Metacognition Behavior of Junior High School Students in Solving Algebra Problems in Terms of Mathematical Abilities

B S Bani [1,a)] , R Ekawati[2] , and E B Rahaju[2]

[1,2] *Postgraduate Program, Surabaya State University, Surabaya, East Java, INDONESIA*

*****Corresponding author: blandina.17070785039@mhs.unesa.ac.id

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Abstract. This study aimed at describing junior high school students metacognitive behavior in terms of thought process, self-reflection and information processing. There were 25 students' participants and three were selected as subject of this study. Mathematical Ability Test (MAT) and two Metacognition behavior' tests (MBT) were given to students' participants and three subjects with high, medium and low mathematics competence were interviewed afterwards. The results of this study showed that students with high ability was able to solve algebraic problems given systematically. Furthermore, students with medium mathematics competence considered to solve algebraic problems but less systematic and still experience errors, while low-ability students do not solve algebraic problems until they are finished and not systematic. The possible effect of this results were discussed to derive the recommendation for future studies.

Keywords*: metacognition, problem solving, algebra*

INTRODUCTION

In the 2013 curriculum, metacognition is a dimension of knowledge that emphasizes the role of students (student centered) in solving problems, while the teacher's task is only as a facilitator. In general, the term metacognition is students' awareness of their thought processes (Ersolu, 2013). Students are required to think systematically in solving mathematical problems independently. Metacognition is students' self-awareness about the cognitive process that is passed when solving a problem (Lioe, 2005). Metacognition is attention to yourself about the thought process, self-reflection, and how to process the information (Tan, 2003). Metacognition is the awareness of students in monitoring and controlling the abilities that exist in students when solving problems (Mokos & Kafoussi, 2013). From some of the opinions above metacognition is self-awareness about cognitive abilities that include thought processes, reflecting on thought processes and how to process information in solving problems

Metacognition is divided into three components, including *awareness, evaluation* and *regulation* (Wilson & Clarke, 2004). *Awareness* as a student's awareness of all learning processes and behaviors that involve every level of reflection, selection of learning strategies and processes of metal that are administered and can cause students to improve learning abilities (Conley, 2014). Awareness is the stage of identifying what students understand about the knowledge they have and is stored in long-term memory (Wilson & Clarke, 2004). So that awareness is awareness of the learning process which includes whether the problem needs to be solved, what concepts are owned, whether the knowledge is appropriate or not, how to solve it and when it is applied and used. Evaluation is a mathematical thinking of students or in other words the assessment of the thinking process that includes the effectiveness of the chosen strategy, assessment of results, assessment of progress, abilities and understanding (Magiera & Zawojewski, 2011).Evaluation is an assessment of students' thinking processes, capacities, and limitations of students in solving problems (Wilson & Clarke, 2004). So the evaluation is how students reflect the concepts used, whether the concepts will get the right results, how students supervise and manage problem solving by using the concepts chosen. Regulation is a student's skill based on cognitive abilities and mathematical thinking includes several parts namely strategy, goals and strategy selection in problem solving (Magiera & Zawojewski, 2011). Regulation is how or why students use certain strategies and how students optimize the source of cognition in solving problems.

Metacognition behavior can be known by examining the statements made regarding the problem solving process (Artzt & Armour, 1992). Metacognition behavior is a statement of students about the problem solving

process starting from controlling and processing information so that it gets the right results (Kuzle, 2018). Metacognition behavior is a statement and activity of a person regarding the problem solving process starting from thinking, planning, monitoring, checking again, as well as deciding and getting the final result (Demirciog˘lu & Argu¨n, 2010). It can be concluded that the metacognitive behavior in this study is a description of the problem solving process (thought process, reflecting the thought process and how to use appropriate information in solving problems) that is indicated by verbal actions.

