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METACOGNITION OF YEAR 12 PACKAGE C LEARNERS ON PERMUTATION

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ABSTRACT

One of the levels in the thinking process that students can use to solve problems is metacognition. Metacognition encourages students to realize and control their thinking process. Metacognition skills are needed to support students' independent learning process, one of which is in the learning process carried out in the Equivalency Education program. This study aims to describe the metacognition skills of Year 12 students on permutation and combination. This descriptive qualitative research was conducted at a Community Learning Center in Bandung, involving 12 subjects. The instruments used in this study were metacognition tests, questionnaires, and interviews. The results showed that students with high Mathematics Initial Ability had metacognition knowledge with reflective use and strategic use levels. Learning citizens with medium initial mathematical ability have metacognition knowledge with strategic use level, and learning citizens with low initial mathematical ability are at the aware use metacognition knowledge level. In the indicator of metacognition skills, learning citizens with high initial mathematics abilities are at the strategic use level, learning citizens with moderate initial mathematical ability categories are at the strategic use level, and aware use, learning citizens with low initial mathematical ability categories are at the tacit use level. In general, the metacognitive abilities of learning citizens in the high, medium, and low initial mathematical categories are at the strategic use, aware use, and tacit use levels.

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INTRODUCTION

Education begins with informal education, which refers to family and environmental education activities. Then when at a certain age, a person will enter formal education. This shows that in practice, the implementation of formal education is limited by various factors, such as the age of learners, place, and time. However, nowadays, for specific reasons, few parents choose informal channels such as homeschooling or Islamic boarding schools (*pesantren*) to educate their children. Therefore, PKBM (Community Learning Activity Center) is also an option to facilitate the learning needs of various school subjects.

The learning process at PKBM encompasses three types: face-to-face learning, tutorial learning, and independent learning (Putra et al., 2017). This implies that, within one semester of learning, students, referred to as learning citizens, have limited opportunities for face-to-face interaction with their tutors. Such conditions come with their strengths and weaknesses. On the positive side, learning citizens can flexibly study according to their time and location, but the downside is that teaching material might not be fully conveyed. This scenario is also applicable to mathematics learning.

Mathematics is among the various school subjects expected to contribute to students' thinking processes and problem-solving competence. In mathematics education, teachers/tutors often utilize competency tests in the form of problem-solving activities as the concluding phase of learning. The objective of conducting competency tests in problem-solving is to assess students' mastery of the given material and to train them to apply their knowledge to different situations and problems (Irham, 2015).

However, many learners still encounter difficulties in the learning process. They struggle to grasp the presented material and lack proficiency in solving mathematical problems. Several factors contribute to this, including limited face-to-face learning sessions with tutors and insufficient student independence in learning. In equivalency education, learning independence is a crucial factor in achieving success because, in practice, face-to-face learning time with tutors occurs only twice a month, necessitating independent study during other times.

Students' learning independence is strongly influenced by their awareness in the thinking process. One of the abilities needed to support awareness in the thinking process is metacognition ability (Anggo, 2011). Metacognition was introduced by Flavell in 1976 (Thayeb & Putri, 2017). Wellman (1985) stated that metacognition isa form of cognition, a second or

higher order thinking process involving active control over cognitive processes. It can also be defined as thinking about thinking, one's cognition about cognition (Purnomo, 2019).

Metacognition skills have a strong influence in increasing students' learning independence. This is in line with the study of Lalang (2021) stating that metacognition skills are very influential in learning independence and can improve students' critical thinking skills. Other research also stated that students with excellent learning independence have high metacognition, so they have high achievement in mathematics (Ardhilah et al., 2020). This means that the lack of student learning independence can be caused by students' low metacognition skills.

Schraw (1998) asserted that metacognition involves the awareness and knowledge of one's cognition. This metacognitive ability is expected to aid students in their thinking processes when solving problems, not only in mathematics but also in problems encountered in everyday life. One of the challenges frequently faced in the daily lives of learning citizens in boarding schools are simple issues, such as creating daily schedules, planning daily cooking schedules, organizing structures, preparing *halaqah* (study groups), scheduling oral exams, and more. These problems are closely connected to one of the topics in mathematics learning, namely permutation.

