Students’ metacognitive ability in solving quadrilateral problem based on adversity quotient

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Abstract. The purpose of this research is to describe the profile of students metacognitive ability in solving quadrilateral problem based on quitter, camper and climber categories. In this research also discuss about the process of students metacognitive answer in solving quadrilateral problem. This research is as qualitative descriptive research. Subject in this research is students 8th grade SMPN 3 Jember. The subjects consisted of three students, one of them is categorized as quitter category, both of them are categorized as camper category, and fourth of them are categorized as climber category. The data is obtained from the Adversity Response Profile, quadrilateral problem solving test, think aloud technique, and depth interview. Based on the result of research data analysis, student as quitter category in solving quadrilateral problem haven’t the awareness to solve the problem. They are easily to give up when they face the problem. While students as camper category in solving quadrilateral problem have the awareness to solve problems to find solutions. However, when they have got a solution, students at this category do not want to look for the other solutions. While students as climber category in solving quadrilateral problem have the awareness to solve problems to find solutions and they want to look for the other solutions. Based on this result, it shows that the students with the higher of AQ level then they have the higher problem-solving skills and the higher metacognition ability in solving quadrilateral problem.

1. Introduction

Development of the country is not far from the education factor. Education is one of way to create a quality human resource. In other words, the quality of education in Indonesia needs more develop. The subject is mathematic. Mathematic is one of obligate lesson that has to be taught in elementary school till university. Mathematic has an important role to problem solving.

Critical thinking and problem solving skills are the important things to solve the mathematical problem as the context for the students to learn [1]. The steps of problem solving are consist of understanding the problem, arranging the plan, implementing the plan, and checking or testing the answer [2]. The steps disclosed by Polya in solving problems are activities that can be carried out during learning and indicators in determining the completeness of learning outcomes. According to Bloom's taxonomy, the completeness of learning outcomes is classified into cognitive, affective, and psychomotor. Anderson & Krathwohl revise the aspect of dimensions of the cognitive processes and the dimensions of knowledge [3]. The process of cognition consists of remembering, understanding, applying, analyzing, evaluating, and creating. While the dimension of knowledge consists of factual, conceptual, procedural and metacognitive.
The thought process is one of the most important things in problem solving. The thought process plays a role in helping students to develop problem solving skills. The thought process is part of cognitive abilities, while the combination of cognitive domain levels is metacognition [4]. Oguz and Ataseven stated that problem solving is related with metacognitive [5]. Cognition skills refer to how well students can control their learning mechanisms and include three important skills including planning, monitoring, and evaluation [6]. While the indicators of metacognition ability according to Pintrich in the following Table 1.

Tabel 1. The indicators of metacognitive ability.

| Metacognitive Skill | Indicators                                                                 |
|---------------------|----------------------------------------------------------------------------|
| Planning            | • Read and understand the problem given                                    |
|                     | • Able to predict the solving plan                                        |
|                     | • Able to determine the solving plan that will be used                    |
|                     | • Able to know the notation to be used                                     |
|                     | • Able to involve prior knowledge in solving the problem                   |
|                     | • Able to solve in other alternative solutions                             |
| Monitoring          | • Doing the right solution steps                                          |
|                     | • Check the correctness of the solution steps                              |
|                     | • Able to set the result                                                  |
|                     | • Check the mistakes of the answer                                        |
| Evaluation          | • Able to determine different way to solve the problem                    |
|                     | • Able to apply this different ways to the problem                        |
|                     | • Paying attention to the worksheet that has been written                 |

Problem solving is not only influenced by metacognition skills, but it is influenced by people’s ability to face difficulties. The intelligence of people in facing difficulties is called Adversity Quotient. It is relevant to the results of research about conducted by Rinawati, Waluyo, and Hartono [7]. The problem solving skills of quitters category are only at the stage of understanding a problem. While campers category can solve problems until the stage of compiling a problem solving plan and climbers category can solve problems until the stage of implementing a problem solving plan. It is show that intelligence of facing difficulties is very necessary to solve the problems.

Based on research conducted by Asik and Erktin, it shows that there is a significant relationship between metacognitive knowledge and problem solving performance [8]. Problem solving performance is significantly correlated with metacognitive knowledge in self-checking, evaluation, awareness and in the use of cognitive strategies. Based on research conducted by Fahmi, Sinaga, and Rajagukguk, it shows that students with high level of mathematical problem solving abilities based on metacognitive abilities are at the level of reflective use and strategic use, students with medium level problem solving abilities based on metacognitive abilities are at the level of aware use, and students with low-level problem solving skills based on metacognitive abilities are at the level of tacit use [4]. The results of research conducted by Ozcan and Gumus in the Australian Journal of Education, it show that metacognition plays an important role in solving mathematical problems [9].

