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AN ANALYSIS OF THE STUDENT METACOGNITION LEVEL IN PROBLEM-SOLVING VIA PROBLEM STORIES IN THE MATERIALS OF THE TWO-VARIABLE EQUATION SYSTEM

Research Article

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Abstract

This qualitative case study aimed at describing the level of students' metacognition in problem-solving using problem stories in the materials of the linear equation system of two variables of VIII class at MTs N 1 Pesawaran Lampung. The participants of the study comprised three students in VIII class of MTs N 1 Pesawaran Lampung in 2019-2020 academic year. In the selection of the participants the purposive sampling method was utilized. The data were collected via collection a test and an interview. For the data validation the triangulation technique was adopted. The results showed that the level of students' metacognition in problem-solving via story problems in the materials of linear equations of two variables was at the level of reflective use, strategic use, and aware use.

Keywords: Metacognition level, problem solving, problem stories, linear equation system

1. Introduction

Problem-solving is essential in learning Mathematics because students are required to have these abilities. However, problem-solving is not an easy thing for students, so appropriate strategies and steps are needed. Therefore, when students solve a problem, the teacher should not only see the final truth of the students 'answers but also needs to look at the students' abilities in formulating their strategies and thinking steps. In problem-solving, there is a more critical process that must be known by the teacher, namely the processes undertaken by students to get answers to the problems given, especially the metacognition process used in solving these problems. As stated in the 'Curriculum and Evaluation Standards for School Mathematics, NCTM,' problem-solving is the central vision of Mathematics education besides reasoning, communication, and connection. Problem Solving is a complex process that involves several cognitive operations, such as collecting and selecting information, heuristic strategies, and metacognition (Risnanosanti, 2008).

This metacognition involves student activities in making connections between problem questions, sifting through the information, and initial knowledge possessed. This activity requires control of the students themselves so that the problem-solving process remains focused on the solution to the problem at hand. Students' self-awareness creates student control in problem-solving in thinking. Thinking awareness is the awareness of the knowledge possessed and the awareness to do something that is thought and the reason it is done. This awareness of

thinking will increase according to the metacognitive activities that arise when solving problems. According to Suharnan's opinion, metacognition is a person's knowledge and awareness of their cognitive processes (Suharnan, 2005). The level of metacognition of a person, according to Swartz and Perkins, is Tacit use, Aware Use, Strategic Use, and Reflective Use (Cambridge Assasment International Education, 2019).

Based on observations and interviews with students during the author's observation period at MTs N 1 Pesawaran, many students had difficulty in learning Mathematics, especially in solving mathematical problems in the form of story problems, so student learning outcomes tend to be low. One area of Mathematics study that becomes a student's weak point in problem-solving was algebra, especially on the subject of the two-variable linear equation system. Many students found it difficult in this material; it could be seen from the low grades and not reaching the completeness limit. Low student math scores could be seen in individual completeness and classical completeness in learning. The average classical completeness for the two-variable linear equation system material still reached 52% with a specified Minimal-Completeness-Criteria value of 75. According to one teacher at MTs N 1 Pesawaran, students' difficulties in solving problems were caused by difficulties in turning story problems into modeling mathematical problems. It was because in solving the problem of the Two-Variable Linear Equation System story problem, students should change changes the Two-Variable Linear Equation System problem first into a mathematical model, then completed the mathematical model and must be returned in its original form. Because learning Mathematics requires reasoning and logic, many students will experience difficulties in Mathematics.

Moreover, many students chose to solve mathematical problems quickly and practically. Usually, students only learned the answers to examples of existing problems and then memorized them without understanding the concept. Besides, the weakness of students was to quote from what the teacher had done on the blackboard. In fact, as the review above, the ability to solve problems is the goal of teaching Mathematics in school. Also, teachers in evaluating the achievement of learning outcomes only emphasized cognitive goals without regard to the dimensions of cognitive processes, especially the level of metacognition. As a result, efforts to introduce metacognition in solving mathematical problems to students were very less or even tended to be ignored. Therefore, one aspect of an interesting dimension of knowledge and skills to be studied more deeply, especially in Mathematics learning, is the aspect of the level of metacognition. Based on this, the researcher wants to describe the level of metacognition of VIII-grade students of MTs N 1 Pesawaran in solving the problem of the problem story in the system of linear equations of two variables.