In Grade 12, many learners struggle distinguishing between the concepts of permutation and combination. Reflecting on the problem above, students' struggles with understanding this topic may stem from their low metacognitive skills. Hence, this research was conducted to investigate their metacognitive knowledge and skills in permutation.

METHOD

This research is qualitative research, employing a phenomenological approach. The researchsubjects were 12 students known as learning citizens in one of the PKBM equivalency education programs in Bandung City.

This research described the characteristics of the metacognitive level, using a test and structured interview as the research instruments. The test instrument consisted of three long answer questions. The test was carried out for two lesson hours. Next, the results of the description test were analyzed to see the students' metacognitive level in solving problems on permutation and combination according to the r indicators, including (1) declarative knowledge, (2) procedural knowledge, and (3) conditional knowledge.

This study consisted of several procedures. First, the researcher divided students into three groups based on their initial mathematical ability: high, medium, and low. Second, researchers matched students' answers on the metacognitive ability test with the available answer key, scored each student's answer, and analyzed answer based on their metacognition indicators to describe their metacognitive level in solving problems. Third, researchers interviewed several students to confirm their thought processes while solving problems. Fourth, researchers determined students' metacognitive levels, which consist of four levels: tacit use, aware use, and reflective use.

The stages of data analysis consist of data reduction, data presentation, conclusion drawing, and verification. The data reduction stage is carried out by preparing the necessary data and discarding unnecessary data. The data presentation stage is carried out to determine the level of students' metacognitive abilities. Furthermore, drawing conclusions and verification, namely comparing and analyzing the data presented based on the indicators of the metacognitive ability test.

RESULT AND DISCUSSION

The first instrument used in this study was a test consisting of three items. This instrument is expected to be able to measure the metacognition ability of citizens while solving problems. Previously, students had been grouped based on their initial mathematical abilities. After students work on metacognition ability questions, the results of students' answers are corrected and scored according to the indicators of metacognition knowledge.

The following are some results of student answers and some examples of interview transcripts conducted to measure students' metacognitive knowledge and skills.

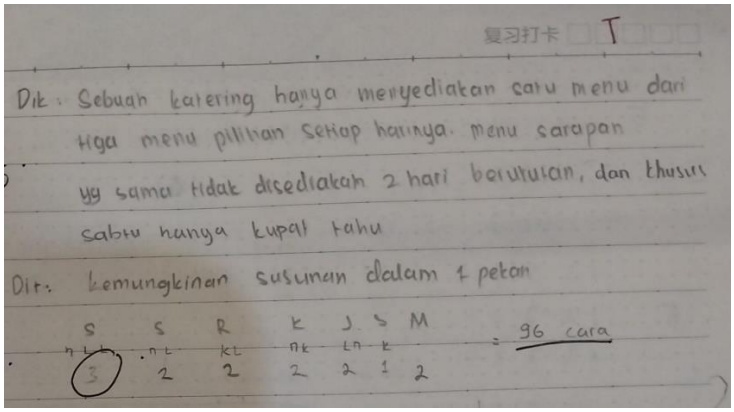

Figure 1. Student answer sheet of high Initial mathematical ability category

The writing on Figure 1:

A caterer provides only one menu out of three options every day. The same breakfast menu is not served two days in a row and only kupat tahu (a traditional Indonesian dish consisting of ketupat) is served on Saturdays.

Figure 1 shows that the student wrote back the known information andwhat was asked. The information written by students with high levels of initial mathematical ability is clear and complete, meaning that students have excellent declarative knowledge. In procedural knowledge, students can develop strategies even though they are less precise. The strategy used is the use of multiplication rules. However, there is a mistake in the solution process; in the Monday column, there should be two possibilities; students write there are three possibilities. This is because students assume that Monday is the first day, and forget that Sunday and Monday are consecutive days, as recorded in the interview excerpt as follows.

P : "Why did you choose this method?"

H1 : "Because in the problem, the order is very important. So, I chose the multiplication rule."

P : "What will you do when you can not answer this problem?"

H1 : "I will solve it by sorting the menus."

P : "What are the difficulties found at Problem 1"

H1 : "I am confused because I am afraid this possibility is misplaced. There could be other possibilities that the solutions are not those."