In addition, the improvement of mathematical problem solving skills can be done through a metacognition skills improvement program. The research results of Rahayu and Istiani in the Journal of Physics: Conference Series, it show that students in the Climber category give the same learning outcomes as students in the Camper category, students in the Camper category give better learning outcomes than students in the Quitter category and students with the Camper category provides the same learning outcomes as students in the Quitter category [10]. Research conducted by Purnomo, et al. in International Education Studies states that there are differences in the characteristics of the metacognition process in high, medium, and low ability students in solving mathematical problems [11]. Based on these studies, it can be concluded that in learning geometry it is necessary to pay
attention to students ‘geometry abilities especially the students’ metacognition processes. The problem solving skills of quitter category are only at the stage of understanding a problem, camper category can solve problems until the stage of compiling a problem solving plan, and climber category can solve problems until the stage of implementing a problem solving plan [12]. Based on these researches it can be concluded that in learning geometry it is necessary to pay attention to students’ geometry abilities, especially the students’ metacognition processes in solving mathematical problems.

One of material in geometry is quadrilateral. Quadrilateral is a polygon that has 4 sides. In this study, we will discuss about trapezoid. Trapezoid is a quadrilateral with two sides parallel. The research of this paper are about the circumference and area of trapezoid. The formula of trapezoid’s circumference is the sum of measures of the sides of the trapezoid. While the formula of trapezoid’s area is \( A = \frac{1}{2} \times (a + b) \times h \), while \( A \) is area of trapezoid, \( a \) and \( b \) is base of trapezoid, and \( h \) is high of trapezoid.

![Figure 1. The elements of trapezoid.](image)

2. Method
This research was a descriptive qualitative research that aimed to describe students’ metacognition ability in solving quadrilateral problems based on camper and climber category. The population in this study was 8th grade students of SMPN 3 Jember of academic year 2019/2020 consisting of 90 students. There are 31 students of VIII-F, 29 students of VIII-G, and 30 students of VIII-H. The object of this research is the metacognition skill of students in solving quadrilateral problems.

**Instruments**
The instruments that used in this research are consist of an Adversity Respone Profile (ARP) questionnaire, a quadrilateral problem solving test, and an interview. The ARP questionnaire is used to classify the AQ level of students. This questionnaire consisted of thirty daily phenomenon which related to what students probably experienced in their daily life. Every phenomenon consisted of 2 questions which had score range 1-5. The calculated score was only the total score which based on 20 phenomenon which considered as negative.

**Tasks**
To analyze the students’ metacognition ability in solving quadrilateral problems, the students asked to solve the quadrilateral problem solving test. The problem is determine the area of trapezoid which is divided into two equal parts. In this problem is known about the two size of an isosceles trapezoid and the circumference. For the illustration of the task, it can be depicted in Figure 2.

![Figure 2. The problem of quadrilateral.](image)

**Problem Solving Test**
Mr. Aryo has a land as trapezoid shaped as the picture above. It’s known that the measurement of AB is 19 meters and the measurement of CD is 9 meters. Mr. Aryo needs 54 meters of wire to make a guardrail. If Mr. Aryo wants to devide the land into two
equal parts to give to both of his children, determine the land area of each section and draw the illustration of dividing the land.

**Data Collection and Data Analysis**

Data collection methods in this study were obtained through Adversity Respone Profile, essay test, depth interview, and think aloud technique. Data analysis in this study includes data reduction, data presentation, and drawing conclusions. The validity of the data in this research uses content validity and subject triangulation.

3. **Research Findings**

This research was conducted to 90 students of eighth grade in SMPN 3 Jember, including Adversity Response Profile (ARP) questionnaire and quadrilateral problem solving test. This questionnaire consisted of thirty daily phenomenon which related to what students probably experienced in their daily life. Every phenomenon consisted of 2 questions which had score range 1-5. The calculated score was only the total score which based on 20 phenomenon which considered as negative. Meanwhile, the square problem solving test consisted of 2 descriptive question about quadrilateral.

