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Students' Metacognition in Solving Numeracy Tasks Based on Adversity Quotient

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ABSTRACT

Metacognition is described as thinking about thinking and is often considered as a second-level cognition that is different from ordinary cognition. This study aims to describe the metacognition of students with adversity quotient (AQ) climber and camper types in solving numeracy tasks. The research used a qualitative-descriptive approach with the subjects of four students of class VIII MTs who were selected using purposive sampling technique based on the results of the Adversity Response Profile (ARP) test. Data were collected through numeracy tasks solving tests, task-based interviews, and observations, then analysed using thematic analysis involving data reduction, data presentation, and conclusion drawing. The results showed that AQ climber type students demonstrated metacognition consisting of metacognitive awareness, regulation, and evaluation with the steps of rethinking prior knowledge, planning the solution, and assessing the work. Meanwhile, AQ camper students showed metacognition in the form of metacognitive awareness, evaluation, and organisation with the steps of rethinking knowledge, evaluating abilities, redesigning plans, and evaluating completion steps. This study provides insight into the variation of metacognition based on AQ type, which can be used to design student character-based mathematics learning strategies.

Keywords: adversity quotient; camper; climber; metacognition, numeracy tasks

INTRODUCTION

Metacognition is often described as the process of thinking about one's own thinking. According to Flavell (1976), metacognition differs from basic cognition as it represents a higher-order form of cognitive activity (Shilo & Kramarski, 2019). Simplified, metacognition is about "thinking within thinking" (Amir, 2019). This involves knowledge about self-regulation and one's role in managing cognitive processes (Bürgler et al., 2022). Studies such as those by Güner and Erbay (2021) suggest that metacognitive abilities are linked to problem-solving skills and positively impact outcomes.

During problem-solving, metacognition helps enhance learning results. Metacognitive skills assist students in making decisions that are precise, systematic, and logical, while also considering various perspectives (Safitri et al., 2020). By engaging in metacognition, students identify existing problems, understand their nature, and formulate strategies for resolution (Sukiyanto, 2020). Metacognition helps students make the right, logical, systematic decisions and consider various points of view on problems (Afri & Windasari, 2021).

Wilson (2001) and Wilson & Clarke (2004) identify three components of metacognition: awareness, regulation, and evaluation (Kuzle, 2018). Metacognitive awareness refers to the awareness to rethink what is known, the ability to solve problems, and the strategies used to solve them. Metacognitive evaluation refers to the awareness to

reconsider the limitations of one's abilities and knowledge in solving problems. The metacognitive regulation refers to the thought of selecting the most appropriate strategy for solving the problem and determining the work steps and goals in each work step (Latifa et al., 2020).

In addition to metacognition, students also need self-confidence, great minds, and resilience to persevere in facing problems (Hulaikah et al., 2020). The ability of a person to manage and change problems with their inner intelligence so that it becomes a challenge that must be solved is known as the Adversity Quotient (Marsitin et al., 2022). Stoltz stated that the adversity quotient is a person's ability to survive, overcome difficulties, and exceed expectations from their efforts and potential (Nurhayati et al., 2022). Stoltz & Weihenmayer (2010) revealed that the way to success is to learn to turn difficulties into advantages, both in business and real life (Anwar & Fitriani, 2020). Student success in learning is directly proportional to the response to overcoming the difficulties they face (Nurwahid et al., 2022). Students with good AQ can endure complex problems and require analytical skills, while students with low AQ will be easily stressed, show an unenthusiastic attitude during learning, and give up easily if faced with complex problems (Purwasih, 2019).

This study aims to address the gap in understanding how metacognition interacts with AQ, particularly in the context of solving numeracy problems. While research has explored AQ from various perspectives, such as the AQ of climbers (Kurniawan et al., 2019), quitters (Khasanah, 2021), and all types of AQ in general (Damayanti et al., 2020), none has specifically examined the relationship between AQ and metacognition in numerical problem solving. AQ, which reflects a person's resilience and fighting power, is known to play an important role in individual success, but how it affects students' metacognitive strategies in numeracy is still an unfilled gap in the literature. Therefore, this study aims to understand students' metacognitive strategies based on their AQ types (climbers, campers, quitters) and their interactions in solving numeracy problems, with the hope of making important contributions to mathematics learning. The findings of this research are expected to assist teachers in designing adaptive learning that considers students' individual differences, improve numeracy learning outcomes, strengthen character education through mental resilience, as well as provide new insights in the theory and practice of mathematics education.

