (Always). In addition, the distribution of metacognitive ability test questions that mathematics lecturers have validated consists of 1 question with 8 questions. It is because the 8 questions represent all indicators of metacognitive ability.

RESULTS AND DISCUSSION

Twenty-four students filled out the metacognitive awareness inventory questionnaire. Some students cannot access Google Formular due to connection limitations and internet quotas. According to what is shown by tutors and students, the obstacle in distance learning is a poor internet connection [16]. In addition, the limited internet quota is also an obstacle to the application of online learning [17].

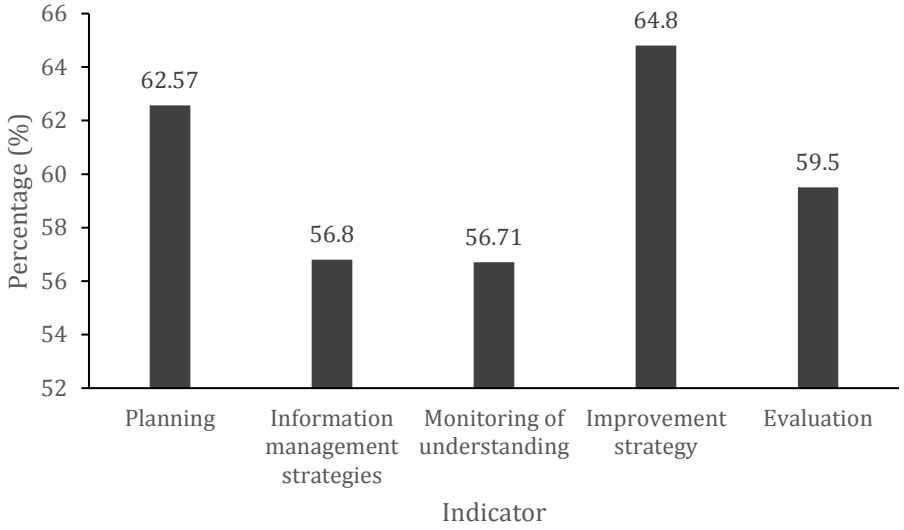

Figure 1. Diagram of the average student response results to the metacognitive awareness inventory indicator questionnaire

The average diagram of the results of student responses to the metacognitive awareness inventory indicator questionnaire is presented in figure 1.

Figure 1 shows that the average student response results to the indicators metacognitive awareness inventory indicator questionnaire, namely for planning indicators of 62.57, strategy managing information is 56.80, monitoring indicator on understanding is 56.71, improvement strategy indicator is 64.80, and evaluation indicator is 59.50.

Then the data was processed

and categorized into good, medium, and low levels of metacognitive ability. The categorization of the level of metacognitive ability refers to the interval and category of metacognitive ability adapted [15].

Table 2. Category of Metacognitive Ability Category

Interval	102.08
KM	Good
72.92 KM < 102.08	Medium
0 KM < 72 ,92	Low

Based on the questionnaire results, 7 students with good metacognitive abilities, 13 students with moderate metacognitive abilities, and 4 students with low metacognitive abilities. Of the 24 students, 6 students were taken as research subjects. The research subjects for the good category are student 1 (S-1) and S-12, the medium category is S-7 and S-13, and the low category is S-10 and S-14. The six students were then given questions on the metacognitive ability test. The test questions are sent via WhatsApp for research subjects in a pdf file, and students are given 60 minutes to work on it. After that, students send their answers to WhatsApp.

The researcher analyzed the results of the answers, and then an unstructured interview was held with the research subjects. However, on the first day of the interview, only 2 students could participate, while the rest conducted interviews the next day. It happens because of limited connections and student quotas.

Based on the answers and interviews of the six subjects, it was found that students with good metacognitive abilities could carry out the planning stage well but were incomplete. In question number 1, with the indicator of understanding the problem, S-1 determines what is known and asked from the problem that is given incompletely. S-12 is able to determine what is known and asked from the problem given correctly and completely. Then the indicator determines the representation and recall of

prerequisite material that can help complete the tasks in questions 2 and 3. In question number 2, S-1 and S-12 model the problem in the form of an incomplete picture. S-1 only draws right triangles without cubes and does not include sizes. While S-12 draws a cube with a right triangle, it's just that he doesn't include an explanation of the distance from point E to line AG on the cube, but in the triangle. In question number 3, S-1 and S-12 can determine the prerequisite concepts used when understanding the questions but are not complete. S-1 and S-12 only list the concepts but are not specific. Next, for the indicators of the completion strategy**,** which is used in question no 4, S-1 compiles the working steps used to solve the problem correctly and completely. Still, it does not follow the prerequisite concepts he listed in question number 3. In question number 3, he includes the prerequisite concepts of the Pythagorean theorem, while in question number 4, he lists the steps for solving using the area of a triangle. Based on the interview results, this happened because S-1 found it difficult to use the method using the Pythagorean theorem. Hence, he used an easier method, namely the area formula of a triangle.