![Figure 3. The number of AQ level.](image)

![Figure 4. The percentage of AQ level.](image)

Based on Figure 3 and Figure 4, students were categorized into each level which has five levels; quitter, transition quitter to camper, camper, transition camper to climber, and climber. Based on Figure 4 showed that AQ level of quitter is 1%, transition quitter to camper is 1%, camper is 57%, transition camper to climber is 39%, and climber is 2%. By this distribution, it show that the percentage of camper students is at most at the AQ level.
After doing ARP questionnaire and quadrilateral solving problem test, then the subject election which would be interviewed was done by choosing 1 student from each levels to be analyzed about their metacognition skill and further responded with using think aloud method. If the data from each level hasn’t been fulfilled, there will be 1 more student elected to be interviewed until the obtained data has been fulfilled. The choosen subjects until the implementation of think aloud method in the following Table 2.

| No. | Code | AQ Category |
|-----|------|-------------|
| 1.  | S-1  | Quitter     |
| 2.  | S-2  | Camper      |
| 3.  | S-3  | Climber     |

Based on the Tabel 2, the metacognition skill indicator obtained by the student in solving square problem in every levels had a different result. One of the test result about square problem solving, interview and think aloud method to the student which was categorized into camper and climber level is explained below.

**Quitter Category**

The answer from S-1 at Figure 5 shows that S-1 is able to write down what is known and asked about the problem. But there is still writing the wrong notation that A-B and C-D should be written without the sign "-". S-1 also felt difficult when solving this problem. This can be seen from the solving steps that have been written incompletely. Even though S-1 can find the final result, but S-2 put the wrong number in the formula that he wrote down. There was many problem-solving steps left behind and the written formula was incompletely. S-2 did not also write the conclusion of the answer which is demanded from the question.

![Figure 5. The student worksheet of S-1.](image)

Based on the completion of the answers written S-1, he only wrote the broad formula in accordance with the final answer requested in the problem. S-1 did not make illustrations on the division of the land of Pak Aryo. In addition, S-1 does not write down other formulas that should be used in solving the problem. This shows that S-1 has not been able to plan problem solving well. S-1 only focused on finding answers to what was asked about the problem, but he did not pay attention to what is known in
the problem as an initial reference in solving problem number 1. Poor planning of the problem results in improper problem-solving. This can be seen in the completion of S-1 answers that are incomplete and many completion steps are passed, even though the final results obtained are in accordance with what was requested in the problem.

The result of think aloud method that was conducted by S-1 during redoing the random determined problem by the researcher to show that there was a planning such as “...the known is AB, CD...”, showed that there was an observation such as, “...but the side isn’t used to determine the width...”, and showed evaluation such as, “...the CD is 19 meters, so it’s correct...”.

Based on the research that had been obtained from the square problem solving test, the result of S-1 showed that S-1 was able to understand the meaning of the question by writing what was known and questioned in the problem. However S-1 felt difficulty when solving the problem. This can be seen from the steps that he/she had written incompletely. There was still a mistake writing incomplete and not precise notation. Besides that, he/she also didn’t write the conclusion of the answer based on the question even though the end result had been correct. As the campers’ metacognitive ability of S-1 can be depict in Figure 6.

![Figure 6](image)

Camper Category

The answer from S-2 at Figure 7 shows that S-2 can understand the purpose of the question by writing what they know and implied in the question. S-2 also face less difficulty when solving this problem. This can be seen from the solving steps that have been written completely, even though it has a random structure. There was no problem-solving steps left behind and the written formula was correct, but he/she did not write the conclusion of the answer which is demanded from the question, even though the final result has been correct.

After obtaining the result of square problem solving test given to S-2, then there was interview session to clarify the answer. Based on the interview with S-2, it shows that S-2 conducted a planning in the problem understanding step, that is to write what he/she known and asked eventhough it was incomplete. S-2 was also able to show from which part he/she knew what things are known and questioned based on the command on the question. Besides that, S-2 was able to plan the formula that was being used to solve the problem. Based on the interview with S-2 showed that S-2 observed in arrangement step and did the plan of problem solving that is being able to determine the strategy of problem solving and write the complete steps to solve, eventhough there was still some mistakes in writing the answer. Based on the interview with S-2 showed that S-2 did evaluation in rechecking the solution obtained, such as checking the result by rechecking the written answer, whether it had been suitable with the question. Besides that, he paid attention to the matter solving until he/she was sure that the steps he/she wrote has been precise. However S-2 could not find alternative answer when he/she asked to look for another answer.
Figure 7. The student worksheet of S-2.

Based on the research that had been obtained from the square problem solving test, the result of S-2 showed that S-2 was able to understand the meaning of the question by writing what was known and questioned in the problem. S-2 also rarely faced difficulty when solving the problem. This can be seen from the steps that he/she had written completely and briefly. But there was still a mistake writing incomplete and not precise notation. Besides that, he/she also didn’t write the conclusion of the answer based on the question even though the end result had been correct. As the campers’ metacognitive ability of S-2 can be depict in Figure 8.
Figure 8. Phase portrait of campers’ metacognitive ability.

