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Metacognitive Identification in Solving Mathematics Problems of Junior High School Students

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ABSTRACT

This study aims to identify the metacognitive level of students in solving mathematical problems. This research is a descriptive research with a qualitative approach. The subjects in this study were students of class VII a total of 65 students. Data collection techniques in the form of tests and documentation. The data analysis technique is done by reducing the data, presenting the data and drawing conclusions. The results showed that overall students who had high metacognitive abilities were 14%, while students who had moderate metacognitive abilities were 51% and students who had low metacognitive abilities were 35%. Most students with high metacognitive abilities have used their abilities well. While students with moderate metacognitive abilities only a few students who have used their metacognitive abilities. Students with low metacognitive abilities have not used their metacognitive abilities in solving mathematical problems according to the polya stage.

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1. INTRODUCTION

Study and learning is a series of activities that humans must have done from birth to death. The learning and learning process is carried out to achieve predetermined educational goals. Learning is a process carried out by a person to obtain changes in behavior as a result of his own experience (Pane & Dasopang, 2017). One's success in learning can also be increased by understanding the learning objectives (Fasha et al., 2018) .Learning activities need to be understood by students to measure the importance of science, to make it happen, you need encouragement from yourself, your family and teachers. (Kallio et al., 2018) said that teacher encouragement is useful to support students in increasing their metacognitive awareness, namely students can set their own learning goals.

In the world of education, the term metacognition or metacognition is known. According to Flavell, metacognitive ability is a person's awareness in the thought process to develop planning, monitoring and evaluating an action (Febriana & Mukhidin, 2019). With the development of metacognition,

students are expected to be accustomed to monitoring, controlling and evaluating what they have done. Metacognition plays an important role in improving thinking processes and achieving learning outcomes (Kaune, 2006). According to North Central Regional Education Laboratory (NCREL) in (Yamin, 2013) states that in general there are three metacognitive components, namely: planning (developing an action plan), monitoring, evaluation (evaluating the plan). It is important for teachers to know students' metacognitive abilities and investigate how far students' mathematical understanding is. Because by knowing the students' mathematical understanding, the teacher indirectly knows the students' problem-solving abilities. National Council of Teachers of Mathematics states that there are five standard process of mathematical abilities that must be possessed by students, among others: problem solving skills, reasoning skills, communication skills, connection and representation skills (Mathematics, 2000).

Mathematics is one of the subjects used to practice problem solving skills. In learning mathematics, almost all of the material discussed uses a problem-solving process. For this reason, students are expected to be able to exploit their metacognitive abilities in the problem-solving process. According to Irfan (2017) problem solving is a process and method in solving problems with imaginative steps and resulting in effective action. Before solving problem solving problems, students must be able to understand the problem first. By understanding the problem, students are able to identify and solve problems appropriately (Anwar & Rahmawati, 2017). One of the mathematical skills that must be mastered by students is problem solving (Yulita & Ain, 2021). According to Polya (1973) the steps for solving the problem are: understanding the problem, making plans, implementing plans and reviewing (evaluation).

Problem solving and metacognitive abilities are two interrelated things. This is in line with Charles and Lester's opinion that there are three aspects that contribute to problem solving, including: cognitive aspects, affective aspects and metacognitive aspects (Rambe et al., 2020). Ability, because in solving mathematical problems students need to be equipped with knowledge metacognitive and skills. According to Risnanosanti (2008) there are at least five aspects that must be mastered by students in solving problems, namely the ability to understand mathematical concepts, mathematical skills, mathematical processing skills, the ability to be positive in mathematics and metacognitive abilities. According to Schoenfeld in (Güner & Erbay, 2021) metacognition is the most important part in the problem solving process. Problem solving is carried out in accordance with the knowledge related to cognition and cognitive regulation, both of which are components of metacognition (Anggo, 2011a).

Research conducted by Fooladvand (2017) states that there are differences in students' problem-solving abilities because each student has different metacognitive skills and thinking skills. In line with research conducted by (Yorulmaz et al., 2021) that there is a significant correlation between metacognitive awareness and problem solving beliefs. While research conducted by (Misa & Mariani, 2021) states that generally students have been able to understand problems, but students are less able to understand problem solving plans. The metacognitive level of students with high mathematical anxiety can cause the problem solving process to be less than optimal (Udil et al., 2017). This shows that there are differences in the level or metacognitive level of each student in solving problems. Another study states that there are differences in the improvement and metacognitive abilities of students with a contextual approach based on cognitive style (Zakiah, 2017). Some of these studies discussed differences in metacognitive abilities, while research that identifies students' metacognitive levels does not yet exist. Therefore, it is necessary to conduct research to identify the metacognitive level of students. In addition, based on the theoretical study that has been presented, it can be understood that metacognitive abilities and problem-solving processes are interrelated. Thus, this study aims to identify the metacognitive level of students in solving mathematical problems.

