The Identification of Mathematics Students’ Characteristic and Metacognitive Level in Mathematical Problem Solving State University of Medan

K M A Fauzi, Z Indra, and A Priyatno
1Faculty of Mathematics and Natural Science, State University of Medan
2Faculty of Languages and Arts, State University of Medan

e-mail: aminunimed29@gmail.com

Abstract. Metacognition is needed in solving mathematics problem. It is defined as the knowledge, awareness, and control of one’s thinking process. In solving mathematics problem, not all students are able to use their metacognitive thinking processes. The objective of this research was to describe Mathematics Students characteristics and level of metacognition in mathematical problem solving and to know students’ metacognitive scaffolding question in answer the question of problem solving at second semester Universitas Negeri Medan. This research use qualitative data which is described to get the students’ metacognitive representation in mathematical problems. That is why this research is included in descriptive qualitative research. The subject in this research is the whole mathematics students’ who’s taking Geometry analytic at State University of Medan. The students’ given test then grouped into three groups that us high level ability, medium and low ability. Every group is taken two subjects to have interview to get more credible data. Then, the data is analyzed to get conclusion from each group. The result of the research is obtained that the high level ability students has reflective cognitive use. Medium level ability students have strategic metacognitive use. Low level ability students have aware use and tacit use. Scaffolding questions given in the test should be help students in completing the problem. From the result of this research is hoped will be source of information and input material for mathematics lecturer, researchers, and all side which needed especially in Faculty of Mathematics and Natural Science State University of Medan’s environment.

Keywords : identification, metacognitive level, mathematics problem solving.

1. Introduction
Mathematics it’s not only related with other multidisciplinary but also the development of modern technology and the power of human thought. So that it’s very needed in dimensions of knowledge and skills which is supporting in learning mathematics deeply. One of dimension aspect of knowledge and skills that interesting to be studied more deeply, especially in learning mathematics is metacognition. The importances of metacognition in learning mathematics supported by the statement of two mathematician expert in education who is well known from USA. “There is also growing support for the view that purely cognitive analyses of mathematical performance are inadequate because they overlook metacognitive action[1]. “Metacognition refers to higher order thinking which involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the
The completion of a task are metacognitive in nature[2]. Therefore learners can be taught strategies to assess their own understanding, calculate how long it takes to learn something and choose an effective plan for learning or solving a problem and metacognitive strategies lead to use reasoning (planning, monitoring and evaluating many ideas of solution) fit with problems. Here is an illustration of metacognitive strategies for metacognitive level in mathematical problem solving.

![Diagram of Metacognitive Strategies](image)

**Figure 1. Illustration of Metacognitive Strategies for Gaining the Ability of Problem Solving Thinking (Modification of Mutia and Fauzi, 2017)[3]**

The originator of metacognition, simply interpret metacognitive as ”knowing about knowin[4]. An early definition of metacognition has become regularly quoted in the literature. He used the term to refer to an individual’s awareness, consideration, and control of his or her own cognitive processes and strategies. The neat division of metacognition into knowledge and regulatory components ignores two key non-regulatory functions of metacognition[5]. These are: individual awareness of thought processes, and individual evaluation of these thought processes. The concept of metacognition as having four historical roots, each of which has provided foundation for approaches to strategies instruction, which we will take up in the next section[6]. The first root is the issue of verbal reports as data—how reliable are people’s reports of their thinking processes? What we can express about what we know, or how does what we can express relate to what we know? The second root is the notion of executive control, which is derived from information processing models. These models feature a central processor that can control its own operations, which include planning, evaluating, monitoring, and revising. The third root is self-regulation, processes by which active learners direct and continuously fine-tune their actions. The fourth root that Brown et al. see underlying metacognition is what they call other regulation, or the transfer of control from other to self. Undergraduated students as researches subjects in this research because statement from due to Baker cited from Dale that the importances of metacognition [1]: “Supervisory of activity more often used by the older children and adults compared with young children. However, older children and adults do not always monitor their understanding and often misjudged as to how well they understand the text.”