In contrast, S-12 compiles the steps used to solve the problem incompletely. He compiled the steps of work directly by finding the area of a triangle without sketching a known picture. Based on the interview results, this happened because S-12 felt it would be faster in the process if they immediately looked for the area of the triangle.

Then at the monitoring stage with monitoring indicators, implementation activity solving the problems contained in questions number 5, S-1, and S-12 can check each step of completion and put a checklist on the part that has been checked and is considered correct properly.

So that S-1 and S-12 can carry out the evaluation stage well but are not complete. In question number 6, with indicators of improvement strategies, if there are errors, S-1 and S-12 do not repeat some of the steps that have been done or try other methods if they find errors because their answers are correct. Then for indicators, evaluate the results obtained**.** There Are questions 7, S-1, and S-12, checking the suitability of the answers with what was asked incompletely. S-1 and S-12 only answered that they were appropriate but did not explain in detail the suitability of the answers with what was asked. Furthermore, for indicators of evaluating the method/strategy used to solve the problem in question no. 8, S-1 cannot use other methods or strategies used to solve the problem. Based on the interview results, S-1 felt that he had not mastered the material, so he only knew this problem and could also use the method with the Pythagorean theorem but had difficulties in its application. While S-12 can use other methods or strategies used to solve problems. He uses the Pythagorean theorem to solve problems correctly and completely.

Students with good metacognitive abilities can carry out all metacognitive stages well in solving problems. Students who have good metacognitive abilities in solving problems will positively impact the learning process and learning achievement [18]. With metacognitive abilities, students can plan, control learning progress and evaluate learning outcomes so that learning becomes more directed and effective [21]. In addition, metacognitive abilities allow students to manage cognitive skills and see their weaknesses so that improvements can be made to actions next [24].

Then, students with moderate metacognitive abilities can do the planning stage, but some indicators cannot be completed properly. In question number 1, with indicators of understanding the problem, S-7 can determine what is known and asked from the problem given correctly and completely. S-13 cannot determine what is known and asked from the given problem.

Based on the interview results, this happened because S-13 felt unable to understand the existing problems. Then the indicator determines the representation and recall of prerequisite material that can help complete the tasks contained in questions 2 and 3. In question number 2, S-7 models the problem in the form of pictures, but there are errors. He drew the cube ABCDEFGH but made an error in drawing the triangle AEG. Based on the interview results with S-7, this happened because he had not been able to calculate and find right-angled triangles that matched the problems asked. The S-13 modeled the problem in the form of an incomplete picture. S-13 only draws a right triangle without a cube but includes the dimensions of the triangle from the calculation of the side diagonals and the space diagonal of the cube. In question number 3, S-7 and S-13 cannot determine the prerequisite concepts used when understanding the questions. S-7 lists the concepts that the cube formula must master, but when interviewed, he answered the formula for the area and volume of a cube. However, S-7 uses a formula that he made himself in answering questions, namely AE×EG/AG. S-13 did not answer question number 3. Next, for indicators of settlement strategy used in question no 4, S-7 composes the work steps used to solve the problem, but there are errors. He arranges the work steps directly by calculating a new formula and then sketching a known picture. Meanwhile, S-13 did not answer question number 4.

Indicators monitoring implementation activity solve the problems contained in questions number 5, S-7, and S-13 cannot check every step of completion and put a checklist on the part that has been checked and is considered correct. S-7 answered that the answer was already in question number 2, even though he only made a sketch of the picture in that statement. After being interviewed, S-7 considered himself to have solved the problem because he had drawn a cube and then marked it according to the directions of the question and determined the

midpoint to get an answer on how far from E to line AG was. But in reality, the S-7 did not solve the problem because no calculations were made. S-13 did not answer statement number 5 on the answer sheet. The student answered using the formula for the area of a triangle, but there were errors in his calculations.

S-7 and S-13 cannot carry out the evaluation stage. In question number 6, with improvement strategy indicators, if there are errors, S-7 and S-13 do not repeat some of the steps that have been done or try other ways if they find errors because their answers are wrong, but they think the answer is correct. Then for indicators, evaluate the results obtained on question 7, S-7 suitability of the answer with what was asked but had difficulty. He still doubted that the answer was correct. Based on the interview results, it turned out that this happened because S-7 had not been able to calculate and find the right-angled triangle. S-13 did not check the suitability of the answer with what was asked. He did not answer question number 7 because he found it difficult to solve it.

Furthermore, for indicators evaluating the methods/strategies used to solve the problems in question no. 8, S-7 and S-13 cannot use other methods or strategies used to solve problems. S-7 answered, but he used the formula he made himself, so he used the wrong formula to solve this problem. S-13 did not answer question number 8 because they found it difficult to solve the problem.

Based on the description above, it can be concluded that students with metacognitive abilities cannot carry out all metacognitive stages in solving problems. They can carry out the planning stage, but some indicators cannot be completed properly. While at the monitoring stage, they cannot monitor implementation activity to solve the problem because one of the subjects misunderstood the intent of the problem posed. In contrast, the other subject experienced a calculation error when solving the problem. Students who have moderate metacognitive abilities can use their metacognitive abilities while solving problems [19]. Then students with metacognitive abilities are unable to carry out the evaluation stage. They give the wrong answer but don't realize it because they think they have given the right answer. So they don't re-check the answer and don't try other ways. In addition, he did not answer several other questions because he found it difficult to solve the problem.