RESEARCH METHODS

This qualitative research seeks to explore and describe the metacognitive processes of students classified as climbers and campers based on their AQ. Conducted in the second semester of the 2023/2024 academic year, the study involved eighth-grade students from MTs schools. Participants were selected through purposive sampling after completing the Adversity Response Profile (ARP) questionnaire. The questionnaire results categorized students into three AQ types: quitters (scores ≤59), campers (scores 95–134), and climbers (≥166) (Stoltz, 2000).

The study focused on climber and camper students, chosen based on their strong communication skills as recommended by teachers. Data were collected through a combination of problem-solving tasks, interviews, and observations, and were analyzed

using thematic analysis. Indicators of metacognition—awareness, evaluation, and regulation—guided the data coding process, as summarized in Table 1.

Table 1. Metacognition Indicators

Component	Indicators
Awareness	1. Rethink of about what is known. 2. Rethink of whether they have encountered similar problems. 3. Rethink of the mathematical knowledge that can help solve the problem. 4. Rethink of about ideas to solve the problem
Evaluation	1. Rethink how they solved the problem. 2. Rethink whether what they did went well. 3. Check their work. 4. Rethink the correctness of the answer. 5. Feel unable to solve the problem.
Regulation	1. Rethink the problem solving plan. 2. Rethink other strategies to solve the problem. 3. Rethink the next step to solve the problem. 4. Using other strategies to solve the problem

Wilson & Clarke (2004)

RESULTS AND DISCUSSION

Data collection was first carried out by giving an adversity response profile (ARP) questionnaire to 38 class VIII students of MTs. The questionnaire results showed 23 camper-type AQ students and 4 climber-type AQ students. In the research process carried out by interview, the researcher considers students with good communication skills, so that the selection of research subjects Based on teacher recommendations, 2 students of the climber type were selected which were then called S1 and S2, 2 camper type students which were then called S3 and S4.

1. Metacognition of AQ Climber Type Students in Problem Solving

The metacognition of AQ Climber Type Students was obtained by analyzing the answer sheets and interviews with the S1 and S2. Figure 1 contains S1's answer sheet for solving numeracy problems.

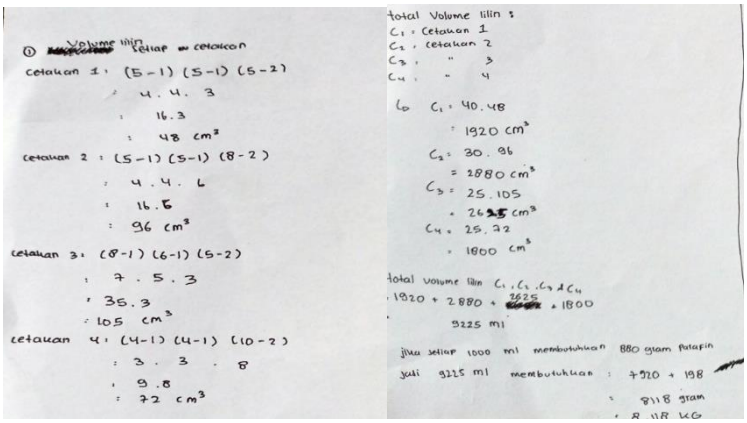

Figure 1. Answer Sheet S1

Based on Figure 1, S1 determines the size of the candle in molds 1, 2, 3, and 4 by subtracting the size of the mold from the thickness of the side of the mold and the distance of the candle from the top of the mold. After getting the size of the candle, S1 calculates the volume of wax in each mold with the volume formula of the block. After finding the volume in each mold, S1 determined the total volume of candles in each mold by multiplying the volume of candles by the number of candles made with each mold. S1 added up the total volume of candles in mold 1, mold 2, mold 3, and mold 4.