2. Metacognition

Metacognition was first introduced by John Flavell, a psychologist from Stanford University in 1976. Flavell defines metacognition as student awareness, consideration, and control of his cognitive processes and strategies (Wilson and Clark, 2004) Metacognition has a vital role in learning Mathematics and in solving mathematical problems. Related to this, metacognition is a student's awareness, consideration, and controlling/monitoring of strategies, as well as cognitive processes themselves.

According to Suherman et al (2001), metacognition is a word related to what is known about him as an individual who learns and how he controls and adjusts his behavior (Suherman, 2001). Someone needs to be aware of the advantages and disadvantages they have. Metacognition is a form of the ability to look at oneself so that what he does can be controlled optimally.

Tacccasu defines metacognition as part of planning, monitoring, and evaluating the learning process, as well as, awareness and control of the learning process (Iswahyudi, 2011). In line with this opinion, Kirsh stated that metacognition, especially in the field of education, is related to activities and skills related to planning, monitoring, evaluating, and improving workability (performance). In this study, metacognition was limited to three components, namely planning, monitoring, and reflection. These three components were a series and are interrelated in metacognition activities.

From the explanation above, it can be concluded that metacognition is an awareness of students in using their thinking to plan, consider, control, and assess their cognitive processes and strategies.

3. Metacognition in Mathematics Learning

In research conducted by Goos and Gilbraith on the role of metacognition for students in mathematical problem-solving activities, they investigated the metacognition strategies of middle school students when they solved mathematical problems individually (Goos and Gilbraith, 2000). Students were given a math problem, and they then solve it individually. After students completed these questions, they were then given a questionnaire as instruments to find out the students' metacognition activities. To find out the metacognition activities of students, metacognition self-monitoring instruments were used, which contained metacognition statements.

From the research, it was concluded that students who used their metacological strategies well when solving mathematical problems (problem-solving) had more ability to solve mathematical problems. The student tried to use his metacology to arrange the steps of thinking in solving mathematical problems.

4. Research Methods

In the study, the qualitative research method was adopted based on a case study research design. The participants were determined through purposive sampling model. The participants were three students of VIII class at MTs N 1 Pesawaran. The process of selecting sthe participants started with giving a question about two variables linear equation system to the VIII-class students of MTs N 1 Pesawaran. From the results of the answers to these questions, students were grouped into three groups based on high, medium, and low-value categories. Data collection techniques in this study used interviews based on the material of SPLDV (two variables linear equation system) questions. The instruments used in the study were: (1) problem-solving questions, and (2) interview guidelines.

5. Result and Discussion

Based on the analysis of task-based interview data that has been carried out, the following is a review of the level of metacognition of students in each category.

5.1 Metacognition Level of Subjects with High Value

Subject T

1) In the planning stage, the subject T performed metacognitive activities: could express problems clearly, knowing the strategies that would be used to solve problems, and could express the use of strategies that would be used in solving problems.

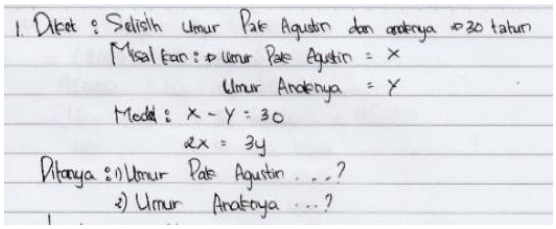

Figure 1. Planning Stage

2) The monitoring stage, subject T performed metacognition activities: could apply a strategy that had been planned well and could do calculations correctly and apply the same strategy to other problems so that they got the right solution.

