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Research Article

Investigating the adversity quotient: Assessing elementary school students' proficiency in solving two-dimensional problems

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Abstract: The Adversity Quotient (AQ) is a measure of a person's resilience in adversity and ability to solve problems in Mathematics. In this study, the solution to the two-dimensional shape problem of grade 3 elementary school students was explained based on the adversity quotient. This type of descriptive exploration is used to conduct qualitative research. Three grade III students of SD Muhammadiyah 9 Malang City were involved in this study representing 3 categories of AQ. The tools used are written exam questions, interview guidelines, and observations. One question related to the circumference of a two-dimensional shape is given in the form of a written test. This study analyzed the learning outcomes of three third-grade students through four stages: data transcription, data selection, data presentation, and drawing conclusions. The results showed two problem-solving patterns based on the AQ category. The first pattern is understanding the problem, planning the problem-solving, executing the plan, and looking back is done by the category of quitters and campers. The second pattern of understanding the problem, planning the problem solving, executing the plan, understanding the problem, planning the problem solving, executing the plan, and looking back is done with the category of climbers.

Keywords: adversity quotient; problem-solving; two-dimensional shapes

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1. Introduction

Adversity Quotient (AQ) is a theory proposed by Paul G Stoltz to measure how well a person can survive adversity and measure a person's ability to overcome crises, solve problems and succeed long-term, predict who gives up and who will stay (Kahfi, 2020). IQ, and EQ are insufficient to be standards capable of predicting one's success. Although the IQ and EQ that a person has in the category are good, but if they do not have high fighting power and sensitivity in responding to the difficulties faced, it will be meaningless (Kahfi, 2020). AQ categories, namely quitter/low AQ, medium champer/AQ, and climber/high AQ (Ratna et al., 2020; Villagonzalo, 2013).

Learning mathematics is one of the learnings that requires AQ skills in solving problems (Hanifah et al., 2024). Questions or situations that ask individuals or groups to make a solution, with the solution not visible are known as problems (Krulik & Rudnick, 1988). Problem-solving is an individual's process of using previously acquired knowledge, skills, and understanding to meet the demands of non-routine situations (Ince, 2018; Rahman, 2019). The student must think in higher order by synthesizing the knowledge he has learned and applying it to new and different situations (Krulik & Rudnick, 1988).

Regarding problem-solving skills, the results of a preliminary study conducted in June 2022 at SD Muhammadiyah 9 Malang stated that the stages of problem-solving carried out by students followed the Polya Stage (Ekowati et al., 2023). The Polya Stages are understanding the problem, planning the problem-solving, executing the plan, and

looking back (Kaur, 2019). The Polya stage is then adapted by Indonesian students in written answers to "known, asked, answered and so". The results of written answers from SD Muhammadiyah 9 Malang students when solving two-dimensional problems in class, students carried out the process of following the Polya Stage "known, asked, answered and so". The teacher judges the student's ability based on the final answer, true or false. No research has ever been conducted related to the stage of solving the problem. Likewise, with the analysis of answers based on adversity quotient, there has never been a similar study. The next question is "How to solve the problem of two-dimensional grade 3 elementary school students based on adversity quotient?".

Several studies have focused their studies on the AQ of school students. Some studies examine the type of adversity and cognitive impact, for example, research that distinguishes between deprivation and threat against the type of adversity (Platt et al., 2018) or the dimensional model of adversity and psychopathology (Sheridan et al., 2020). On a global scale, adversity research has used multivariate statistical methods (Brieant et al., 2024). Other studies use targeted maximum likelihood estimation to account for various adversities that occur simultaneously (Platt et al., 2018). In Indonesia, research on adversity has also been conducted, one of which is a study that analyzes socio-economic factors and cognitive development (Maika et al., 2017). Several other studies related to AQ also involve other variables, such as academic performance (Firdiansyah & Rosikhoh, 2024), interpersonal relationships (Hasanusi et al., 2024), and critical thinking skills (Rahayu & Vizha, 2024). In a search on the Scopus database, there was only one publication involving two-dimensional shape and problem-solving (Suryaningrum et al., 2020). However, no research has been found that examines further related to solving problems in the three categories of adversity quotient. In addition, there has not been a pattern of problem-solving carried out by the subject according to the Polya Stage.