Based on Figure 1, S1 performs metacognitive evaluation indicated by the scribbles on the work that indicate S1 looking back at the work. S1's metacognitive evaluation are also seen in the interview results which show S1 looking back at the answers and knowing there are writing errors. The excerpt of the interview with S1 is shown as follows.

P : Why is there a scribble on your answer sheet?

S1: Because I wrote it wrong.

P : How do you know if you wrote it wrong?

S1: Yes, I checked the calculation sheet and there was an error when copying.

S1 performs metacognitive awareness, namely S1 remembers problems that have been solved and uses this experience to help solve the problem at hand. Excerpts of interviews with S1 are presented as follows.

P : Have you ever encountered a similar problem?

S1: Never,

P : Can your memory help you in solving the problem?

S1: Yes, In the section looking for volume and looking for paraffin, this is not even 1000 so find what percentage of 1000.

S1 performs metacognitive regulation namely S1 rethinks the plan so that the work to be done must be in order.

P : Did you rethink your plan?

S1: Yes.

P : Why did you think about it again?

S1: I think back so that the work must be in order.

Figure 2 contains S2's answer sheet for solving numeracy tasks.

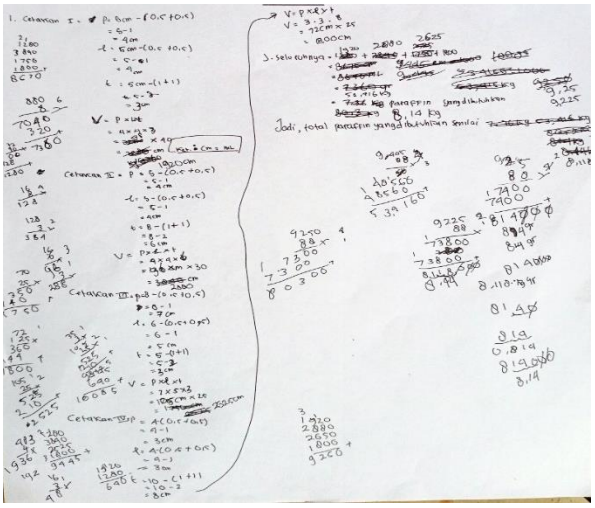

Figure 2. Answer Sheet S2

Based on Figure 2, S2 performs cognitive, namely, S2 determines the size of the wax in molds 1, 2, 3, and 4 by subtracting the size of each mold from the thickness of the mold and the distance of the wax from the top of the mold. After determining all the wax volumes in each mold, S2 adds them all up to determine the total volume of paraffin. Based on the calculations made by S2, S2 determined the total paraffin requirement used to make candles.

Based on Figure 2, S2 performs metacognitive evaluation indicated by the scribbles on the work that indicate S2 looks back at the work. S2's metacognitive evaluation is also seen in the results of the interview which shows S2 recalculating and looking back at the problem. The excerpt of the interview with S2 is shown as follows.

P : Why are there many scribbles on your answer sheet?
S2: Because it was wrong, not careful enough.
P : Did you check your answer again?
S2: Yes.
P : How did you recheck your answer?
S2: Counting again and looking at the question again.

S2 performed metacognitive awareness, namely S2 rethought the experience when solving similar problems because there were similarities with the problem at hand. The excerpt of the interview with S1 is presented as follows.

P : Have you ever encountered a similar problem?
S2: Yes, almost similar.
P : Did you think back to your experience?
S2: Yes.
P : Why did you rethink?
S2: Similar to the step of calculating the blocks.

S2 performed metacognitive regulation, namely S2 rethinking the plan because at the end S2 felt confused. The excerpt of the interview with S1 is presented as follows.

P : Did you rethink your plan?
S2: Yes.
P : Why did you rethink your plan?
S2: Because at the end I was a bit confused about how to calculate it.

S2 performed metacognitive regulation were also shown in the interview results when S2 rethought the next step because he was confused in the middle of the work and when S2 changed the work steps. The excerpt of the interview with S2 is shown as follows.