Metacognitive behavior can be implemented in disciplines studied in junior high school, one of which is algebra. algebra is a major part of mathematics learning for students related to symbols, letters and signs (Shahrill, 2014). Therefore, students need to develop algebraic abilities through problem solving. problem solving is looking for or finding patterns and guidelines in order to get results (Ngalimun, 2017). Problem solving is defined as the process used to get results using cognitive and affective abilities (Ince, 2018). From some of the opinions above, problem solving is a cognitive process (identifying, representing, planning steps, controlling the knowledge possessed and evaluating the concepts, information and completion steps) carried out by students to get the final results using information and mathematical operations that have been known before. thus it will connect concepts and build understanding so that it will foster self-confidence, thoughtful thinking and independence of students in solving problems (Yoyen,2017).

The importance of problem solving in mathematics will stimulate students' beliefs in solving problems especially algebra. algebra is teaching material related to operations, relations, functions and one branch that studies about solving problems using symbols, instead of constants and variables (American Haritage, 2014). each item of algebra used to determine the level of understanding of students has different levels of difficulty, while the difficulty of junior high school students who have not been able to solve the problem of teaching using negative numbers and have not been able to interpret letters whose values are unknown (Trezise & Reeve, 2017). Based on a survey conducted by researchers still many students experience confusion in understanding the concept of algebra. The location of the difficulty experienced in the addition of algebraic fractions with different denominators. some students still cannot understand the sum with different variables, for example $2x + 3y + y = 6xy$. In addition, based on the results of the Program for International Student Assessment (PISA), in 2015, Indonesia was still in a lower position, despite experiencing a warning in the mathematics field from 375 in 2012, to 386 in 2015 (OECD, 2018).

Form of problems experienced by students above suggests that students are less able to solve algebraic problems. problem solving is a cognitive ability that is focused on the process to get the final result. This is an activity carried out by students during the problem solving process (Mayer & Wittrock, 2006). Each problem solving process identifies, represents, thinks about the steps, and evaluates the results obtained with the formulas, concepts and steps to solve the metacognitive behavior. Students who have high abilities tend to be easier in solving mathematical problems compared to students who are of medium and low ability (Caleb, 2015). So the ability is the capacity of students to solve problems because the abilities possessed by each student is different even though they are of the same age and the same class (Robbins & Timothy, 2013)

Based on the description above, the research question to obtain the following answers is how the metacognition behavior of high, middle, and low ability junior high school students in solving algebra problems?.

METHOD

Subject

This study uses a descriptive study with a qualitative approach to describe the metacognitive behavior of three subjects taken from St. Middle School students. Joseph in Surabaya. This research was conducted in class VIII semester I and 25 participating students consisting of 14 female students and 11 male students, because participants had received algebra material. By using purposive sampling techniques and the help of mathematics subject teachers will choose communicative students to conduct interviews consisting of one high-ability participant, one medium-ability participant and one participant with low ability to.

Analysis

In collecting data, a mathematical ability test (MAT) was conducted and a metacognition behavior test (MBT). MAT contains contains five test essay questions related to material numbers, sets, algebra, linear equations and inequalities that have been taught in semester one. MBT 1 and MBT 2 consists of three questions with algebraic material, each of which consists of three questions with algebraic material. Have been tested on 4 students outside of the research subjects. Then the tests were conducted two days in a row because the MAT and MBT I tests were conducted to see the mathematical abilities and behavior of metacognition while the

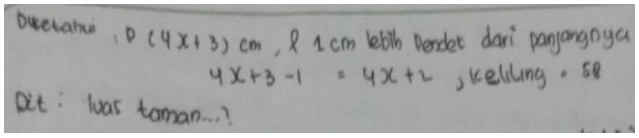
second day was carried out by MBT II to obtain data triagulation and each subject works individually with a 60-minute processing time.