Research on solving math problems based on adversity quotient is urgently needed, given the challenges students face in learning mathematics which often leads to anxiety and low motivation to learn (Canavan, 2019; Charlo, 2020). By understanding and integrating AQ, we can identify how students' resilience in the face of adversity affects their ability to solve math problems, which in turn will support the development of a more effective and responsive curriculum. Given the importance of mental resilience in education today, this research not only has the potential to improve student learning outcomes but also prepares them to face challenges outside of school, making it a crucial step in creating a resilient and adaptive generation in the future. Therefore, the purpose of this study is to analyze the problem-solving patterns of grade III elementary school students in solving flat geometry problems based on the AQ category.

2. Materials and Methods

This research was conducted through a qualitative approach and descriptive exploratory method (Creswell, 2012, 2014). The instruments used are AQ questionnaires, two-dimensional shape description problems, interview guidelines, and observations. The study begins with determining the AQ category, giving problems and observations, analyzing observations, interviews, and written test questions. The research step follows Figure 1.

The two-dimensional shape problem is given according to Basic Competency 3.10 Explain and determine the circumference of a two-dimensional shape. While the indicators specified are indicators 3.10.1 Describes the circumference of a two-dimensional shape and 3.10.2 Calculates the circumference of a two-dimensional shape (Lu et al., 2020; Pantaleo, 2021). The problem given is as shown in Figure 2.

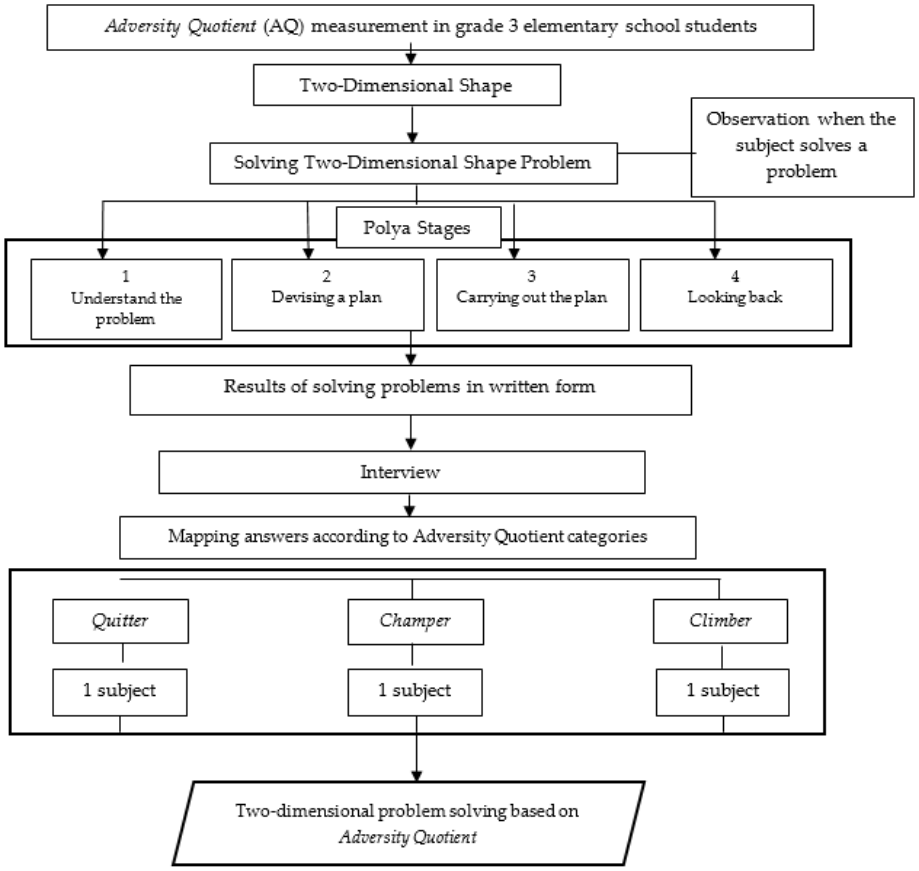
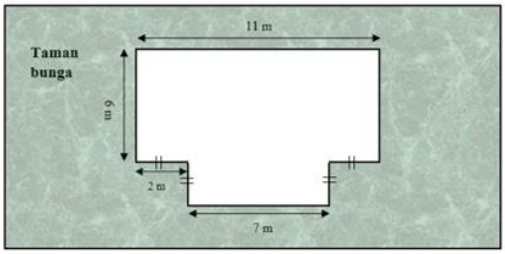


Figure 1. Research steps

There is a rectangular garden belonging to Mr. Adi as seen in the picture below. So far, Pak Adi's garden has been underutilized so that many wild plants grow. Mr. Adi plans to build a swimming pool and flower garden in the garden. A sketch of the swimming pool and flower garden is shown in the Figure below.