P : Did you think about the next step?
S2: Yes.
P : Why did you think about the next step?
S2: Because I was a bit confused in the middle.
P : Did you change the solution method?
S2: Yes, the one I used was wrong, so I changed it.

Based on this, AQ climber students rethink whether they have encountered similar problems. Metacognitive awareness helps students train to make the best plan (Fitria et al., 2020). AQ climber students rethinks the solution plan, rethinks the next step, changes the solution step, rethinks whether what is done is going well, and checks his work. This is by research conducted by Wilson and Clarke (2004) that indicators of metacognition awareness include thinking back about what is known, recalling whether I have solved problems before, thinking back to something that can help, and thinking back to what to do, indicators of metacognition arrangements include making plans to solve and rethinking what to do next,

and indicators of metacognition evaluation include thinking back about how my work, rethinking whether what was done was successful, and checking work.

2. **Metacognition of AQ Camper Type Students in Problem Solving**

The metacognition of AQ Camper Type Students was obtained by analyzing the answer sheets and interviews with the S3 and S4. Figure 3 contains S3's answer sheet for solving numeracy problems.

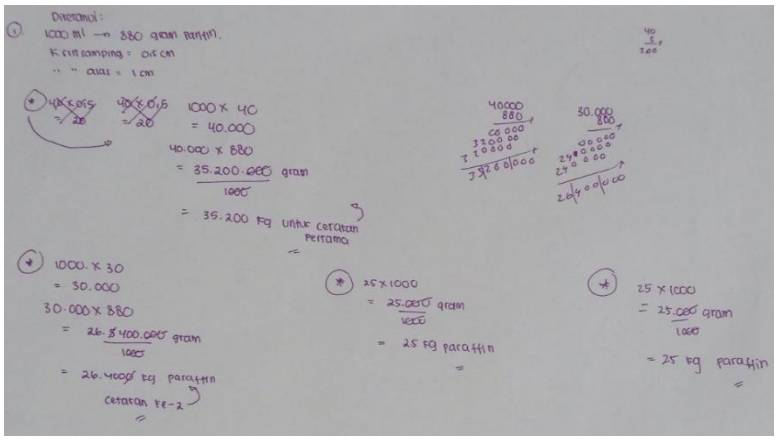

Figure 3. Answer Sheet S3

Based on Figure 3, S3 performs cognition, namely, S3 writes the information known from the problem. S3 calculates the paraffin requirements in molds 1, 2, 3, and 4 using the formula 1000 times the number of candles made with each mold, and the results obtained are multiplied by 880. S3 divided the calculation results by 1000 to obtain the paraffin requirement in kilograms.

Based on Figure 3, S3 performs metacognitive evaluation indicated by the presence of scribbles on the results of the work which indicates S3 looks back at the work. S3 metacognitive evaluation also seen in the results of the interview which shows S3 look back at the work. The excerpt of the interview with S3 is shown as follows.

P : On your answer sheet there are scribbles, is there a reason why there are scribbles?

S3: I was confused about where to start.

P : Did you check your solution steps?

S3: Yes.

S3 performed metacognitive evaluation also shown in the interview results when S3 feels unsure of his ability to solve problems. The excerpt of the interview with S3 is shown as follows.

P : Are you sure you can solve number 1?

S3: No.

P : Why not sure?

S3: I did it carelessly, I don't know where to start.

S3 performed metacognitive regulation, namely rethinking the work plan because S3 doesn't know how to solve it. Excerpts of interviews with S3 are presented as follows.

P : Did you rethink your plan?

S3: Yes

P : Why did you rethink?

S3: Because to solve this I don't know where to start.

Figure 4 contains S4's answer sheet for solving numeracy tasks.