In the conditional knowledge indicator, the student could articulate the logical reason for choosing the strategy: the problem was related to arrangements involving permutation and multiplication rules. Moving on to the indicators of metacognitive skills, we observe that students can devise appropriate problem-solving plans in planning skills, but the results are inaccurate. Regarding information processing skills, students can articulate their thoughts using clear sentences but leave them incomplete due to errors. In monitoring skills, students know the aspects being monitored but exhibit lapses inappropriateness. As for evaluation skills, while working on problems, students did not initially assess their work or recognize errors. However, during the interview, after being reminded, students realized their calculation errors and could

accurately evaluate the results of their work.

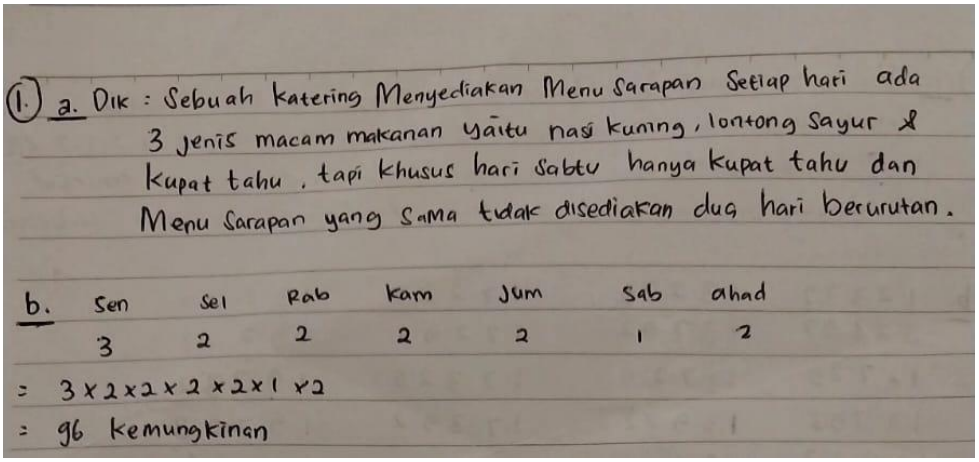

Figure 2. Student answer sheet of moderate initial mathematical ability category

The writing in Figure 2:

A caterer provides a daily breakfast menu with three types of food: nasi kuning (yellow rice), lontong sayur (rice cake with vegetable curry), and kupat tahu. On Saturdays only kupat tahu and the same breakfast menu are not provided two days a row.

In the student's answer sheet (Figure 2), the student wrote all the knowninformation but did not write what was asked in the problem. The student immediately wrote the answer by ordering the days from Monday to Sunday. This method is not very different from the previous student in the high initial mathematical ability category. The following are the results of interviews with students with medium initial mathematical ability using the code M1.

Interview results of medium initial mathematical category students code L

P	:	"Why did you use this method?"
M1	:	"Because it is the easiest way."
P	:	"What will you do when you have difficulty working on a problem?"
M1	:	"I will ask a friend who understands better."
P	:	"When working on Problem 1, did you look at the solution steps in other similar problems?"
M1	:	"Yes, look at the sample problems in the textbook."
P	:	"What difficulties did you experience when working on this problem?"

M1 : "I was not sure what method to use."

P : "Then, are you sure about the solution?"

M1 : "I was not sure at first but then after rechecking, I was convinced."

P : "What caused the uncertainty?"

M1 : "Because I did not understand the questions at first."

In planning skills, students can formulate problem-solving plans, but errors occur during the process. As for information processing skills, students can express information in their language with clear sentences, but the expressions are incomplete. This is evident when students arrange seven columns, corresponding to the number of days, and fill each column with the possible number of menus. However, like the previous student (M1), student M2 also makes an error when determining the possible number of menus for Monday. Regarding monitoring skills, students can recognize the aspects being monitored in problem-solving but not always appropriately. In terms of evaluation skills, students can assess the results of their work, but the assessment is not always appropriate. During the interview, the student mentioned that he rechecked the results of his work, even though errors were present.

