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Metacognition patterns of the students in solving mathematical problems: Analyzed from adversity quotient and gender

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Abstract

Background: Metacognition plays a crucial role in students' problem-solving abilities in mathematics. However, students exhibit diverse metacognitive patterns when tackling mathematical problems.
Aim: The research aimed to explore the metacognition patterns of students in solving mathematical problems, with a focus on the influence of Adversity Quotient (AQ) and gender.
Method: A qualitative approach with a phenomenological design was employed. Participants were mathematics students from Universitas Muhammadiyah Jakarta, from the academic year 2021/2022, including three male and three female students, each representing AQ climber, camper, and quitter types. Data collection involved tests, observations, and interviews.
Result: The findings revealed varying metacognition patterns among students based on AQ and gender. Male and female climbers showed comprehensive metacognitive involvement across all knowledge components – declarative, procedural, and conditional. Male campers displayed involvement in declarative and procedural knowledge, whereas male quitters did not demonstrate engagement in any of the three knowledge types. Female campers occasionally involved declarative and conditional knowledge, but female quitters lacked involvement in all three types. In terms of cognition regulation, both male and female climbers met all indicators of planning, monitoring, and evaluating.
Conclusion: The study concluded that student metacognition patterns in solving mathematical problems differ significantly when viewed through the lenses of AQ and gender, with the exception of students identified as climbers.

INTRODUCTION

Metacognition is very important in the process of solving mathematical problems. Metacognition is needed by students to analyze mathematical problem-solving questions (Ozdogan et al., 2019). This is supported by research results Vula et al., (2017) states that students who are taught based on metacognitive strategies and are able to apply metacognition achieve better results than those who do not apply them in solving mathematical problems. Metacognition is needed by students to develop their process of thinking and has important role in their learning process, as well as at the time they are looking for solutions when facing mathematical problems (William & Maat, 2020).

Some of the research results show that someone who is successful in solving mathematical problems is influenced by his metacognitive activities. This condition attracts attention because the ability to solve mathematical problems is an ability that students are expected to master after they learn mathematics, but in fact in Indonesia knowledge about

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metacognition in solving mathematical problems has not been studied much (Ahdhianto et al., 2020; Ozdogan et al., 2019). In the process of solving problems using metacognition can help students to be able to know what they have to solve, help observe conditions in actual problems, and understand how to find solutions to a problem (Kuzle, 2013). So, metacognition is the key to successful problem solving (Siegel, 2012). Therefore, metacognition needs to be discussed in order to open up insights and become concerned about the importance of students mastering the process of metacognition in solving mathematical problems.

Yildirim and Erzoslu found that there was a significant correlation between problem solving and metacognition in which r = 0.673 and p = 0.01. These findings prove that metacognition has an important role in problem solving, which is related to the ability to control and manage cognition as a more focused problem solver in solving a particular problem (Yildirim & Ersözlü, 2013). Therefore, teacher should teach students to become good problem solvers, namely by letting them be accustomed with problem solving and making them aware of their own thinking process (Yildirim & Ersözlü, 2013).

William (2020) showed that the successful of someone in solving mathematical problems affected by his/her metacognitive activity. This attracts attention because the ability in solving mathematical problems is the one expected to master by the students after they have studied mathematics, however, in fact, in Indonesia, the knowledge of metacognitive concept in solving mathematical problems is still not much discussed. By using metacognitive in the process of solving problems, students will be able to recognize what they have to handle, what is the real problems, and what solutions to take (Azzahra & Mariani, 2022; Kuzle, 2013). Generally, metacognitive is the key to solve problems successfully (Siegel, 2012). Thus, it is necessary to discuss this, hence, it will become the focus and open the insights on how important it is for students to master their metacognitive process in coping with mathematical problems.

There are two important metacognitive skills in dealing with mathematical problems, namely self-monitoring and planning. Self-monitoring is referred to individual's ability to do direct checking from a process of problem solving. While planning involves complex problem solving into subs of goal so that the problems can be solved separately and orderly to accomplish clearer final step. In solving mathematical problems, metacognitive assists students by showing which problems need to be solved, differentiating what the real problems are and understanding on how to achieve goals or solutions to solve those problems (Kuzle, 2013).