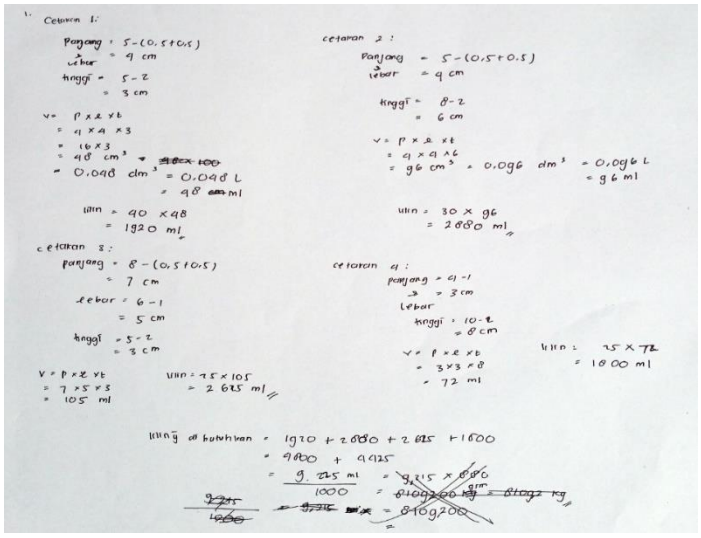

Figure 4. Answer Sheet S4

Based on Figure 4, S4 performed a cognitive where S4 determined the size of the candles in molds 1, 2, 3, and 4 by subtracting the size of the mold from the thickness of the side of the mold and the distance between the candle and the top of the mold. S4 calculated the volume of wax in each mold and then multiplied the result by the number of candles made with each mold. Next, S4 divided the result by 1000.

Based on Figure 4, S4 did a metacognitive evaluation indicated by the scribbles on the work indicating that S4 looked back at the work. S4's metacognitive evaluation also seen in the interview results which showed S4 looking back at the calculations on the answer sheet. The excerpt of the interview with S4 is shown as follows.

P : Did you check your answer again?

S4: Yes.

P : How did you check it?

S4: Yes, I looked at the calculation again.

S4 performed metacognitive evaluation also shown in the interview results when S4 checked the previous steps in solving the problem. The excerpt of the interview with S4 is shown as follows.

P : Did you rethink the previous step?

S4: Yes.

P : Why did you rethink the previous step?

S4: Because there might be a miscalculation.

S4 performed metacognitive awareness, namely S4 rethinking problems that have been encountered because it might provide ideas in solving problems. The excerpt of the interview with S4 is shown as follows,

P : Have you ever encountered a similar problem?

S4: I have.

P : Did you rethink the problem?

S4: Yes.

P : Why did you rethink?
S4: Maybe it can be useful, the method can be a clue.

S4 performed a metacognition regulation, namely rethinking the solution plan. The excerpt of the interview with S4 is shown as follows.

P : Did you think about the plan you made?
S4: Yes.
P : Why did you rethink your plan?
S4: Because it's a bit different from the previous problem.

The study results show that adversity quotient (AQ) camper type students tend to evaluate the numeracy problem solving process by rethinking the solution plan, checking the work, and reflecting on their success or difficulties, but often feel doubtful about their own abilities. These findings are consistent with the indicators of evaluation metacognition described by Wilson and Clarke (2004) and support Magiera and Zawojewki's (2011) view of the importance of awareness in understanding the task and one's own abilities. However, this study adds a unique context to numeracy, where camper types need more time to ensure the accuracy of their solutions. Theoretically, these findings reinforce the literature on the relationship between AQ and metacognition (Flavell, 1979; Stoltz, 1997), while practically, these results point to reflection-based learning strategies to support camper-type students in building their confidence and learning resilience.

CONCLUSION

Based on the data analysis conducted by researchers, AQ climber students can solve numeracy tasks and perform metacognition in solving numeracy tasks. Metacognition performed by AQ climber students are metacognition awareness, metacognition evaluation, and metacognition regulation. Metacognition begin with thinking back about what they know, evaluating the information needed, planning the solution steps, and assessing the results of their work. AQ camper-type students can solve numeracy tasks and perform metacognition. Metacognition performed by AQ camper students are metacognition awareness, metacognition evaluation, and metacognition regulation. Metacognition begin with rethinking what is known, evaluating the information needed, and planning the solution steps.

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