

<https://doi.org/10.51574/kognitif.v6i1.3245>

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**How to cite:** Wijayani, T. R., Muzdalipah, I., & Setialesmana, D. (2026). Analysis of Students' Mathematical Representation Ability in Terms of Adversity Quotient. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 6(1), 338–355. <https://doi.org/10.51574/kognitif.v6i1.3245>

To link to this article: <https://doi.org/10.51574/kognitif.v6i1.3245>



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## Analysis of Students' Mathematical Representation Ability in Terms of Adversity Quotient

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### Article Info

#### Article history:

Received May 28, 2025

Accepted Feb 16, 2026

Published Online Mar 07, 2026

#### Keywords:

Adversity Quotient (AQ)  
Mathematical Representation Ability  
Climbers  
Campers  
Quitters

### ABSTRACT

This study aims to describe students' mathematical representation abilities in terms of Adversity Quotient (AQ). The study used a qualitative method with a descriptive approach. Four students of grade XI MIPA MA Serba Bakti were selected purposively based on the results of the AQ questionnaire to represent the categories of Climbers, Campers–Climbers, Campers, and Quitters–Campers. The research instruments were an AQ questionnaire, a mathematical representation ability test, and a validated interview. Data were analyzed using the Miles and Huberman model which includes data reduction, data presentation, and conclusion drawing. The results showed that the higher the AQ category, the more complete, detailed, and correct the mathematical representation produced. Conversely, the lower the AQ category, the mathematical representation tends to be incomplete, incoherent, or produce incorrect answers. This finding confirms the relationship between AQ and mathematical representation abilities. Theoretically, this study strengthens the study of the role of non-cognitive factors in mathematics learning, while pedagogically its implications encourage teachers to consider AQ factors in designing learning strategies.



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## Introduction

Mathematical representation capability is one of the process standards set by NCTM (2000) because it plays an important role in making it easier for students to connect abstract ideas with more concrete forms such as symbols, graphs, diagrams, or written text. Representations help students solve problems using various strategies and communicate mathematical ideas more clearly (Artiah & Untarti, 2017; Klara et al., 2021). In the learning process, the implementation of mathematics aims to encourage students to think logically, consistently and systematically, as well as hone their problem-solving skills (Sugiarti et al.,

2022). Therefore, mastery of mathematical representation skills is an important prerequisite to support conceptual understanding and problem-solving skills.

In practice, students' mathematical representation skills often face challenges. Students often struggle with translation between representations, such as converting story problems into mathematical models, presenting visuals, or reinterpreting solutions symbolically or verbally. This inability to move between representations can lead to procedural and conceptual errors in solving mathematical problems (Duval, 2006; Program & Pendidikan, 2024). This condition shows that mathematical representation ability is not just a supporting skill, but a fundamental competency that needs to be developed systematically in mathematics learning. Based on the results of interviews with mathematics teachers at MAS Serba Bakti, it was stated that students' mathematical representation skills were still lacking. This was indicated by the fact that some students were still unable to translate story problems into various mathematical forms. The results of the quiz on circle equations showed that students' mathematical representation skills were still low. Only 4 out of 27 students were able to meet the visual representation indicator, and only 3 students were able to solve symbolic representation problems on circle equations. In addition, many students tended to simply copy examples without trying other alternative solutions. The variety of student responses when facing difficulties, ranging from trying alone, discussing, to giving up, illustrates the differences in fighting spirit or Adversity Quotient (AQ). This shows that each student has the ability to face their own difficulties. The difference in student abilities is Adversity Quotient (AQ).

Obstacles to solving mathematical representation problems will encourage students to persevere in solving them. Students' activities in mathematical representation involve not only complex thought processes but also a strong sense of struggle in addressing a difficulty, which is categorized by their Adversity Quotient (AQ) (Sugiarti et al., 2022). Stoltz (2005) defines AQ as an individual's intelligence in facing difficulties and turning them into challenges to be overcome. Nuraeni et al. (2022) argues that Adversity Quotient (AQ) can not only predict a person's reaction in handling a difficult situation, AQ can also predict a person's strength and perseverance, increasing success in working with teams, relationships, families, communities, cultures, societies, and organizations. In solving problems, students not only need mathematical representation skills but also the ability to deal with a problem or difficulty.