The differences of students' ability in encountering challenges or problems are also important to take into account. The abilities that exist within a person in facing challenge or problem and finding solution for that problem is called adversity quotient (AQ). According to Stolz (2000), adversity quotient is the ability possessed by someone in observing difficulty and managing that through his/her intelligence so that it becomes a challenge to solve (Singh & Sharma, 2017). The concept of AQ arouse because the concept of Intelligence Quotient (IQ) to measure someone's level of intelligence and the concept of Emotional Quotient (EQ) as one's intelligence in affective aspect are considered as less predictive towards one's success (Fadhila & Gistituati, 2019; Stolz, 2000).

Students' success in learning mathematics depends on how they deal with the existed problems. In this life, including in education world, it is a common fact that there are students who have higher intelligence than others. Intelligence is seen as something relative, since individual's intelligence is different. If it is related to the ways in overcoming difficulties, then

the intelligence used is Adversity Quotient. Adversity quotient is individual's intelligence in solving any existed problems. It is frequently identified by the fighting power to fight adversity. It is considered as thing that very supports students' success in improving their learning achievement (Malik & Mariani, 2019). The students who possess high adversity quotient would obviously more capable in facing adversity. On the contrary, those with lower adversity quotient tend to take difficulties as the end of their fights and hence, their learning achievement becomes lower (Hidayati & Taufik, 2020; Hulaikah et al., 2020).

Stolz opined that AQ consists of three types; high AQ (climber), medium AQ (camper), and low AQ (quitter). Adversity Quotient (AQ) which is concepted as individual's fighting power is a very important factor to maximize the potentials of IQ and EQ. Thus, at this point, Adversity Quotient is very important to get the ideas of students' spirit and fighting power in solving problems (Listiawati & Sebayang, 2019; Stolz, 2000). The differences in the abilities of male and female students in dealing with a challenge or problem also need attention. The ability that exists in a person in facing a challenge or problem and looking for a solution to the problem is known as adversity quotient (AQ). This was also explained by Güner & Erbay, (2021) and Olakanmi et al., (2017) who revealed that a correlation of problem-solving questions was needed by involving the process of cognition to teach mathematical problem-solving skills effectively.

This condition is supported by research conducted Walshaw et al., (2017) that male and female students have different abilities in solving mathematical problems because their thinking processes are different and the way they involve their metacognitive activities is also different. Furthermore, the research conducted Khairunnisa & Ninig, (2017) obtained the result that metacognitive abilities had not been used properly by male students because they only fulfilled the planning stage. Meanwhile, female students have used their metacognitive abilities well in solving problems because they fulfill the three stages of metacognitive abilities. This is in line with research by Lutfia & Sylviana (2019) which states that the mathematical problem-solving abilities of female students are better than male students. This is due to the time management of female students which is better than male students. Different things conveyed by Forgasz & Markovits (2018) the results of his research show that men are superior in solving mathematical problems compared to women. Male students have a higher level of self-confidence and are more active during the learning process. When solving mathematical problems, male students involve more metacognitive activities. The results of these different studies indicate that the mathematical problem-solving abilities of male and female students may be different due to differences in their thinking processes and metacognition.

In previous research, there was no complete discussion of metacognition in terms of adversity quotient and gender, existing research still discusses each component separately, so there is a need for research that discusses it in full. Prior study conducted by Lestari et al., (2018) found that metacognition patterns of male students did not involve all indicators and only fulfilled planning step. While female students had used all their metacognition patterns better since in solving problems, they fulfilled the three steps of metacognition patterns. This research findings were in line with the study of Zubaidah et al., (2021) in which they said that the abilities of female students in solving mathematical problems were better than the male ones. These were due to time management of female students were better than the male ones. However, research conducted by (Zubaidah et al., 2017) revealed that there was no significant

difference on Adversity Quotient of male and female students. Both of these students had their own characteristics to find effective strategies to overcome problems.

Looking at the gaps of different results of the previous studies above, this research explored how metacognition patterns of the students in solving mathematical problems discussed from Adversity Quotient levels and gender. These research results are expected to be information and new knowledge sources for the readers. Further, students' metacognition patterns in dealing with mathematical problems can be seen from the process the students took in finishing problems. The purpose of this research is to analyze and find out how students' metacognition patterns are viewed from adversity quotient and gender.