To estimate the cost that must be prepared, Mr. Adi must calculate the circumference of the swimming pool. Help Mr. Adi determine the circumference of the swimming pool!

Figure 2. Two-dimensional shape problems

The data collected are analyzed for problem-solving steps carried out by students. The research analysis was conducted in four stages: (1) data transcription; (2) selection and selection of appropriate data; (3) identifying the presentation of data based on the stage of problem-solving, (4) drawing conclusions based on research results (Ekowati et al., 2021; Wulandari et al., 2021).

3. Results

The first step of research, the determination of the subject of research is carried out. The subjects of the study were 3 grade 3 students of Khatijah SD Muhammadiyah 9

Malang City. The process of obtaining research subjects, namely a) Researchers determine the location of research at SD Muhammadiyah 9 Malang City, b) Researchers conduct *Focus Group Discussion* (FGD), and c) filling out AQ questionnaires by students. A total of 24 students filled out the questionnaire, obtained 1 quitter category student, 3 climbers students, and 20 campers students. From 3 categories, students are selected who solve problems according to the Polya Stage (Suwandayani et al., 2021). In the end, 3 research subjects were obtained who met the AQ category. 1 student category quitter, 1 student category camper, 1 student category climber. The following is an explanation of the problem resolution according to Polya's stages.

3.1 Subject 1 (S1) (A campers type)

Problem-solving is carried out in writing and strengthened from the results of interviews, observations, and field notes.

3.1.1 Stage 1 Understanding the Problem (UP)

In the first stage, what S1 does is write down known information. When writing this is what the analysis then indicates. S1 writes down this known information including the criteria for understanding the problem as present in Figure 3.

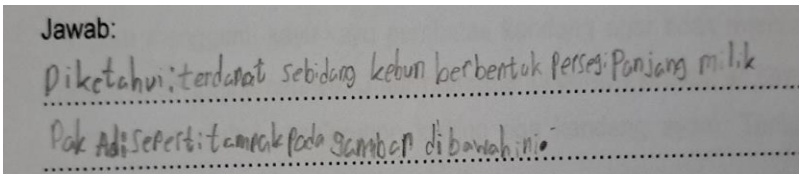


Figure 3. Answer written by S1

Based on Figure 3, information was obtained that S1 had written down known information, namely "there is a rectangular garden owned by Mr. Adi as shown in the picture below". This is also reinforced by interview results that support written answers such as the quote below.

R : What information does S1 know about this issue?
S1 : Length and width (while showing the length and width of the swimming pool image)
R : Do you want to add more information?
S1 : Size (while pointing using index finger as shown in Figure 4)

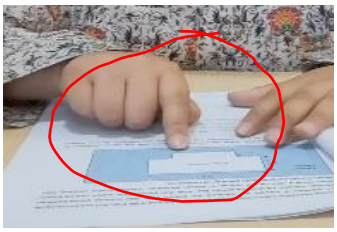


Figure 4. Subject S1 shows information on the stage of understanding the problem

3.1.2 Stage 2 Devising a Plan (DM)

After writing down the known information, S1 stated the problem resolution plan through interviews such as the following quote.

R : Are you clear about the question on this issue?
S1 : Question "What is the circumference of the swimming pool?"
R : What steps were taken to answer this question?
S1 : Add them all up (sides) (while moving his hands around the pool)

In the results of this interview, S1 is indicated to perform analysis on objects, images, or symbols to state a problem-solving plan. In addition, S1 also expresses the meaning of the circumference of a two-dimensional shape.

3.1.3 Stage 3 Carrying out the Plan (CoP)

At the stage of carrying out the plan, S1 provides written answers as listed in Figure 5.