Climber Category

The answer from S-3 at Figure 9 shows that S-3 can understand the purpose of the question by writing what they know and implied in the question. S-3 also face less difficulty when solving this problem. This can be seen from the solving steps that has been written completely, even though it has a random structure. There was no problem solving steps left behind and the written formula was correct, but he/she did not write the conclusion of the answer which is demanded from the question, even though the final result has been correct.

Figure 9. The student worksheet of S-3.

After obtaining the square problem saving test result which was given to S-3, then there was an interview conducted to clarify the result of S-3. Based on the interview with S-3 shows that S-3
conducted a planning in terms of understanding the problem that is writing what were the known things and questions correctly. S-3 was also able to show the logical flows about where they obtained the request of the question. Based on the interview with S-3 showed that S-3 conducted an observation in the steps of arranging and planning the problem solving plan that is the ability to determine the strategy of problem solving and write the solving steps completely, even though there are still several mistakes in writing the answer. S-3 was also very careful with the answers that he/she is really sure about it. Based on the interview with S-3 shows that S-3 did evaluation in rechecking the solution, that is to check the lack of the result or the process by rechecking the answer, whether it had been suitable with what the question wanted. Besides that, he/she looked at the way how they solved the problem until they were sure with what they wrote. When there was a skipped or incorrect steps, he/she would be able to revise it.

The result of think aloud method which was conducted by S-3 when redoing the problem with random determined problem by the researcher showed that there was a planning, such as “...so the question is about the width of each part, therefore the formula is...”, showing that there’s observation, “...then, the DE side, oh ya, it should be AB...”, and showing evaluation such as “...the height is 12 meters, so the width is...hm.. eightyfour square meters...”. As the climbers’ metacognitive ability of S-3 can be depict in Figure 10.

Figure 10. Phase potrait of climbers’ metacognitive ability.

4. Discussion
This research was conducted to describe the profile of students’ metacognitive ability in solving quadrilateral problem based on AQ level. The findings of this research indicated that student as climber category has most complete metacognition ability than quitter and camper. But climbers have a difference compared to camper and quitter. Climbers are not easy to give up when solving a given problem. Students with climbers have high spirits and try to find alternative solutions besides what they get. Meanwhile, students with a camping level also have high spirits and are more likely to be quite satisfied with the solutions they get, without looking for other alternatives. While the students as camper category has more complete metacognition ability than quitter. Camper are easily satisfied with what they get without wanting to try more to provide maximum results in solving problems. While quitter are not able to connect known data with the problems they face until they think about finding a solution plan, cannot do the right steps and are unable to solve the problem in a different way. Quitters give up easily when working on quadrilateral problem solving.

This result in line with Asik and Erktin (2019) result. Its shows that there is a significant relationship between metacognitive knowledge and problem solving performance. Climber has metacognitive knowledge and problem solving skills better than quitter and camper. Furthermore, this result in line with Fahmi at.al. (2019) result showing that the students with high level of mathematical problem solving abilities based on metacognitive abilities are at the AQ level of climber. This indicated that when we can improve the AQ level, it will improve the students problem solving skills and the students metacognitive abilities.
5. Conclusion

Students' metacognition skills in solving quadrilateral problems using Polya's problem-solving steps found that students with low AQ level (quitter) had the characteristics of a complete metacognition process, including planning, monitoring, and evaluating. However, quitter are not able to connect known data with the problems they face until they think about finding a solution plan, cannot do the right steps and are unable to solve the problem in a different way. Students' metacognition skills in solving quadrilateral problems using Polya's problem-solving steps were found that students with AQ level students (camper) had the characteristics of a complete metacognition process, including planning, monitoring, and evaluating. But students of this level are not able to find a different way so they are unable to apply other ways. Students at this level tend to hold on to the solutions they have obtained, without wanting to find alternative solutions that can be used to solve the problems they face. Students' metacognition skills in solving quadrilateral problems using Polya's problem-solving steps were found that students with high AQ level (climber) had the characteristics of a complete metacognition process, including planning, monitoring, and evaluating. Students at this level tend to try to find alternative solutions in addition to what they have obtained to solve the problems they face. Students of this level are able to find different ways and are able to apply these methods. Based on this result, it shows that the students with the higher of AQ level then they have the higher problem-solving skills and the higher metacognition ability in solving quadrilateral problem.

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