METHODS

The research was conducted using a qualitative approach with a phenomenological design. Qualitative research is a study based on the philosophy of post-positivism, used to investigate natural objects, in which the researcher as the key instrument, data collection techniques are conducted in triangulation, data analysis is qualitative, and the findings of qualitative research are focused on meanings than generalization (Cresswel, 2015). Phenomenology design used was hermeneutic. This design was developed by Ricoeur (Bohorquez, 2010). According to Ricoeur, this hermeneutic approach aims to understand a phenomenon systematically, tightly, and deeply, and not only on the surface. The selection of this approach due to the necessary to integrate experience and meaning in which that meaning is related to that experience. These two views complement each other. Phenomenology cannot understand various phenomenon completely and thoroughly without naming the experiences of the participants.

The choice of these research subjects was based on the consideration that the students at this semester had studied Linear Algebra and Basic Mathematics on the previous semester as pre-requisite subjects for Linear Program. Comprehensive analysis was done by involving Adversity Quotient. Adversity Quotient is classified into three categories, namely Climber, Camper, and Quitter. The categories of AQ were based on the data from questionnaire distributed two times to see the consistency of the students in giving the answers.

The participants in this study were students of Mathematics Education, Faculty of Education, Universitas Muhammadiyah Jakarta, 6th semester, 2022. The criterion of the analysis was suitable with the one developed by Stoltz (2000) presented in the following Table 1.

Table 1. The Criterion of Adversity Quotient (AQ)

Interval of AQ Test Score	Category
81 – 120	Climber
41 – 80	Camper
0 – 40	Quitter

Interpretation:

1. Climbers (score 81-120), people who think of possibilities and try to pass life difficulties with bravery and truly disciplinary. They think of possibilities and never let age, gender, race, physical or mental disability or other obstacles block their efforts.
2. Campers (score 41-80), people who are easily satisfied with the results obtained. They do not want to proceed their efforts to gain more than what they have gotten. At this point, they end their efforts because they are satisfied already with the results they reached. But at least,

campers dared to face the challenge to achieve certain point. Those who are included into campers might not use all their capabilities. Usually, they are looking for safe situation.

3. Quitters (score 0-40), people who stop their efforts. These persons are easy to get frustrated and discouraged, tend to be passive, having no passion to reach top of the success. They ignore, close or leave the core of human drive to strive.

Referring to the criterion above, they were 6 students selected to be the participants of this research work including male students with Adversity Quotient categories of climber, camper, and quitter and female students also with categories of climber, camper, and quitter. Data collection techniques of this research were tests, observation, and interview. All test results, observations and interviews were analyzed to answer research questions. Analysis steps on the results of these tests, observations, and interviews following the steps of qualitative data analysis (Cresswel, 2015) namely: carefully collecting data obtained from test results, preparing and organizing data for analysis activities, reading carefully, coding data, carrying out database exploration and coding, describing findings and establishing themes, report and represent some of the findings obtained, interpret the findings, validate the accuracy of the findings.

The instruments used in this study were test questions of solving problems. The analysis of interview data was conducted by several steps; data reduction, data presentation, making conclusion and verifying conclusion. Test questions of solving problems data were analyzed based on the correctness of the answers on each solving indicator on the answer key. Data analysis of the test results was referred to the correctness of the solving ways taken by the participants in accordance with the solving guide. The results of these participants' work were then analyzed and reported descriptively based on each step of problem solving and adjusted to the results of the interview to be put into the categories of their Adversity Quotient. For the sake of accuracy, the data should be credible.

RESULTS AND DISCUSSION

Results

Metacognition Patterns of the Students in Solving Problems Analyzed from Adversity Quotient

Along the process of problem solving, the students used their metacognition to help them in succeeding problem solving. The students with good ability to solve problem were able to use their metacognition well, conversely, those with low ability in dealing with problems used their metacognition in less optimum (Izzati & Mahmudi, 2018). Patterns of metacognition during problem solving based on the level of problem-solving ability adapted from Irham (2016) and Pate & Miller (2011) are as follows: Expert Problem-Solving Metacognition Patterns, Hypothetic Problem-Solving Metacognition Patterns, and Primitive Problem-Solving Metacognition Patterns. The pattern of expert problem-solving metacognition shows that students with high problem-solving abilities are able to involve all components of metacognition from knowledge of cognition and regulation of cognition. In the early stages students monitor declarative knowledge to identify problems, this is in line with what is formulated (Pate & Miller, 2011).Then in the final stage students evaluate when checking again for the solutions that have been determined. Differences in metacognition patterns in Expert Problem Solving and Hypothetical Problem Solving are in the monitoring stage during the

completion step. Where students with Hypothetic Problem-solving metacognition patterns do not monitor declarative knowledge, procedural knowledge and conditional knowledge in problem solving steps. Students can evaluate but are unable to find and justify errors. Students with Primitive Problem-Solving abilities only involve the monitoring process when identifying problems, then there is no more regulation of cognition involved. In knowledge of cognition students only use declarative knowledge when identifying problems and do not involve conditional knowledge during problem solving.