2. Research Method
Research method that used in this research is the qualitative approach with descriptive data, this is based on a formula which appears in this research, demanding researcher to conducted exploration activities in order to understand and explain the problems that became the focus of this research.
problem. Descriptive research is applied to perform measurements of certain phenomena. Then the collection of various datas and information will be done through observation, interview techniques, the study of the documentation as long as the required data. The purpose of this type of research is to determine the characteristics of students in solving problems and the level of metacognition.

3. Result And Discussion

3.1. Result

From the 45 students who carry out tests of problems solving. In analyzing data mathematical problem solving ability test requires deepening through the triangulation of data to establish valid data results and a strong conjecture. Triangulation of data in this research is conducted through analysis of problem-solving work written by students and interviews with respondents in accordance with the level of ability metacognition that has been set. This interview was conducted in August and September with four meetings and conducted by researchers with each of the respondents indicated analyzing the results of tests done students and to uncover the student opinion on the work that has been written, related to the matter, the students are divided into three categories the level of ability.

| Table 1. The Result of Mathematical Problem Solving Ability |
|-----------------|-----------------|
| Details        | Data            |
| Number of Problem | 4              |
| The Lowest Score    | 38             |
| The Highest Score   | 100            |
| Mean ($\bar{x}$)    | 74.57          |
| Standard Deviation (SD) | 16.34 |

Based on these scores, students are grouped into three levels of mathematical problem solving ability. According to Arikunto (2013) using the group selection rules.
1. Low group with a score of less than or equal to $\bar{x} - SD$
2. The group was worth more than $\bar{x} - SD$ is less than or equal to $\bar{x} + SD$ and
3. High group with a score more than $\bar{x} + SD$

| Table 2. Categorizing of Mathematical Problem Solving Ability |
|-----------------|-----------------|-----------------|
| Group           | Limitation Value (X) | Amount The Students’ | Percente Problems of Ability |
| Low              | $x \leq 58.39$  | 8              | 18               |
| Medium           | $58.39 < x \leq 88.75$ | 32             | 71               |
| High             | $x > 88.75$     | 5              | 11               |

Each group in the select two students to be interviewed. The interview was conducted by researchers with the six students were selected that deepening of the pre-defined categories. Researchers ask for results of the fourth formative exam work done by the students by showing the test results back and recording interviews. Researchers used the interview guidelines and develop a frequently asked questions (semi-structured method) according to the respondents and the findings during the interview.
3.2. Discussion
The data used for the analysis was the result of students’ worksheet and the transcript of the interview the subject of research. Data on students' metacognitive level identification based on indicators has been made.

3.2.1. Description and Data Analysis S2 Problem 4
The result of the worksheet S2 problem solving number 4 in picture below:

![Worksheet of Student 2 Problem Number 4](image)

**Figure 2.** Worksheet of Student 2 Problem Number

From figure 2. Student 2 was doing the test number 4 correctly and systematically. And for the right column S2 wrote the scaffolding question that help S2 to answer the problem. So for the analysis and explanation from the S2’s answer about the metacognitive level and scaffolding question there is:

a. Metacognitive Level
In the written test data seen their planning activities, S2 write what is known and asked properly in solving the question. At the time of the interview S2 also able to explain what is known and asked correctly also able to provide a good reason to use formula. In the written test data looks a monitoring aspect that is able to give reasons to support the process of thinking in using problem solving strategies. In the interview S2 are also able to identify and explain the steps of completion and sure can apply the same strategy on other problems. In the written test data looks aspect of the evaluation that is can write down the answers of the above questions correctly and .At the time of the interview S2 also believes and double check the answer. Conclusions: Subjects S2 who has high mathematical ability at the metacognitive level is Reflective Use.
b. Scaffolding Question
From the results of tests on the picture above, the scaffolding question given students' very helpful in answering questions about the test so it can work with a good test.