2. METHODS

This research is a descriptive study with a qualitative approach. The stages in this research contain several things, including: problem formulation, data collection, data analysis and drawing conclusions.

The subjects in this study were seventh grade students at SMP Negeri 1 Gondang. Data collection was carried out on December 13, 2021 using a mathematical problem solving test. This study used two classes, namely: VIIA and VIIB as many as 65 students. The data in this study is data on the ability to solve mathematical problems. The source of this research data was taken from the problem solving ability test of class VIII SMP Negeri 1 Gondang students. Data was collected by means of tests and documentation.

Qualitative research instruments in the form of tests. This instrument is equipped with scoring guidelines to make it easier for researchers to give an assessment. Validation of the test instrument was carried out by two validators, namely Lecturer of Education Mathematics, University of Muhammadiyah Surakarta. Content validity that is assessed is in the form of conformity of the questions with indicators of competency achievement and indicators of problem solving. The validation results from the two validators stated that the instrument was suitable for use with revisions in the scoring section. The material used in the test is algebraic material. Because algebra is one of the branches of mathematics that learns about solving mathematical problems. In addition, algebra material presents problems in everyday life, so that it can make students interested and not bored when solving the problems given. The material being tested is algebra with the grid presented in Table 1.

Table 1. Test question grid

Basic Competency	Questions Indicator
Solving problems related to algebra and operations in algebraic forms	Classifying algebraic forms Expressing problems in algebraic form Solving real problems in algebraic form

Students are expected to be able to demonstrate their metacognitive abilities in solving these problems. In this study, the indicators that the researcher wants to know are presented in Table 2.

Table 2. Metacognitive Components and Problem Solving

Metacognitive Components	Problem Solving Indicator
Planning Monitoring Evaluation	Understanding the problem Making a plan Implementing a plan Reviewing

Results of the description test are analyzed and the metacognitive level is determined based on the indicators provided have been made, namely: understanding the problem, making a plan, implementing the plan and reviewing it. Data analysis techniques in this study were carried out in three ways, namely reducing data, presenting data and drawing conclusions. The data reduction stage is done by selecting the important things that are needed and discarding the things that are not needed. The stage of presenting the data is done by determining the metacognitive level based on problem solving indicators in the form of a description. Then draw conclusions, namely: comparing and analyzing the data that has been presented based on problem solving indicators.

3. FINDINGS AND DISCUSSION

Test questions were used to measure students' metacognitive abilities in solving problems given based on the polya stage. Scoring is done by calculating the score of each stage of problem solving to the maximum score of the stages. It is used for to find out how far the students' metacognitive abilities in solving mathematical problems. Here is one of the questions on the metacognitive ability test: "Andi has two rectangular pieces of paper. The first paper has a size of (3a + 1) cm x 2(a - 1) cm. the second paper measures (a – 1) cm x (2a – 1) cm. what is the difference in the area of the two papers?

The metacognitive level categorization is based on student test results in solving problems based on the polya stage, namely understanding the problem, making plans, implementing plans and reviewing them again. Based on the scoring results, the total number of students based on each metacognitive level obtained from the test is presented in Table 3.

Table 3. Overall student metacognitive

Interval	Metacognitif Level	Number of Students	Percentage
$x \geq 20$	High	9	14%
$15 \leq x < 20$	Moderate	33	51%
$x < 15$	Low	23	35%
	Total	65	100%

Based on Table 3. it can be seen that the overall metacognitive level of students with the highest percentage is the moderate metacognitive level, which is 51%. The low metacognitive level has the second highest percentage of 35% and the high metacognitive level has the lowest percentage of 14%. The metacognitive components measured in this study include: planning (developing an action plan), monitoring, evaluation (evaluating the plan). Categories of students based on metacognitive components are presented in Table 4.