The involvement of metacognition was created into patterns representing students' abilities in coping with problems.

Metacognition patterns when facing problems analyzed from Adversity Quotient of Knowledge of Cognition component are as follows:

1. **Metacognition Patterns of Male Students with the Categories of Climber, Camper, and Quitter**

   Male participants with Adversity Quotient of climber category were coded as C1, with camper category as C2 and with quitter category as C3. Data analysis results of test questions of problem solving, observation, and interview were shown in each step involving the steps of metacognition process.

   a) *Declarative Knowledge*

      In this step, male student with climber category (C1) showed that he was able to involve all components of metacognition at the knowledge of cognition component. At this level, C1 recalled back declarative knowledge in his memory to identify problems, expressed factual knowledge in his memory, and these were in line with what was formulated by Pate & Miller (2011). As well as the student with camper category (C2) which involved declarative knowledge in his memory to identify problems. Meanwhile, male students with quitter category (C3) did not involve declarative knowledge in his memory to identify problems, hence, he made mistakes in making mathematical models.

   b) *Procedural Knowledge*

      In understanding problem, C1 had awareness in the connecting his procedural knowledge; that was in order to understand problems more, he decided to use strategies in drawing graphic by firstly determining the cut points in which eliminating or substituting of linear equation were initially taken. C2 also involved his procedural knowledge in understanding problems so that he was able to select which strategies to use to draw graphic. Meanwhile, C3 did not involve his procedural knowledge, hence, in choosing finishing strategies, he experienced difficulties.

   c) *Conditional Knowledge*

      C1 involved conditional knowledge, that was why he knew well when a strategy needed to be used or when and why both declarative and procedural knowledge should be involved in solving mathematical problems. C1 realized that he was able to solve the questions of solving problems since all the finishing steps had been explained before and also, he understood the importance of predicting time to spend in accomplishing questions of solving problems. C2 did not always involve conditional knowledge and because of that, he sometimes was confused when he should use conditional knowledge.

Likewise, C3 did not involve conditional knowledge, hence, he found difficulties in solving problems since he ran out of time. Besides, C3 could not predict time needed to accomplish the questions of solving problems since conditional knowledge was not involved.

2. Metacognition Patterns of Female Students in the Categories of Climber, Camper, and Quitter

Female participants with Adversity Quotient of categories climber were coded as P1, with camper as P2, and with quitter as P3. Data analysis results of their working of test questions of solving problems, observation and interview showed their metacognition patterns as follows:

a) *Declarative Knowledge*

At this step, female student with climber category (P1) showed that she was able to involve all components of metacognition at knowledge of cognition. At this stage, P1 recalled back declarative knowledge in her memory to identify problems in expressing factual knowledge in her memory, these were in line with what was formulated by Pate & Miller (2011). As well as female student with camper category (P2) who also involved her declarative knowledge in her memory to identify problems. The same thing happened to female student with quitter category (P3) who involved declarative knowledge in her memory, too. Thus, in identifying problems, either P1, P2, and P3, did not experience difficulties.

b) *Procedural Knowledge*

In understanding problems, P1 had awareness in connecting procedural knowledge she possessed, that was to understand the problems more, which strategies to use in drawing graphic by firstly determining the cut points in which eliminating and substituting of linear equation were initially taken. P2 also involved procedural knowledge in dealing with problems so that she was able to decide which strategies to choose in drawing graphic. However, P3 did not involve procedural knowledge, hence, she encountered difficulties in applying strategies.

c) *Conditional Knowledge*

P1 involved conditional knowledge so that she understood when a strategy should be used and when and why both declarative and procedural knowledge should be involved in solving mathematical problems. P1 realized that she was able to accomplish questions of solving problems since the finishing steps been understood before and also, she was aware of the importance of predicting time to spend to finish the questions of solving problems. P2 did not always involve her conditional knowledge which sometimes made her confused when she had to use conditional knowledge. Likewise, with P3, who did not involve her conditional knowledge, hence, she experienced difficulties while working on the questions since she ran out of time. Additionally, P3 could not predict time needed to deal with the questions of solving problems so that she frequently ran out of time while doing the questions, thus, the tasks were not accomplished.