3.2.2. Description and Data Analysis S4 Problem 2
The result of the worksheet S4 problem solving number 2 in picture below:

From figure 3, Student 4 was doing the test number 2 activities due to repetition to answer the problem. And for the right column S4 doesn’t wrote the scaffolding question. So for the analysis and explanation from the S4’s answer about the metacognitive level and scaffolding question there is:

a. Metacognitive Level
In the written test data seen their planning activities, namely S4 write what is known and asked of the problem. At the time of the interview S4 is also able to explain most of what is written. In the written test data seen S4 monitor the process of thinking only through repetition activities using formulas and concepts. In an interview S4 is also able to explain the steps of completion. In the written test data seen their evaluation activities that use another concept. In an interview S4 does not believe the answers are written, but knowing the right steps to resolve the matter. Conclusions: Subjects S4 who has medium mathematical ability is at the Strategic Use metacognitive level.
b. Scaffolding Question
From the results of the tests on the figure above, questions provided by students have nothing to do with solving the problem in the above test.

3.2.3. Description and Data Analysis S3 Problem 5

Problem application related to Parabola
The afternoon, Pak Sadi was doing sports in the field near his home, Golf sports. When Mr. Sadi hit the golf ball, the ball bounced high with its peak point (4.3) forming a parabola. Make the equation of the topped parabola in (4.3) which has the symmetrical axis x = 4 and the length of the latus rectum 8, which is formed by the golf blow! Then sketch the figure!

The result of the worksheet S3 problem solving number 5 in picture below:

![Figure 4. Worksheet of Student 3 Problem Number 5](image)

From figure 4. Student 3 was doing the test number 5, based on the student's answer, it is known that the student uses procedures. Able to understand and analyse the information given in question or can structure the information into smaller parts to recognize patterns or relationships. The equation obtained is correct while the graphic sketch is open upwards not correctly so because the coordinate point in the image is less obvious.

4. Conclusions
1. The result of students’ ability in mathematical problem solving are high, medium and low.
2. The results of research metacognitive level that used in mathematical problem solving in each categorizing, namely: Students who are classified as high mathematical ability in Reflective Use at metacognitive level. Students with in Reflective Use at metacognitive level has metacognition activities and able to understand the problem well, able to plan with good problem-solving strategies, able to realize the concept and know how to count are used properly also able to evaluate properly. Students who are classified as medium mathematical problem solving ability in metacognitive level is Strategic Use. Students with in Strategic Use at metacognitive level has activities such as able to understand the problem well, able to plan with good problem-solving strategies, quite capable of realizing the concept and know how to count are used properly also able to evaluation quite capable of doing well. Students who are classified as low mathematical ability in Aware Use at metacognitive level and also be classified in Tacit Use at metacognitive level.
Students with in Aware Use at metacognitive level has metacognitive activities as quite able to understand the problem well, quite capable to plan problem-solving strategies well, quite capable of realizing the concept and know how to count are used properly and also quite capable to evaluate properly. While students with a metacognitive level at Tacit Use has metacognitive activities as less able to understand the problem well, less able to plan problem-solving strategies well, students are less able to realize the concept and how to count are well used and also less able to do the evaluation with good.

3. Scaffolding questions given in the test should help students in completing the problem and questions always lead to the completion of the work so that Scoring students can answer the questions on the test.

5. Recommendations
Based on the findings and conclusions on the researchers gave some suggestions are:

1. For students, the problem in mathematical problem solving should use metacognition to guide thinking in mathematical problem solving.
2. For Researches, study subjects who needed assistance in learning. It’s made some difficulties in research. It was a concern for researchers so that it could categorize students at a degree in which they were metacognishim.
3. For Lectures, The provided learning material, it’s should always be guided the students’ thoughts and use the metacognition components in his thinking to solve the problem.

6. Acknowledgements
This research is funded by the State University of Medan in accordance with the contract number: 292D/UN 33.8/PL/2019

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