Students in the Adversity Quotient (AQ) Climbers category demonstrated the most optimal mathematical representation skills compared to other categories. They were able to convert problems into relevant visual representations, construct accurate mathematical models, and explain the solution process using coherent and logical written descriptions. These findings align with research findings Husain et al. (2022) which revealed that students with high AQ tend to be able to utilize and coordinate various forms of representation in solving mathematical problems. This ability reflects mastery of multiple representations, as stated by Lesh, Thomas (1987) that deep mathematical understanding is characterized by the ability to use and relate visual, symbolic, and verbal representations flexibly. In the AQ Campers category, students have presented visual and symbolic representations, but the accuracy and completeness of the presentation are still limited, so the resulting representations do not fully help clarify the problem. This condition supports the view Goldin (2002) which states that the quality of representation significantly influences the fluency of mathematical reasoning and communication of ideas. Meanwhile, students in the AQ Quitters category are generally only able to write mathematical models without adequate visual representation and verbal explanation, resulting in incomplete solutions. This difference in patterns indicates that non-cognitive factors such as academic persistence and resilience also influence the quality of mathematical representation, as emphasized by Andrew (2006) that individuals with higher levels of academic resilience tend to demonstrate better engagement and consistency in

completing academic tasks. Based on this description, this study examines students' mathematical representation abilities in terms of Adversity Quotient (AQ) with the topic of circle equations at MAS Serba Bakti. Based on this gap, this study focuses on describing students' mathematical representation abilities, viewed from the AQ category, in the circle equation material at MAS Serba Bakti. This study is expected to provide theoretical contributions regarding the influence of non-cognitive factors on mathematical performance, as well as practical implications for teachers in designing learning strategies that consider the diversity of students' AQ.

## Method

### Types of research

This research uses a qualitative method with a descriptive approach. According to [Charismana et al., \(2022\)](#) Qualitative research is research that produces descriptive data in the form of written words from observed behavior. This approach was chosen because the research objective was to describe variations in students' mathematical representation abilities according to the Adversity Quotient (AQ) category in depth, not just measuring scores or frequencies. With a descriptive approach, researchers can describe phenomena in their entirety, identify behavioral patterns, and capture the meaning that emerges from students' test answers and interviews ([Creswell John W., 2014](#)). Based on the opinions that have been described, by using descriptive qualitative research methods, this study describes the mathematical representation ability of students in terms of Adversity Quotient (AQ) in the material of circle equations for class XI MA. The description in this study was carried out through direct observation of the results of the AQ questionnaire, solving mathematical representation ability test questions and interviews.

### Subject

The research subjects were selected by purposive sampling to represent different AQ categories: Climbers, Climbers–Campers, Campers, and Quitters–Campers. Of the 27 grade XI MIPA MA Serba Bakti students who participated in the AQ questionnaire and mathematical representation test, 4 students were selected who were willing to be research subjects, able to provide complete data through tests and interviews, and able to communicate verbally to explain their answers. The selection procedure was carried out through observation, short interviews and recommendations from mathematics teachers to ensure the subjects met the criteria for communication and readiness to participate. All subjects gave informed consent and the subjects' identities were kept confidential.

### Instruments

There are three types of research instruments used. The first is a modified Adversity Quotient (AQ) questionnaire based on theory [Stoltz \(2005\)](#) consisting of 40 statements. The questionnaire is used to group students' Adversity Quotient (AQ) categories. The questionnaire used was validated by lecturers from the Mathematics Education Study Program at Siliwangi University and psychologists to ensure the items matched the indicators, and its reliability was tested through a small-scale trial. The questionnaire questions were as follows.

**Table 1. Questionnaire Questions Adversity Quotient (AQ)**

No	Statement
<b>Control dimensions</b>	
1.	I stay calm when facing difficult math problems.
2.	I am confident that I can complete the math assignment even if it is complicated.
3.	I give up easily when I encounter difficulties in learning mathematics. (*)
4.	I believe that every math problem has a solution.
5.	I feel helpless when my math grades are bad. (*)
6.	I was able to control myself when one of my friends made fun of me.
7.	I get nervous when I speak in front of the class. (*)
8.	I prefer to think rationally (reasonably) when I have disagreements with friends.
9.	I don't like it when people point out my mistakes. (*)
10.	I'm lazy to study because I get bad grades. (*)
<b>Origin &amp; Ownership Dimensions</b>	
11.	I study hard to improve my low grades.
12.	I find it hard to forgive people who have disappointed me. (*)
13.	Difficult subjects aren't a significant obstacle for me to follow.
14.	I skipped class because I didn't like the teacher. (*)
15.	I disliked certain subjects because I didn't like the teacher. (*)
16.	I recognized my mistakes when I failed a math assessment.
17.	I accepted criticism from friends about my math learning style.
18.	I blamed others when I got a bad math grade. (*)
19.	I took responsibility for my math learning outcomes.
20.	I made excuses when I couldn't do math homework. (*)
<b>Reach Dimensions</b>	
21.	I can accept any risks that befall me.
22.	If I have a problem with someone, I will keep my distance. (*)
23.	My failure to represent the school makes me study harder.
24.	I can't make the right decisions when I'm having problems. (*)
25.	I don't like going to school because certain subjects don't interest me. (*)
26.	Failing in math doesn't affect my enthusiasm for learning.
27.	Difficulties in math make me lazy about studying other subjects. (*)
28.	I stay focused on studying even when I have problems outside of academics.
29.	Failing in one math topic makes me pessimistic about other subjects. (*)
30.	I can separate personal problems from academic tasks.
<b>Endurance Dimensions</b>	
31.	I believe that my math difficulties are only temporary.
32.	I keep trying different ways to solve math problems.
33.	I feel like my math difficulties will continue. (*)
34.	I get bored easily when I have to practice math problems over and over again. (*)
35.	I stay motivated even after failing math tests repeatedly.
36.	I am able to persevere in difficult situations.
37.	It takes me a long time to forgive people who have hurt me. (*)
38.	I complain about the difficult assignments my teachers give me. (*)
39.	Even though I'm tired, I still do my homework after school.
40.	I become moody when no one wants to be my friend. (*)