Metacognition Patterns When Solving Problems Analyzed from Adversity Quotient of Regulation of Cognition Component were as follows:

1. Metacognition Patterns of Male Students (L)
Male Students with Climber Category (C1)
Planning
Referring to coding and analysis of the answers' results, tests' results and interview, C1 was able to read and understand problems, identify the cases known and being asked. At this planning step, he had fulfilled all indicators of stating informational mathematic sentences that he had known, questioned, and was thinking of any possible alternative strategies to take. Thus, at this level, C1 had performed all indicators.

At the planning stage, C1 was able to attain all indicators in which reading and understanding problems, identifying known cases and being asked to be stated into informational mathematic sentences and also thinking of any strategies that could be selected. These were in accordance with the theory proposed by Baylor (2006) and adopt from Kaune et al., (2011) which explained that planning is related to planned activities that organize all learning process. The same thing was also stated on OLRC News (2004) that the ability of planning the learning process followed by setting strategies to manage information related to those actions is very necessary at planning activity.

Based on the description above, it can be said that C1 had awareness towards the knowledge he possessed and was able to relate this to the questions, hence, he was capable to write and explain the finishing steps that he used. This consciousness showed metacognitive activity in planning problem solving. This was in line with the research of Siegel (2012), which proved that male subjects involved their metacognitive since they were able to think of planning flows in solving problems, the formula, time needed, and strategy to overcome the problems.

Monitoring
At the stage of monitoring, C1 was able to accomplish all indicators; selecting appropriate strategies, applying those strategies in solving the problems, using these strategies as the solutions to cope with the problems accurately and thoroughly. As the theory expressed by Kaune et al., (2011) stating that monitoring stage is related to the activities of monitor series of learning progress. In other words, C1 had achieved metacognitive indicators to execute monitoring, namely answering questions correctly related to solving problems. In line with this, according to Izzati & Mahmudi (2018), the students who involve their metacognitive in doing finishing plan will be able to monitor every step that they have taken to deal with adversities. In answer C1 has completed it by compiling tables, drawing graphs and making solutions correctly, this can be seen in Figure 3 below:

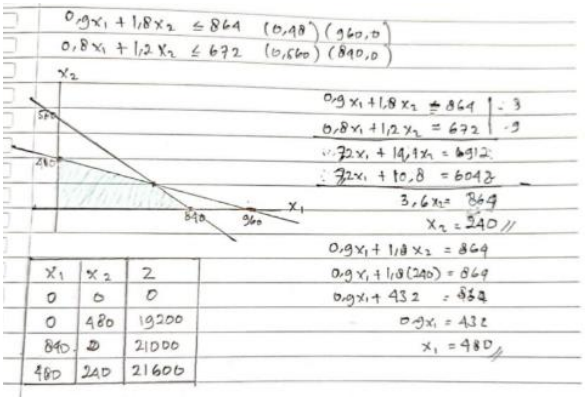


Figure 2. Answer Snippet of C1

Evaluating

At evaluating stage, based on figure 3 C1 was able to accomplish all indicators and re-check the process he had taken in solving the problems, confirm the solutions used in finishing process, conclude the relevance between solutions and problems, and also evaluate the mathematical problems that he had been through. C1 had fulfilled all metacognitive indicators at evaluating step in which he confirmed his belief about the finishing results, described the planning to re-checking, as well as explained whether or not he did a re-checking. Thus, it was concluded that C1 involved all his metacognitions to evaluate.

At evaluating level, C1 was successful in answering the questions and able to explain or argue correctly on each of the finishing strategies' step. He evaluated the mathematical problem solving that he had done well and made the conclusion correctly. These were also suitable with his responses in the interview; the main ideas of his interview's results described as follows:

In the interview, C1 gave the answers correctly, hence, both the test and interview results were consistent. The correct answer was revealed in the evaluation, namely responding correctly to the minimum cost of $2850. C1 was able to conclude the relevance between solutions and the cases given. Besides, he was also able to evaluate the finishing of mathematical problems that he had done.