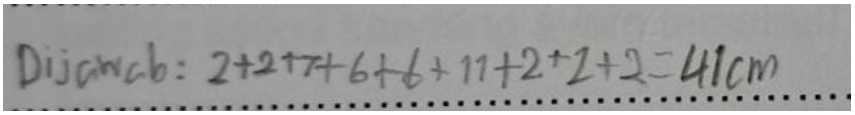


Figure 5. S1 students carrying out problem solving

S1 resizes the sides of the build listed in the picture into a summation form. In this case, students carry out the process of integration indication. Students convert the sign into another representation that is addition and use the symbol "+" (sum). The sum result is "41 cm" and this answer is wrong.

3.1.4 Stage 4 Looking Back (LB)

At this stage, S1 in writing stated a conclusion "So the cost that Mr. Adi must prepare is 41". This answer states the existence of mathematical arguments to support solving the problem as shown in Figure 6.

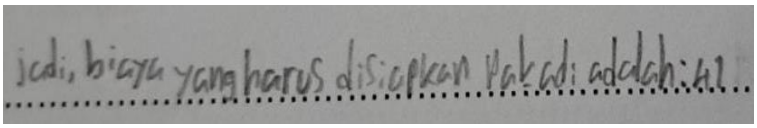


Figure 6. Looking back stage

The results of this interview indicate an indication of justification. S1 uses objects and signs. S1 also stated during the interview as quoted from the interview below.

R : Please explain this sentence" (pointing to the sentence "So the cost that Mr. Adi must prepare is 41").

S1 : the result of this summation (designates the number 41 from the previous calculation).

Overall, problem-solving by S1 follows the flow of understanding the problem, devising a plan, carrying out the plan, and looking back. The next problem-solving flow we symbolize UP-DP-CoP-LB. The results of solving this S1 problem are in the form of wrong answers. The answer, which is worth 41, is wrong. The error is at the DP stage, S1 sums up all sides and results in an incorrect calculation. S1 adds twice one side that has a size of 2 cm.

3.2. Subject 2 (S2) (A climber type)

3.2.1 Stage 1 Understanding the Problem (UP)

Based on S2's written answer, the stage of understanding the problem is analyzed from Figure 7.

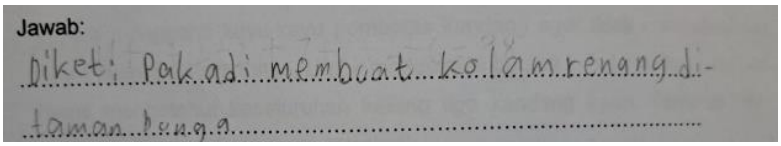


Figure 7. S2 Write answer

S2 written and interview answers state the information known in the question. S2 identifies from the pool image. S2 also analyzed the size of the swimming pool as stated in the following interview.

R : What information is on this issue?

S2 : Yes Mr. Adi's swimming pool

R : Is there any other information?

S2 : Yes, the size (his hand points to the size of the swimming pool image).

3.2.2 Stage 2 Devising a Plan (DP)

The S2 subject writes a problem-solving plan by stating questions on the problem. The written answer given by S2 in the form of a question on the problem was also reinforced by the results of the interview which stated the problem resolution plan as the following quote. Figure 8 shows S2's stated resolution plan.

R : Describe the question listed in the problem.
S2 : What is the circumference of Mr. Adi's swimming pool?
R : How is the problem solved?
S2 : Yes, the circumference is calculated, summing this all up (pointing to all the side sizes).

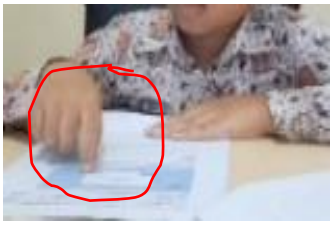


Figure 8. Subject S2 stating the problem resolution plan

The results of written answers, interviews, observations, and based on S2 field notes show that the planning stage of problem-solving begins with conducting an indication of analysis, namely students looking at objects, images, or symbols to write down what is asked. S2 conveys through its gestures how to determine the circumference of the swimming pool.

3.2.3 Level 3 Carrying out The Plan (CoP)

The S2 subject performs problem-solving as described in the written answer. Based on the written answer, it is known that S2 changes the size of the poolside into another representation, namely a mathematical sentence. Then S2 also connects mathematical sentences using the hyphen "+" and associates those symbols with previous knowledge. In this case, S2 gets the sum result which is 28 as in Figure 9.