Table 4. Metacognitive components as a whole

Metacognitive components	Students Metacognitive Category			Percentage
	High	Moderate	Low	
Planning	5	30	20	84.6%
Monitoring	6	12	5	35.3%
Evaluation	4	2	1	10.7%

Based on Table 4. It can be seen that of all respondents there were only 55 students (84.6%) who did planning, then there were 23 students (35.3%) who did monitoring and there were only 7 students (10.7%) who did evaluations in solving math problems. Students who have high metacognitive abilities are able to use their metacognitive abilities well in solving problems. This can be seen in the results of student answers who are able to write clearly and correctly the process of problem solving. Examples of the results of students' answers with high metacognitive abilities are presented in Figure 1.

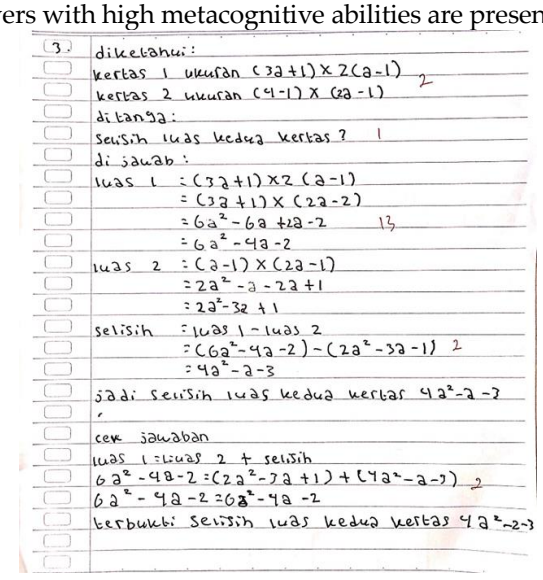
3.) diketahui:
kertas 1 ukuran $(3a+1)\times 2(a-1)$
kertas 2 ukuran $(4-1)\times(2a-1)$
ditanya:
selisih luas kedua kertas ?
di jawab:
luas 1 $=(3a+1)\times 2(a-1)$
$=(3a+1)\times(2a-2)$
$=6a^2-6a+2a-2$
$=6a^2-4a-2$
luas 2 $=(a-1)\times(2a-1)$
$=2a^2-a-2a+1$
$=2a^2-3a+1$
selisih = luas 1 − luas 2
$=(6a^2-4a-2)-(2a^2-3a-1)$
$=4a^2-a-3$
jadi selisih luas kedua kertas $4a^2-a-3$
cek jawaban
luas 1 = luas 2 + selisih
$6a^2-4a-2=(2a^2-3a+1)+(4a^2-a-3)$
$6a^2-4a-2=6a^2-4a-2$
terbukti selisih luas kedua kertas $4a^2-a-3$

Figure 1. Answers of students with high metacognitive

Attention to Figure 1. It can be seen that students with high metacognitive abilities have understood the information provided and the purpose of the questions from the problem. Students are also able to write down information that is known and asked clearly and completely. Judging from the plan and the completion process, students write down the steps of completion in a systematic and detailed manner and describe each step of solving the problem. Students also check the answers to prove the truth of the answers.

Meanwhile, as many as 51% of students with moderate metacognitive abilities still have not maximally used their metacognitive abilities in solving mathematical problems. This can be seen in 20% of the results of student answers that are less systematic in the process of finding answers. In addition, students also did not carry out the process of checking answers. Examples of the results of students' answers with moderate metacognitive abilities are presented in Figure 2.