Male Student with Camper Category (C2)

Planning

At planning stage, C2 was able to identify cases that he had known and being questioned by stating what he had understood completely, however, he was still unable to express mathematical information he had known correctly and did not mention what was asked including what finishing alternatives to take. If referring to the theory proposed by Baylor (2006) and adopt by Kaune et al., (2011) which stated that planning is related to planned activity organizing all learning process, C2 was not able to organize half of his learning process completely, so that it gave impacts to the next stage.

Monitoring

At monitoring step, C2 was not able yet to fulfill the indicator of selecting correct strategies and applying those strategies in solving problems, besides, he was unable either to find solution to the cases given accurately and thoroughly since he was not meticulous when drawing graphic, thus, the drawing process was stopped while it was not finished yet. Referring back to

the theory of Baylor (2006) and Kaune et al., (2011) monitoring step is related to the activities of directing a series of learning progress, and it did not happen to C2.

Evaluating

At evaluating stage, C2 did not re-check his problem-solving process that he had been through because when dealing with questions, he was too hasty and forgot to complete his graphic Figure, but in fact, C2 was able to confirm the solutions he chose through finishing process, additionally, he was also able to conclude the relevance between solutions and cases given and also accomplish the indicators of evaluating mathematical problems that he had done.

Male Student with Quitter Category (C3)

Planning

At the planning stage, C3 was not able yet to identify the cases he had known and being asked since he did not mention those two aspects completely, he was unable either in using informational mathematics into sentences correctly and did not state the things asked, besides he was failed in thinking of alternative solutions. If it was referred to the theory expressed by Baylor (2006) and adopt by Kaune et al., (2011) planning is related to planned activity organizing series of learning process thoroughly, this indicated that C3 did not organize all learning processes well, hence, it might affect the next step.

Monitoring

At monitoring stage, C3 was only able to fulfill the indicator of selecting appropriate strategies and indicators to apply the strategies in countering problems, only, he did not fulfill the indicator of using finishing strategies yet to get solutions over the cases given accurately and carefully since he was not meticulous when drawing graphic so that the drawing process was not finished yet. If it was referred to the theory of Baylor (2006) and Kaune et al., (2011), monitoring stage is related to the activity of directing series of learning progress, it did not happen to C3 in which his learning progress series were not well-directed yet. C3 was not able to apply strategies in completing problems in which it could be clearly seen from incompleteness graphic Figure that he drew, additionally, some parts were not shaded. Besides, C3 did not use finishing strategies to get solutions over the problems given accurately and carefully.

As what Widiyasari et al., (2022), opined,when students are able to understand problems well, they have involved their metacognitive. C3 did not use strategies to find appropriate strategies either to overcome the problems given accurately and carefully, this can be seen in Figure 4 below:

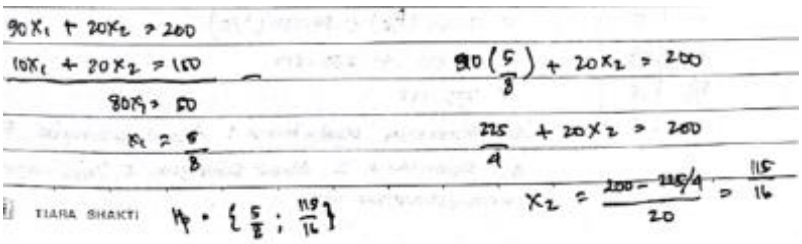


Figure 4. Answer Snippet of C3

On that figure 4 answer snippet of C3 above, , it is clear that C3 did not pass the entire process at the monitoring stage, namely he was unable to choose the right solution strategy and his answer was wrong due to his carelessness. Further, this was also supported by his responses in the interview in which at monitoring stage, he performed as follows:

In the interview, C3 was in doubt when answering questions indicated from his test and interview results, he consistently answered the questions even though they were not correct. As well as in the observation activity, his eyes and gesture showed that he was confused.

Evaluating

At the stage of evaluating, C3 did not fulfill the re-checking indicator in dealing with problems that he had been through because he was hasty and forgot to accomplish his graphic Figure, he did not confirm gained solutions yet through finishing process since he was wrong in understanding the questions, he had not completed all indicators of concluding the relevance between solutions and cases given as seen from the incorrectness of finishing process and did not fulfill evaluation indicator of overcoming mathematical problems that he had done.