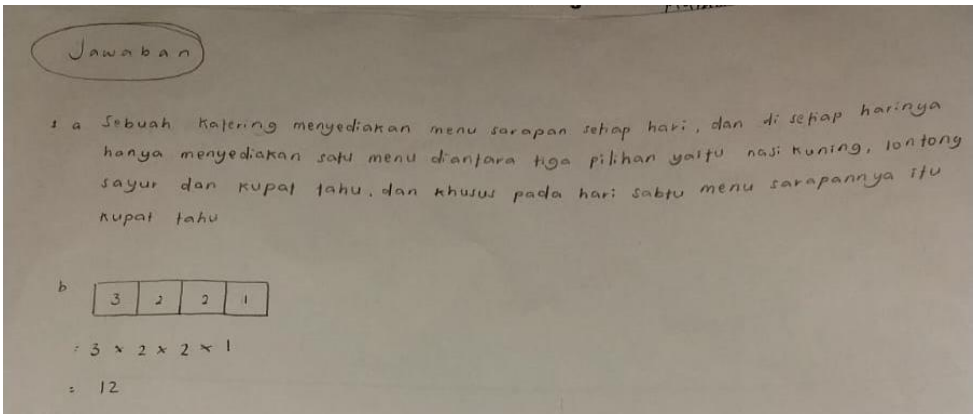

Figure 3. Student answer sheet of low initial mathematical ability category

The writing in the Figure 3.

A caterer provides a daily breakfast menu with three types of food: nasi kuning (yellow rice), lontong sayur (rice cake with vegetable curry), and kupat tahu. On Saturdays only kupat tahu and the same breakfast menu are not provided two days a row.

The following is the interview excerpt of low initial mathematical ability category student.

P	:	"How did you start writing like this?"
L1	:	"I looked at my friend..."
P	:	"Okay, so did you have trouble working on problem number one?"
L1	:	"Yes..."
P	:	"What are the difficulties?"
L1	:	"The difficulty is that you know the formula, but you do not know what to do with it"
P	:	"When working on the problem, are you sure of your answer?"
L1	:	"Not sure, because I do not know what to do with it."
P	:	"Okay, well thank you."

Metacognitive knowledge refers to people's awareness and ability to supervise and control their thinking processes. This means that they can recognize what they know as a collection of information used in the thinking process, which includes declarative knowledge (known information), procedural knowledge (skills and procedures), and conditional knowledge (knowledge of when and how to use it) (Pathuddin, 2016). Based on the results of the metacognition test, students' knowledge is very diverse; some are classified as tacit use, aware use, and strategic use. In general, the metacognition knowledge of learning citizens based on the metacognition test is at the aware use level. This level can be identified through the ability of the learners to articulate the problem clearly, showing an understanding of the concept (formula) and how to calculate it, but are not able to make corrections if errors occur, and lack of evaluation of their thinking. The learners with high initial mathematical ability are at the strategic use level. This level is illustrated through their ability to understand the problem and communicate it clearly, as well as being able to provide reasons that support their thinking. However, they have not evaluated the results of their thinking, so they have not investigated or reviewed their understanding critically (Alkadrie et al., 2015).

On declarative knowledge, most learners can identify what they already know, but when expressed in writing, there are shortcomings in their explanations. All learners were able to express a close understanding of the information known in the question and what was asked, and they were also able to mention what material was used to answer the question. And on average, they could express their awareness of material mastery. In procedural knowledge, most learners can formulate problem-solving strategies appropriately but are less precise in adapting them according to the problem at hand. The learners could explain their plan in solving the problem and describe the steps they would take during the problem-solving process. In

conditional knowledge, most students had difficulty explaining the logical reasons for using a strategy. However, specifically, students with high initial mathematical ability showed a good understanding of conditional knowledge. They could logically articulate the reasons for using the strategy with clear and comprehensive sentences.

CONCLUSION

Based on the research results obtained from the metacognition test and student interviews, it is evident that learning citizens with high initial mathematical ability demonstrate metacognition knowledge at the strategic use level. Meanwhile, those with medium initial mathematical ability exhibit metacognition knowledge at the aware use level and learning citizens with low initial mathematical ability possess metacognition knowledge at the tacit use level. Further findings from the metacognition test and interviews reveal that learning citizens with high initial mathematical ability have metacognition skills at the strategic use level, those with medium initial mathematical ability demonstrate metacognition skills at the aware use level and learning citizens with low initial mathematical ability display metacognition skills at the tacit use level. In summary, the metacognition skills of students in the high, medium, and low initial mathematical ability categories are at the strategic use, aware use, and tacit use levels, respectively.

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