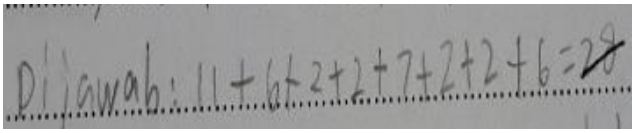


Figure 9. Carrying out the plan of subject S2

At the interview, S2 followed up on the implementation of the plan by asking permission to correct the answers. S2 felt that there was a miscalculation. In the end, the researcher is allowed to revise the answers.

3.2.4 Stage 4 Understanding the Problem (UP)

Based on the results of the implementation of the problem-solving plan, S2 said in the interview session there was a wrong answer. S2 stated a miscalculation at the time of calculating in the previous stage. Then S2 performs an analysis indication of the previous calculation. At this stage S2 carries out indication analysis activities, especially indicators "students detect known signs, symbols, objects/images". The results detect mathematical sentences and then students ask permission to correct the answers.

3.2.5 Stage 5 Devising a Plan (DP)

S2 plans to recalculate the additions made. This is because S2 reanalyzed the answer. During the researcher interview, S2 stated that there was a miscalculation. Excerpts of the interview are as follows.

R : Why was the answer deleted?
S2 : Yes, wrong answer

At this stage, S2 carries out an indicative analytical reasoning process, the multimodal used is verbal multimodal. Then there was a semiotic triad using Pak Adi's swimming pool object. The sign used in the form of oral communication is a type of symbolic

sign. Interpretation is the ability of students to connect symbols and signs to solve problems.

3.2.6 Stage 6 Carrying out The Plan (CoP)

Based on the predefined plan, S2 recalculates the problem. S2 integrates indications with indicators, students connect symbols and signs with previous knowledge (the ability to add integers). Students perform calculations as shown in Figure 10.

Figure 10 shows a change in the answer from 28 to 38. At this stage, S2 states the ability to associate symbols and signs with prior knowledge, students connect symbols and signs to solve problems, and students convert symbols and signs into other representations.

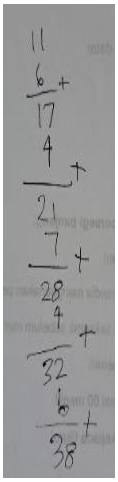


Figure 10. S2 proof of write

3.2.7 Stage 7 Looking Back (MK)

The results of S2's written answer at the lookback stage are shown in Figure 11.

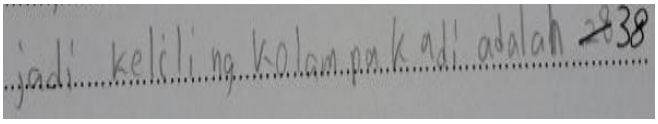


Figure 11. Written answer

S2 states the proof of mathematical argument to support the solution of the problem in the form of a conclusion marked by the correction of the answer from the number "28" to "38". At the stage of looking back, S2 uses an object in the form of a swimming pool owned by Mr. Adi. Overall, the problem-solving stage carried out by S2 is understanding the problem, devising a plan, carrying out the plan, understanding the problem, devising a plan, carrying out the plan, and looking back (UP-DP-CoP-UP-DP-CoP-LB).

3.3 Subject 3 (S3) (A Quitters type)

3.3.1 Stage 1 Understanding the Problem (UP)

S3 writes answers at the stage of understanding the problem like Figure 12.

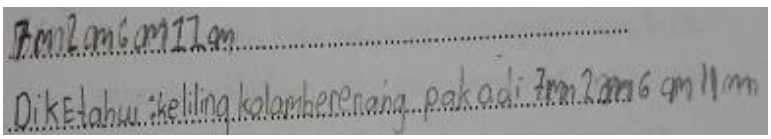


Figure 12. S3 write answer results at the understanding problem stage

Based on the results of the written answer above, it is known that S3 conveyed known information on the issue. In addition, S3 stated the oral answer from the interview about

the side size information to find around Mr. Adi's swimming pool. S3 also resizes into other representations at the time of understanding the following interview excerpt issue.

R : What information does S3 know about this issue?
S3 : Mr. Adi swimming pool size 7m, 2m, 6m, 11m

3.3.2 Stage 2 Devising a Plan (DP)

At the problem resolution plan stage, S3's written answer states the problem resolution plan as Figure 13.