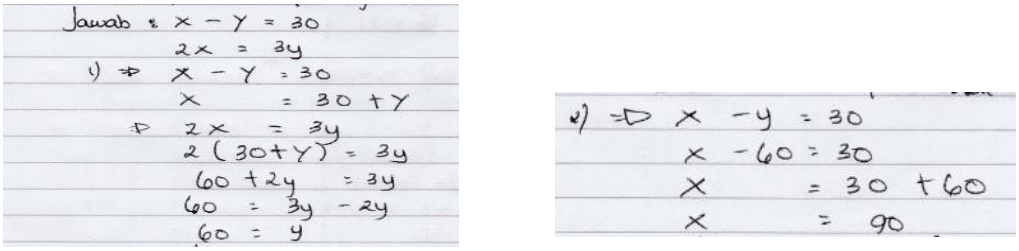

Figure 2. Monitoring Stage

3) In the examination stage, the subject T performed metacognitive activities: checking the final results of the answers, but not checking all the steps taken, and believing the results they have obtained.

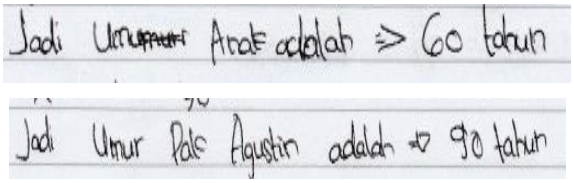

Figure 3. examination stage

Based on the description and appropriateness of indicators above, In the level of reflective use the subject reflect on their thinking before, during, and after solving the problem (Setyadi. 2016). Then can be concluded that the level of metacognition of subjects with the level of metacognition of students in the high-value category is reflective use, with the appearance of metacognition level indicators as follows.

a. The planning stage: can understand the problem and can reveal what is known and what is asked but have doubts in determining the steps that will be used in problem-solving.
b. The monitoring stage: can provide answers, but cannot provide supporting reasons, realize misconceptions (formulas) but cannot correct calculations, and subjects are unsure about their work, to continue the problem-solving step requires angling questions.
c. The examination stage: re-examine or evaluate the results obtained but are not sure of the answers.

T of the high category was the level of reflective use.

5.2 Metacognition Level of Subjects with Medium Value

Subject S

1) In the planning stage, the subject S performed metacognition activities: could understand the problem and could express what was known and what was asked but had doubts in determining the steps that would be used in problem-solving.

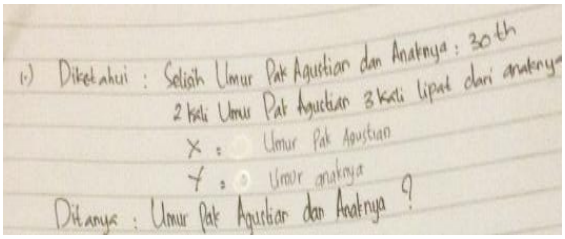

Figure 5. planning stage

2) Monitoring stage, subject S performed metacognition activities: could provide answers, but could not provide supporting reasons, realized misconceptions (formulas) but could not correct calculations, and subjects were unsure about their work, to continue the problem-solving step required angling questions.

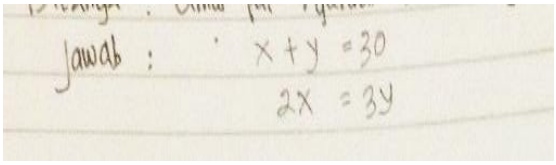

Figure 6. monitoring stage

3) In the examination stage, the subject S re-examined or evaluated the results obtained but was not sure of the answer.

Based on the explanation and appropriateness of indicators, In the level of strategic use, the subject are conscious to use various strategies to improve their thinking accuracy (Setyadi. 2016). Then it can be concluded that the level of metacognition of subjects with the level of metacognition of students in the medium value category is strategic use, with the appearance of metacognition level indicators as follows.

a. The planning stage: can understand the problem and can reveal what is known and what is asked but have doubts in determining the steps that will be used in problem-solving.
b. The monitoring stage: can provide answers, but cannot provide supporting reasons, realize misconceptions (formulas) but cannot correct calculations and subjects are unsure about their work, to continue the problem-solving step requires angling questions.
c. The examination stage: re-examine or evaluate the results obtained but are not sure of the answers.

S of the medium category was the level of strategic use.