2. Metacognition Patterns of Female Students (P)

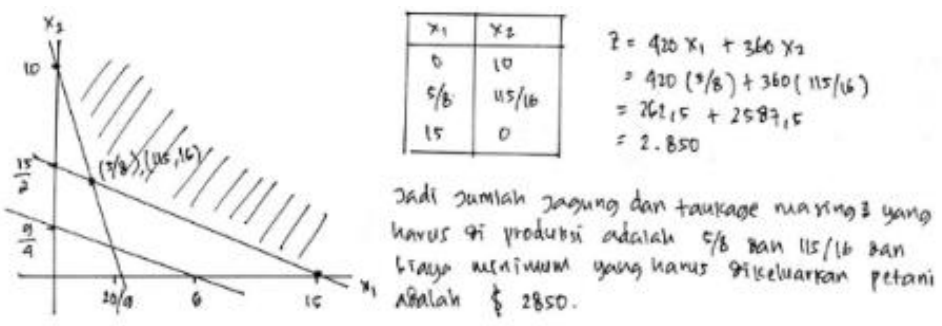
Female Student with Adversity Quotient of Climber (P1)

Planning

At the planning phase, P1 accomplished all indicators of this step; she read and understood all questions, identified things that she had known and being asked, stated these things in informational mathematical sentences and thought of any possible alternative finishing strategies. These were in line with the theory expressed by Baylor (2006) which stated that planning is related to any planned activity that organizes learning process. The same thing was also described on OLRC News (2004) that the ability of planning the activities of learning proceeded by setting up strategies to manage information related to conducted learning process is very crucial to do at planning stage.

Based on test and interview results at planning stage, P1 had selected appropriate strategies in which she firstly determined cut points before drawing graphic, she was also able in applying strategies in coping with problems, this was shown by the completeness of that graphic Figure, even more, P3 used finishing strategies to get solutions over the cases given, accurately and carefully. These all could be seen from her answer sheet.

P1 drew graphic and shaded the required finishing part correctly. Her work is shown in the following Figure 5:



Translated Version:

So, the amount of corn and bean sprouts that must be produced respectively is $\frac{5}{8}$ And $\frac{115}{16}$ and the minimum cost that must be incurred by farmers is $ 2850.

Figure 5. Answer Snippet of P1

Monitoring

In accordance with the theory of Baylor (2006), all monitoring stages are related to activities directing series of learning progress. P1 had passed this stage correctly based on the indicators. Therefore, the research results showed that this female student with Adversity Quotient of camper category, at monitoring stage, working on the questions as it was planned orderly and carefully, additionally, she believed that the finishing process of the problems was correctly taken already.

Evaluating

Referring to both test and interview results of P1 at evaluating stage, P1 did re-checking the finishing process that she had been through, confirming the solutions she attained with finishing step, concluding the relevance between the solutions and the cases given, and evaluating finishing process of mathematical problems she had done. These could be seen from Figure 7 above in which after drawing the graphic, P1 looked for critical points of each equation and decided which points to select to hit the maximum profit. P1 finished the graphic Figure correctly and her answers both in the tests and interview results were consistent at this monitoring phase.

At this step, P1 was also able fulfilling all indicators, namely re-checking all finishing process she had been through, confirming the solutions she had chosen with that finishing process, concluding the relevance between the solutions and the cases given, and also evaluating the finishing process of mathematical problems she had done.

Female Student with Adversity Quotient of Camper Category (P2)

Planning

Based on the results of tests and interviews, at the planning stage P2 met all the indicators, namely reading and understanding the questions, identifying the cases she had known and being asked, stating in informational mathematical sentences what she had known and being asked, and thinking of any possible alternative strategies to overcome problems. These were in accordance with the theory proposed by (Baylor, 2006; Kaune et al., 2011) which explained that planning is related to planned activities organizing a series of learning process. The same opinion was also stated on OLRC News (2004), explaining that the ability of planning activities of learning followed by setting up the strategies to manage all information related to learning process taken is very important to do in the process of planning.

Monitoring

At the stage of monitoring, P2 was able to choose appropriate strategies, determine the cut points before drawing graphic, and apply finishing strategies, these were revealed from the completeness of graphic Figure, additionally, P2 had used finishing strategies to get solutions over the problems accurately and carefully. These could be seen from her answer sheet.