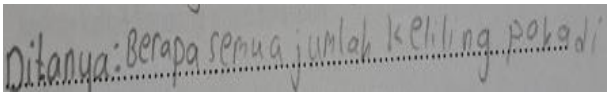


Figure 13. Troubleshooting Plan from S3 Write Answer

Then continued interviews, observations, and based on field notes. The results of the interview with S3 can be known from the following interview excerpts.

R : What is asked on this issue?
S3 : This problem asks "What is the circumference (pool) of Mr. Adi?"
R : how to solve it?
S3 : index finger S3 points to everything that states represent the meaning of the flat circumference concept as Figure 14.

Figure 14. S3 gesture at the problem resolution plan stage

3.3.3 Stage 3 Carrying out the Plan (CoP)

The S3 subject performs the problem-solving as explained from the results of the written answer in Figure 15.

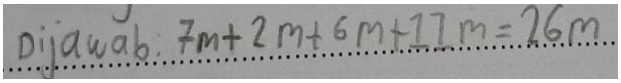


Figure 15. S3 write the answer when carrying out the plan

In general, the carrying out the planning stage by S3 uses written answers. S3 provides the ability to change the sign to another representation, connect with the symbol to solve problems, and the ability of S3 to associate the symbol with the knowledge it has before.

3.3.4 Stage 4 Looking Back (LB)

S3 performs the stage of looking back by verbally stating "how to find the circumference of the wake by summing the known side size 7m+2m+6m+11m". The results of oral answers are also reinforced by the S3 Gesture which explains the size of these sides. In addition, it is also supported by the written answer S3 states "So all the circumference of the swimming pool is 26 m" as shown in Figure 16.

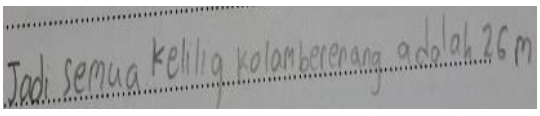


Figure 16. S3 spoken answers during the look back stage

The statement shows evidence of mathematical arguments to support the solution of the problem in the form of conclusions marked with the word "so" and the number "26

m". At this stage looking back, S3 uses an object in the form of Mr. Adi's swimming pool. Troubleshooting done by S3 starts with understanding the problem, solving the problem, executing the plan, and looking back. Overall, the problem-solving stage carried out by S3 is understanding the problem, devising a plan, carrying out the plan, and looking back (UP-DP-CoP-LB).

4. Discussion

4.1 The Quitters Subject

The pattern of problem-solving carried out by the quitters' subject is the UP-DP-CoP-LB pattern. These patterns have accommodated Polya's stages in problem-solving, namely understanding the problem, devising a plan, carrying the plan, and looking back (Adnan et al., 2019; Kaur, 2019). Although there is 1 pattern that is not done in order, each stage has emerged and begins with understanding the problem (Polya, 2004). Polya stages can be performed in different sequences (Kaur, 2019). The opinion conveyed by Polya (2004) is one of the bases that the second pattern is included in solving problems.

The stage of problem-solving involves four main steps, namely understanding the problem, planning, implementing the plan, and reviewing the steps that have been taken (Polya, 2004). In the first step, understanding the problem plays a major role as it will help students extract irrelevant information and be clearer about what is being requested. This step is followed by planning the next step. Furthermore, students need to find the right solution strategy, which can include formulas or plans of other methods. Planning followed by implementation, ratified with systematic steps, students are required to be careful with calculations and deal with long notes. Finally, students need to review what they are doing. The fourth step is to review and confirm if the solution is correct so that students can do both correctly and excellently. This problem-solving system allows students to learn. In adversity, quotient learning, this type of student is not used to learning in difficult conditions. Therefore, there is little possibility of a difference in the order of problem-solving in this type.

4.2 The Champers Subject

The pattern of problem-solving carried out by subject campers is the UP-DP-CoP-LB pattern. These patterns have accommodated Polya's stages in problem-solving, namely understanding the problem, devising a plan, carrying the plan, and looking back (Adnan et al., 2019; Kaur, 2019). Although there is 1 pattern that is not done in order, each stage has emerged and begins with understanding the problem (Polya, 2004). Polya stages can be performed in different sequences (Kaur, 2019). The opinion conveyed by Polya is one of the bases that the second pattern is included in solving problems according to Polya.