5.3 Level of Metacognition of Subjects with Low Value

Subject R

1) The planning stage, subject R performed metacognitive activities: could understand the problem and could express what was known and what was asked, could not determine the steps that would be used in problem-solving.
2) The monitoring stage, subject R, did the metacognition activity: could not continue working on the questions.
3) In the examination stage, subject R did not evaluate the results obtained.

Based on the explanation and appropriateness of indicators, In the level of aware use, the subject is aware of what they are thinking (Setyadi, 2016). Then it can be concluded that the level of metacognition of subjects with the level of metacognition of students in the low-value category is aware use, with the emergence of metacognition level indicators as follows.

a. The planning stage: can understand the problem and can express what is known and what is asked, but cannot determine the steps that will be used in solving the problem.
b. The monitoring stage: cannot continue working.
c. The examination stage: do not evaluate the results obtained.

R of the low category was the level of aware use.

6. Conclusion

Based on the results of research on the level of metacognition of students of MTs N 1 Pesawaran, t can be obtained the following conclusions:

1. The level of metacognition of students in the high-value category is reflective use, with the following indicators for the level of metacognition appearing.

a. The planning stage: can express problems clearly, know the ways that will be used to solve problems, and be able to express strategies that will be used in solving problems.
b. The monitoring stage: being aware of misconceptions, and being able to give reasons that support his thinking, being able to apply well-planned strategies, and do calculations correctly.
c. Examination stage: evaluates the results obtained but does not check all the steps taken and believes the results that have been obtained.

2. The level of metacognition of students in the medium value category is strategic use, with the emergence of indicators of the level of metacognition as follows.

a. The planning stage: can understand the problem and can reveal what is known and what is asked but have doubts in determining the steps that will be used in problem-solving.
b. The monitoring stage: can provide answers, but cannot provide supporting reasons, realize misconceptions (formulas) but cannot correct calculations, and subjects are unsure about their work, to continue the problem-solving step requires angling questions.
c. Examination stage: re-examine or evaluate the results obtained but are not sure of the answers.

3. The level of metacognition of students in the low-value category is aware use, with the appearance of the metacognition level indicator as follows.

a. The planning stage: can understand the problem and can express what is known and what is asked but cannot determine the steps that will be used in solving the problem.
b. Monitoring stage: cannot continue working.
c. Evaluation stage: do not evaluate the results obtained.

7. Conflict of Interest

The authors declare that there is no conflict of interest.

8. Ethics Committee Approval

The authors confirm that the study does not need ethics committee approval according to the research integrity rules in their country.

References

Cambridge Assasment International Education. (2019). Metacognition; from https://www.cambridgeinternational.org/Images/272307-metacognition.pdf Accessed on 20 Juli 2020

Goos, M., and Gilbraith, P.R. (2000). A Money Problem: *A Source of Insight into Problem Solving Action. Queensland* : The University Of Queensland Retrieved from; http://www.cimt.plymouth.ac.uk/journal/pgmoney.pdf. Accessed on 28 Agustus 2019

Iswahyudi, G. (2011). Aktivitas Metakognisi Mahasiswa dalam Memecahan Masalah Pembuktian. Dalam Budiyono dan (Eds). *Prociding Seminar Nasional Matematika dan Pendidikan Matematika.* Surakarta: FKIP Universitas Sebelas Maret.

Risnanosanti, R. (2008). Kemampuan Metakognitif Siswa dalam Pembelajaran Matematika. *Jurnal Pendidikan Matematika.* 4(1), 86-98.

Setyadi, D., Subanji, and Muksar, M. (2016). Identification of Students' Metacognition Level in Solving Mathematics Problem about Sequence. *IOSR Journal of Research & Method in Education.* 6(6), 01-07.

Suharnan, E. (2005). *Psikologi Kognitif.* Surabaya: Srikandi

Suherman, E. dkk. (2001). *Common Textbook Strategi Pembelajaran Matematika Kontemporer*. Bandung: Jica UPI

Wilson, J. and Clark, D. (2004). Toward the Modelling of Mathematical Metacognision Mathematics. *Education Research Journal*. 6 (2), 25-48.