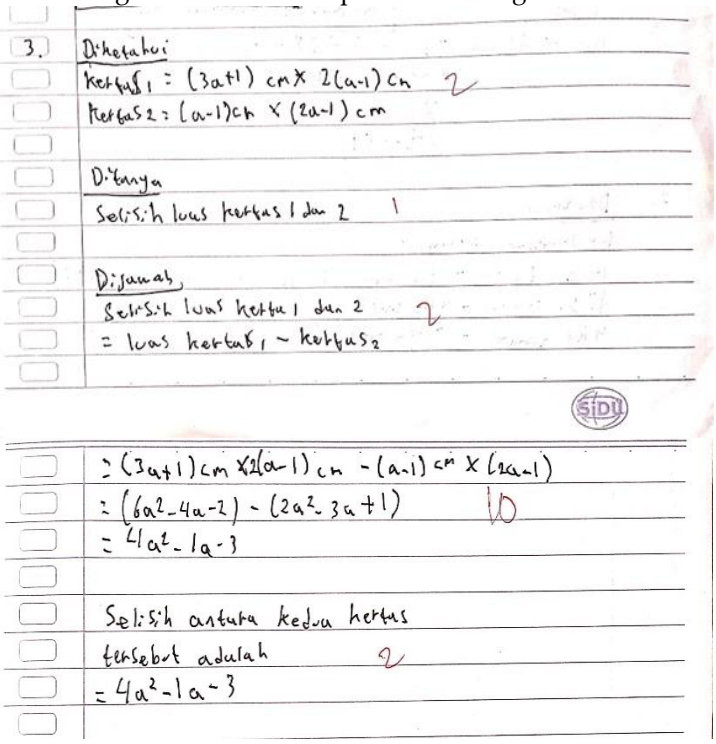

Figure 2. Answers of students with moderate metacognitive

Attention to Figure 2. It can be seen that students with moderate metacognitive abilities have understood the information provided and the purpose of the question from the problem. Students are also able to write down information that is known and asked clearly. In addition, students also wrote a settlement plan, but students were less systematic in describing the process of finding answers. Students also do not carry out the process of checking answers. They only write down the final result of the answer.

Meanwhile, there are 35% students with low metacognitive abilities. In general, students with low metacognitive abilities do not use their metacognitive abilities in solving mathematical problems. This can be seen in the results of students' answers that do not use the problem solving process in solving the problems given. Examples of the results of students' answers with low metacognitive abilities are presented in Figure 3.

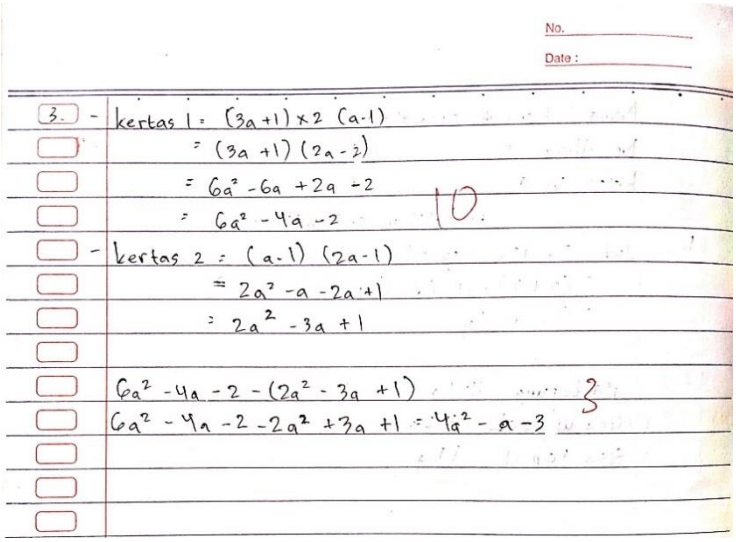

Figure 3. Answers of students with low metacognitive

Attention to Figure 3. It can be seen that students with low metacognitive abilities do not use their metacognitive abilities in solving problems. Students also do not write down the information that is known and asked. In addition, students did not write a completion plan and did not carry out the process of checking answers. But what is interesting is that students write down the completion process correctly.

Discussion

This study describes the high, medium, and low metacognitive levels. The metacognitive level categorization is based on the results of the metacognitive ability test in solving mathematical problems that have been carried out. In this study as a whole it was seen that 60% of students had used metacognitive abilities in solving mathematical problems. Students can solve the problem if they have understood the problem on the question. Problem solving is used by students to solve or solve a given problem by using the knowledge, skills and understanding they have. This is because problem solving performance has a significant relationship with metacognitive ability (Özkubat & Rüya, 2021).

In general, when students are given a problem, the first step they take is to understand the problem given and understand the information contained in the problem. Then they make plans from the problems given by remembering the formulas or concepts that have been explained by the teacher and from the experience of problems that have been done before. Because in solving problems students are required to think critically and creatively to find alternative solutions and determine the steps for the given problem (In'am, 2014). Problem solving will make students interested in solving these problems because they can be applied in everyday life (Al-Amin & Murtiyasa, 2021). It can be seen from the students' answers, most students with high metacognitive abilities are able to understand the problem and the information provided. Students are also able to plan the solution of the given problem. In addition, students are able to describe the problem solving process systematically and correctly and check the answers that have been written. This shows that students with high metacognitive abilities are able to manage their abilities well and maximally in solving mathematical problems. As many as 51% of students with moderate metacognitive abilities were able to understand the information provided and were able to plan the solution of the given problem. However, in the completion process as many as 20% of students were incomplete and systematic in describing the completion process. In addition, students do not check the answers that have been written. This shows that students with moderate metacognitive abilities have not maximally used their abilities in solving mathematical problems. In contrast to students who have high and moderate metacognitive abilities. As many as 35% of students with low metacognitive abilities did not write a completion plan. Students immediately write down the