From the results of MBT analysis, MBT 1 and supported by algebraic test scores, students are grouped into three categories, namely high (score > 80), medium (60 ≤ score < 80) and low ability (score < 60). After two hours of MAT and MBT 1 work, the researcher conducted an interview using the semi-structure method to obtain the validity of the data from each subject regarding MBT 1 that had been completed. Two days later, the three subjects took the MBT 2 metacognition behavior test and the interview contained three algebraic questions, which were not much different from MBT1. The researcher asked several questions to find out students' metacognitive behavior in solving algebraic problems in depth. Therefore, specifically presented in the form of indicators as follows several phases, namely (P1) Problem identification, (P2) Problem representation, (P3) Planning how to solve, (P4) Planning performance, and (P5) Evaluation, each divided into five aspects (Kapa, 2001).

RESULTS AND DISCUSSION

a. Metacognitive behavior for Highly Ability Subjects (HAS)

In the third question HAS, begin to identify with how to read three times and write what is known from inside the problem with relevant and use the concepts of algebra, circumference and area. then HAS makes a representation of the problem by connecting known information with newly acquired information, using multiplication, addition and division operations. in completing planning how to solve HAS using the right strategy because it is in accordance with the information, the concept has been chosen. HAS completes the procedure that corresponds to the answer sheet given starting with writing the unknown, starting to find the width, because the width that is known in the problem is not yet clearly known. The final step HAS to re-evaluate by checking the work twice to avoid mistakes.



HAS fulfills all indicators of metacognition behavior. During the HAS interview, answering the questions relevant to what was written on the answer sheet. The following is a transcript of the interviewer's interview and HAS.

P = What did you do before knowing the information about the questions and questions?

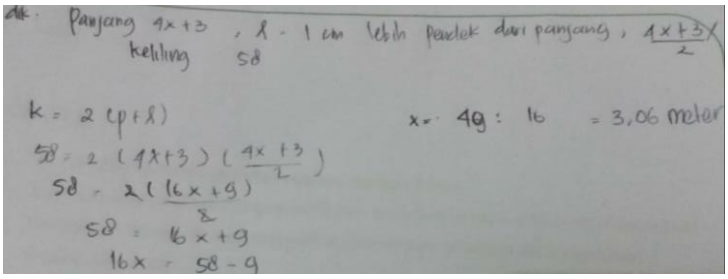
HAS = By reading the questions twice and writing down what is known to be $4x + 3$ length, the width of 1 cm is shorter than the length, because the length is $4x + 3$ then, the number 3 is reduced by 1, so the result is $4x + 2$ and the circumference is 58. Asked about the area of the park.

P = Pay attention to $4x + 3 - 1$. Why subtract 1 is only 3, give your reason!

HAS = Because 4 contains the variable x then only 3 is reduced, because of the rules of algebra, we can add and subtract if the numbers have the same variable and rank

b. Metacognitive behavior for Medium Ability Subjects (MAS)

In the third MAS question, start identifying by reading the problem several times and writing down what is known from within relevant problems and using algebraic and perimeter concepts. then the MAS makes a representation of the problem by linking information that is known to information that has just been obtained, but is not relevant. in the problem how to solve MAS write what is known and use the concepts and steps appropriately. planning how to solve MAS using completion steps is not relevant to the concept and gets no results. MAS does not meet the evaluation behavior because it does not re-examine the concepts, information and steps that have been done

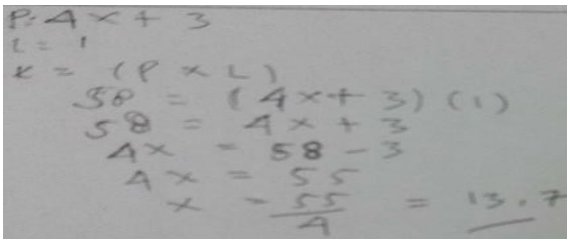


Credit is only professional on indicators P1, and P3 while not professional on indicators P2, P4 and E1. During the interview MAS answers questions that are relevant to what is written on the answer sheet. The following is a transcript of the interview of the interviewer and MAS.