Students not succeeding in solving problems often occur because of their ignorance of how they will do it. They don't realize they already have a concept or understanding but do not know how to arrange and use existing concepts [22].

Then students with low metacognitive abilities, S-10 and S-14, can do the planning stage, but some indicators cannot be completed properly. In question number 1, with indicators of understanding the problem, S-10 cannot determine what is known and asked from the given problem. He did not answer the question because he felt he did not know what to determine from what was known and asked in the question. While S-14 determines what is known incompletely, there are errors when determining what is asked of the problem. It lists the cube ABCDEFGH with the dimensions of its sides but does not write down the right triangle AEG in the known parts. Then in the part that is asked, he writes that side A+side B+ side E. Side E =?. Based on the interview results, this happened because S-14 thought that the solution to the written question had to use the formula to find the answer, so he wrote it down in the part that was asked. The indicator determines the representation and recall of prerequisite materials that can help complete the tasks in questions 2 and 3. In question number 2, S-10 and S-14 model the problem in the form of pictures, but it is not complete. They only drew the cube ABCDEFGH but not the right triangle AEG. But both have different reasons when interviewed. Based on the interview results with S-10, this happened because he only knew how to model the problem in the form of a cube but did not understand how to model the problem of the length of the side of a triangle into an image. Meanwhile, S-14 forgot to draw a right triangle using the dotted line, which is usually used to draw the shape's interior, so he only drew the cube. In question number 3, S-10 cannot determine the prerequisite concepts used when understanding the questions. He did not answer the question because he felt difficult. While S-14 can determine the prerequisite concepts used when understanding the questions, they are incomplete and have errors. It lists the concepts that must be mastered by the formula for the area of a cube and the triangle area but are not specific. The formula for the area of a triangle can indeed be used to solve problems but not with the area of a cube. Next, for the indicators of the completion strategy used in question no 4, S-10 does not compile the work steps used to solve the problem. He did not answer question number 4 because he found it difficult. In contrast, the S-14 compiles the work steps used to solve the problem but is not complete. He only answered by calculating the formula for the area of a triangle.

Meanwhile, at the monitoring stage, with monitoring indicators, implementation activities solve the problems contained in questions number 5, S-10, and S-14 cannot check every step of completion and put a checklist on the part that has been checked and is considered correct. They did not answer question number 5. But when interviewed, S-10 did not answer because they did not know what formula to use. Meanwhile, S-14 did not answer because he could not find the answer even though he knew the formula to be used.

S-10 and S-14 cannot carry out the evaluation stage. In question number 6, with improvement strategy indicators, if there are errors, S-10 and S-14

do not repeat some of the steps that have been done or try other methods if they find errors because they do not provide answers to question number 6. Then for indicators to evaluate the results obtained**,** there are questions 7, S-10, and S-14 that do not check the suitability of the answer with what was asked. They did not answer question number 7 because they found it difficult to solve it. Furthermore, for indicators evaluating the methods/strategies used to solve the problems in question no. 8, S-7 and S-13 cannot use other methods or strategies used to solve problems. They did not answer question number 8 because they found it difficult to solve the problem.

It can be concluded that students with low metacognitive abilities cannot carry out all metacognitive stages in solving problems. They can only carry out the planning stage, but some indicators cannot be completed properly. Low cognitive levels can make plans but cannot monitor and cannot evaluate their thinking processes in solving mathematical problems [20]. Students with low metacognitive abilities have problems determining the formulation and selection of strategies in problem-solving and understanding the questions given. So they only reach the stage of designing or monitoring [22].

The weakness of this research is that this research is only done through the *WhatsApp* due to connection problems and internet quotas and the memory capacity of *cellphones* the students So that researchers cannot optimally control the process of implementing metacognitive ability test questions carried out by students. Maka dari itu apabila sarana dan prasarana peserta didik mendukung, alangkah lebih baiknya jika menggunakan aplikasi *zoom* atau aplikasi video *conference* lainnya ketika soal tes kemampuan metakognitif peserta didik dilaksanakan. Sehingga peneliti dapat mengontrol pelaksanaan soal tes kemampuan metakognitif peserta didik secara maksimal.

CONCLUSION

Based on the research and data analysis results, it can be concluded that students with good metacognitive abilities can carry out all metacognitive stages well in solving problems, including planning, monitoring, and evaluating stages. Students with metacognitive abilities cannot carry out all metacognitive stages in solving problems. They can carry out the planning stage, but some indicators cannot be completed properly. Then at the monitoring stage, they cannot monitor implementation activity to solve the problem because one subject misunderstood the intent of the problem posed. In contrast, the other subject experienced a calculation error when solving the problem. While at the evaluation stage, they could not complete all the indicators. Students with low metacognitive abilities cannot carry out all metacognitive stages in solving problems. They can only carry out the planning stage. Some indicators cannot be completed properly. Then they cannot carry out the monitoring and evaluation stages with all indicators.

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