completion process briefly without writing down information that is known and asked. In addition, students did not check the answers and immediately wrote down the final answers. This shows that students with low metacognitive abilities do not use their abilities in solving mathematical problems.

Metacognitive abilities and problem solving are interrelated student activities. Problem solving is carried out in accordance with the knowledge related to cognition and cognitive regulation, both of which are components of metacognition (Anggo, 2011a). The metacognitive component consists of planning, monitoring, evaluation. In the results of student answers in solving problems the three components have been implemented but only partially. Planning is a student activity in planning the problem solving process to be carried out. And determine the right strategy for the given problem. In the planning, it can be seen from the results of student answers that vary greatly depending on the questions given. Overall as many as 60% of students can write down the information that is known and asked in full. Monitoring is an assessment and improvement of the strategies used in solving problems.aspect monitoring is generally carried out by students with high metacognitive abilities and students with moderate metacognitive abilities. Meanwhile, students with low metacognitive abilities have not carried out monitoring in solving problems. Evaluation is a student activity in assessing the steps that have been taken while solving problems. In the evaluation, only students with high metacognitive abilities did the evaluation, namely by checking answers with different formulas. While students with moderate and low metacognitive abilities have not evaluated, they only write down the final results

Based on the description of the metacognitive component, it can be concluded that not all students use metacognitive abilities well in solving problems. In using their metacognitive abilities, students have different ways to monitor and regulate their thinking. This is adjusted to the thinking ability of each student. The research findings show that students with high metacognitive abilities are able to use their metacognitive abilities well. This is in line with research conducted (Aktan, 2020) that students with high metacognitive awareness will succeed in mathematics. The metacognitive component plays an important role in solving mathematical problems, because it can help students succeed in solving problems. When students are faced with problem solving problems, students recall the explanation of the material related to the problem. Then they begin to think of an appropriate plan and resolution process. In addition, students' awareness in planning, monitoring and evaluating can minimize the occurrence of errors. In line with the opinion (Febriana & Mukhidin, 2019) that metacognition is awareness of one's thinking process. One of the causes of errors in solving problems is that students do not apply the polya step in the problem solving process, including by writing down the information that is asked and known then writing down the completion process systematically and checking the answers that have been written (Pradana & Murtiyasa, 2020).

Based on this description, it can be concluded that the use of metacognitive abilities in solving problems is closely related. By familiarizing students with problem-solving questions, they can develop students' metacognitive abilities. In line with research conducted by (Murtiyasa & Al Karomah, 2020) that problem solving can make student learning outcomes better, this is because the provision of problems can stimulate students' thinking skills in solving problems. Metacognitive skills are very influential on the success of students in solving problems (Güner & Erbay, 2021). In addition, metacognitive abilities can improve students' ability to solve mathematical problems (Nanang, 2012). By involving students in solving mathematical problems, students will be able to develop their metacognitive abilities (Anggo, 2011b). The use of metacognitive abilities takes place continuously during the mathematical problem solving process. This study confirms that problem-based learning can abilities in solving problems (Anjelina et al., 2021). solving In addition, problem solving abilities can be improved through a problem solving approach (Husna & Burais, 2019).

4. CONCLUSION

Based on the research that has been done, it can be concluded that the metacognitive ability of the students still needs to be improved. Overall students who have high metacognitive abilities are 14%,

while students who have moderate metacognitive abilities are 51% and students who have low metacognitive abilities are 35%. Students with high metacognitive abilities have used their abilities well, namely by fulfilling all problem solving indicators. Meanwhile, students with moderate metacognitive abilities only met a few indicators. Students with low metacognitive abilities do not meet these indicators. The results of this study indicate that metacognitive abilities play a role in improving the ability to solve mathematical problems. This information becomes input for teachers in designing the learning process, namely familiarizing students with problem solving questions. For further researchers, it is hoped that there will be research with a wider and varied sample to obtain comprehensive information.

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