P = What do you do before knowing the information about the questions and questions?
MAS = I read the problem several times and wrote down what is known, which is $4x + 3$ length and 1 cm width shorter than the circumference of 58 cm
P = What procedure did you use to solve the problem?
MAS = First write down the known length $4x + 3$, width 1 cm longer than the length, so $4x + \frac{3}{2}$, because 3-1 has 2.
Second, the circumference formula = 2 $(p + l)$
So 58 = 2 $(4x + 3)$ $(\frac{4x+3}{2})$), add up the numbers that have the same variable then divide the number 2 outside the parentheses with the denominator.

c. Metacognitive Behavior for Low Ability subjects (LA

In the third LAS question, begin to identify by reading the problem several times and writing down what is known from within the relevant problem and using the concepts of algebra and circumference. LAS represents information irrelevantly, LAS does not do the problem how to solve it relevantly because the information used is not relevant. LAS does a planning performance but does not get results and LAS does not reevaluate



LAS is only proficient on the P1 indicator while not proficient on P2, P3, P4 and E1 indicators. At the time of the LAS interview answering questions relevant to what was written on the answer sheet.

P = How do you know the purpose and commands of the problem?
LAS = I read the questions a few times, then write down what I know, pan. I read the question many times, then write what is known, length $4x + 3$ and width 1 cmjang $4x + 3$ and width 1 cm
P = Is there any previous information that matches the newly acquired information?
LAS = Addition, multiplication and subtraction, because in the long value there is a "+" and to find out the circumference there is a "$p\ x\ l$"

This study uses three high, medium, and low subjects to solve algebra problems. Regarding metacognitive behavior (Kuzle, 2018), two subjects with different abilities have different behaviors. Highly capable subjects provide detailed steps related to the process and conceptual knowledge that affect most problem solving

processes when the subject is able to provide steps that are not detailed (Caleb, 2015). suggested that metacognition activities (behaviors) occur while students solve problems.

CONCLUSION

This research shows students' metacognitive behavior in solving algebraic problems. Students convey various ways and reasons in solving the given problem. students with high metacognition skills in problem identification behavior do three activities namely awarenes, namely identifying questions in the form of using concepts correctly. Evaluation in the form of reflecting back the concepts used. the process of thinking information in memory, which is often done to form concepts, reason and make decisions in solving problems and regulations reviewing the concepts used. Behavioral problem representation performs three activities, namely Awarenes, which is thinking about information relations appropriately. Evaluation in the form of reflecting the impact of the relationship of information used and regulations reviewing the information used. behavior problem problem how to solve do three activities namely awarenes that is thinking about the accuracy of the steps with the information and concepts previously thought. Evaluation in the form of reflecting the impact of determining the steps to be used. metacognitive behavior, especially in planning by selecting and assessing the effectiveness of the strategies to be used is very necessary to be successful in solving complex problems (Kuzle, 2018), and regulation reviewing the steps used. Behavioral Planning Performance performs three activities namely Awarenes namely consciously controlling problem solving step by step. metacognition is the students' awareness of their own thoughts in solving the problems given Evaluation in the form of reflecting on the results of solving the problem is correct. high ability subjects can solve problems systematically and get the right results (and regulation reviewing the steps and results obtained. students with high ability to use holistic problem solving, because they have strong problem solving skills (Kapa, 2001). Successful metacognitive behavior must be based on detailed problem solving (Wilson & Clarke, 2004). Behavioral evaluation conducts three activities namely awarenes, evaluation and regulation by reviewing the steps of completion starting from the selection of concepts, information, steps of completion and results (Purnomo, 2017).

capable students are only fulfilling identification behavior which includes three awareness activities by reading questions and writing what is known, Evaluation is confident by identifying questions and reviewing. Medium capable students only fulfill the hoe to solve behavior which includes three conscious awareness activities with the completion steps to be used, the evaluation reflects back on the steps to be used and reviews whether there are other strategies

Low ability students only fulfill indetification behavior which includes three awareness activities by reading questions and writing what is known from within the problem, and consciously using the right concept. Evaluation reflects back on whether the way is appropriate in determining the concept and reviewing

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