According to George Polya, the problem-solving stage consists of four main steps: understanding the problem, preparing a plan, implementing the plan, and reviewing and re-examining. In the first stage, understanding the problem is crucial to ensure that all the information and questions in the question are identified. Students need to explore what is known and what needs to be sought. Furthermore, in drawing up a plan, students must choose the right strategy, such as using relevant formulas or drawing diagrams, to direct them toward solutions. After that, the third step is to carry out the plan that has been prepared by following the steps systematically and carefully and making the necessary calculations.

The final stage, reviewing and re-checking, involves reviewing the results obtained to ensure their accuracy and checking whether the answers meet what is requested in the question. Conducting a review at each step and trying alternative approaches if necessary is essential to validate the results. In today's educational context, it is important to adapt Polya's methods to technological developments and digital resources that can help students, such as interactive learning apps and online platforms that offer practice questions as well as discussion forums. By integrating technology into this process, students can

more easily understand the problem-solving steps and improve their critical thinking skills in solving math problems.

4.3 The Climbers Subjects

The UP-DP-CoP-UP-DP-CoP-LB pattern was carried out by subjects with the climbers category. The Polya stage carried out by students begins with understanding the problem. Students perform the stages of understanding the problem characterized by: (1) knowing what is known and asked, (2) writing or explaining it in their language, (3) focusing on the most important part of the problem (Daulay & Ruhaimah, 2019; Maulyda et al., 2019; Polya, 2004). The problem-solving plan stage, is to see how problems are connected and how vagueness is connected with data to get ideas for making a problem-solving plan (Fitriani et al., 2022). Carrying out the problem-solving plan, is characterized by the realization of the settlement plan in the form of calculations. After the completion plan is made, the implementation of the plan is carried out as usual. The stage of looking back at solving the problem, is done by checking the results, interpreting the answers obtained, reviewing whether other ways can be used to get the same solution, and reviewing whether there are other solutions so that solving the problem is required not to be quickly satisfied from just one solving result, but needs to be studied with several solutions (Yayuk et al., 2024). This stage is characterized by: (1) re-examining the calculations that have been done, (2) making conclusions from the answers obtained, and (3) looking for or checking answers in other ways (Kaliky et al., 2019; Son et al., 2019). Polya completion steps are carried out in sequence and no stages are passed. According to Polya (2004), Stages can be carried out in different sequences. But all stages must be done well. Because if there are stages that are passed, it can affect the resolution of the problem.

The Polya stage has been carried out by all three research subjects who ultimately obtained 2 different patterns. The patterns produced by the subjects of quitters and campers were different from the patterns produced by the student patterns of the climbers category. By knowing the difference in this pattern, at least it can be known that AQ can be used to determine the size of a person's response when facing difficulties. In addition, AQ is a set of equipment that has a scientific basis to improve self-response to the difficulties encountered (Kahfi, 2020). The three categories of AQ can classify a person's resilience in the face of adversity, measure a person's ability to overcome any crisis, solve problems and achieve long-term success, estimate who gives up and who can persevere (Suryaningrum et al., 2020).

The UP-DP-CoP-UP-DP-CoP-LB pattern was carried out by subjects with climbers' categories and the UP-DP-CoP-LB pattern carried out by *quitters* and campers categories showed differences in the three categories. The quitter type is a subject who chooses to quit, leave, avoid obligations, or withdraw from the tasks assigned to him. The second type, camper, where someone who feels enough in his climb, then chooses to stop and camp even though he still has the opportunity to continue climbing. Last is the type of *climber*, which is someone who is classified as a climber. His lifetime of dedication regardless of his background, gain or loss, bad luck or good will be obtained (Ratna et al., 2020).

5. Conclusions

There are two problem-solving patterns of the three types of AQ. The UP-DP-CoP-UP-DP-CoP-LB pattern was carried out by subjects with climbers' categories and the UP-DP-CoP-LB pattern carried out by quitters and campers' categories showed differences in the three categories. The first pattern is understanding the problem, planning the problem-solving, executing the plan, and hindsight done by quitters and campers. The second pattern, namely understanding the problem, planning problem-solving, implementing the problem resolution plan, understanding the problem, planning problem-solving, implementing the problem-solving plan, and looking back is done by the category of climbers. In the first pattern, participants gave incorrect answers not because they had not carried out all stages of reasoning or Polya's semiotics. However, there is a wrong process when integrating at the implementation stage of the problem resolution plan. Therefore,

it is necessary to conduct further research on the quality of solving mathematical problems in all three categories.

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