Evaluating

At evaluating stage, P2 was able to re-check her finishing process over the problems she had been through, confirm gained solutions with finishing process, conclude the relevance between solutions and cases given, and evaluate the finishing steps taken to solve mathematical problems. These all could be seen in the following Figure 9 in which after completing graphic Figure, P2 looked for critical points of each equation and determined which points to be selected to get maximum profit. However, P2 did not write the amount of the profit, hence, the conclusion she made was less complete.

Female Students with Adversity Quotient of Quitter Category (P3)

Planning

Based on coding and analysis results of participant's answers in both test and interview, P3 was not able to read and understand problem, identify cases she had known and being asked, fulfill indicator of stating informational mathematics sentences towards the things that she had understood and being questioned and think of any possible alternative strategies to be taken. If referring back to the theory of (Kaune et al., 2011) which described that planning phase is related to activities directing a series of learning progress, P3 did not achieve this indicator; her learning progress series were not well-directed yet. The similar thing was also stated on OLRC News (2004), that the ability of planning the activities of learning process proceeded by setting up strategies to manage information related to learning process is very pivotal to do at planning level.

Monitoring

At the stage of monitoring, P3 was not accomplish all indicators yet, unable to choose appropriate strategies, did not apply strategies in countering problems, and did not use finishing strategies to get solutions over the cases given, accurately and carefully. P3 did not draw the graphic with the reason of running out of time because the mistakes of modelling the mathematics in the beginning of doing the questions, thus, P3 could not find which part should be shaded and not.

Based on the description above, it could be concluded that P3 metacognition pattern in monitoring stage to cope with problems was not well-implemented especially in fulfilling her metacognition process when drawing graphic to solve the questions.

Evaluating

At the evaluating phase, P3 was not able yet to accomplish all indicators since she did not re-check the finishing process over the problems she had been through because she was hasty and made mistakes, hence, she did not have time to draw graphic, did not confirm the solutions taken with finishing process due to misunderstanding the questions, unable to fulfill the indicator of making conclusion about the relevance between solutions and the cases given since the finishing process was incorrect and did not accomplish the indicator of evaluating mathematical problems that she had done since she did not make conclusion.

Judging from the pattern that occurs according to the theory described by Irham (2016) and Pate & Miller (2011). So, it can be said that male students of the Climber type have an Expert Problem-Solving metacognition pattern, Camper type males have a Hypothetic Problem-Solving Metacognition Pattern, and Quitter type males have a Primitive Problem-

Solving Metacognition Pattern. Likewise with female students. Judging from the pattern that occurs, it can be said that female students of the Climber type have an Expert Problem-Solving metacognition pattern, Camper type women have a Hypothetic Problem-Solving Metacognition Pattern, and Quitter type women have a Primitive Problem-Solving Metacognition Pattern.

CONCLUSIONS

This study reveals that both male and female participants of the 'Climber' type engaged all aspects of metacognition in the 'knowledge of cognition' component. They recalled declarative knowledge to identify problems and articulated factual knowledge. Male participants of the 'Camper' type also utilized declarative knowledge to identify problems and procedural knowledge to understand them, but they did not apply conditional knowledge, leading to challenges in completing questions due to time constraints. Female 'Camper' type participants employed declarative knowledge but did not consistently use conditional knowledge, resulting in occasional confusion about when to apply it. Male 'Quitter' type participants did not use declarative, procedural, or conditional knowledge, leading to errors in mathematical modeling and problem-solving. Similarly, female 'Quitter' type participants also did not engage in declarative, procedural, or conditional knowledge, facing difficulties in mathematical modeling and problem-solving.

These findings confirm that the metacognition patterns of students differ based on adversity quotient and gender, except for those of the 'Climber' type, where both males and females exhibited similar metacognition patterns. 'Climber' type males demonstrate an Expert Problem-Solving Metacognition pattern, 'Camper' type males show a Hypothetical Problem-Solving Metacognition Pattern, and 'Quitter' type males display a Primitive Problem-Solving Metacognition Pattern. The same applies to female students. Future research could explore other variables, such as mathematical abilities.

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AUTHOR CONTRIBUTIONS STATEMENT

RW was responsible for conceptualizing the study, drafting the original manuscript, conducting the analysis, developing the methodology, creating the instruments, reviewing and editing the manuscript, handling correspondence, and translating the document.

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