Information: (\*) = Negative Statements

Second, the mathematical representation ability test consists of a single descriptive problem on the topic of circle equations. This instrument has been validated by mathematics education lecturers through content validity and indicator suitability. The Mathematical Representation Ability Test used is as follows.

**Table 2. Mathematical Representation Ability Test Questions**

Basic Competencies	Indicators of Competence Achievement	Indicators KRM	Question
Solve problems related to circle equations.	1) Create a picture to clarify the problem and use it to solve the problem. 2) Create equations or mathematical models from given representations and solve problems involving mathematical expressions. 3) Write steps to solve the problem and make conclusions using words or written text.	1) Visual representation. 2) Symbolic representation. 3) Verbal representation.	Mount Merapi is one of the volcanoes that is still active and frequently erupts. The impact of the eruptions that occur often causes earthquake shocks with varying magnitudes. When viewed from a satellite, it can be seen that the radius of the earthquake's reach is quite wide, so seismologists map the affected area into Cartesian coordinates at the point (x, y). Andapraja Village felt the earthquake vibrations at coordinates (-1, 2). 15 minutes later, Buanamekar Village and Cikupa Village also felt the earthquake vibrations. Buanamekar Village is 8 units to the right and 4 units down from Andapraja Village, while Cikupa Village is 1 unit to the right and 7 units up from Buanamekar Village in the Cartesian diagram. From the data, where are the coordinates of Buanamekar Village and Cikupa Village, and determine the equation of the circle formed?

Third, semi-structured interviews were used to gain more in-depth information about students' thought processes in solving problems. Interviews were conducted using a standardized question guide, then recorded and fully transcribed for analysis. The interview guide used is as follows.

**Table 3. Interview Questions**

No.	Interview Questions
1	What information can be obtained from this question?
2	What was the first step you took to solve this problem?
3	Are you sure that to solve this problem you need the general form of the equation of a circle?
4	What steps did you take to solve this problem?
5	Are you sure about the answer to this question?

To ensure the validity of the data obtained from the three instruments, the validity of the instruments in this study was carefully considered. The Adversity Quotient (AQ) questionnaire and the mathematical representation ability test underwent content validity testing through expert judgment, namely a Mathematics Education lecturer at Siliwangi University and a psychologist. This content validity testing approach ensures that the instruments truly represent

the abilities being measured. The test conducted in this study was the content validity index, so that the instrument was declared content-appropriate before being used (Rahman et al., 2024). By fulfilling the validity and reliability aspects of the instrument, this research is expected to produce accurate data that can be scientifically accounted for.

### Data Collection

Distribution of Adversity Quotient (AQ) questionnaires, mathematical representation ability test results, and interviews. The activities in this study began with providing Adversity Quotient (AQ) questionnaire instruments to students. After the results of the questionnaire were obtained, students were categorized into Adversity Quotient (AQ) categories including climbers, campers-climbers, campers, quitters-campers, or quitters. Next, students received and worked on mathematical representation ability questions. The results of students' mathematical representation ability work were analyzed for each category, and interviews were conducted to further explain the results of the work on the questions.

### Data Analysis

This research uses qualitative data analysis techniques. Data analysis is the process of processing and organizing data in a structured manner obtained from field notes, interview results, and documentation (Soegiyono, 2015). This stage includes grouping data into specific categories, breaking data into more specific units, synthesizing, identifying patterns, determining relevant information, and drawing conclusions so that the results obtained can be clearly understood by the researcher and the reader. The data obtained in this study include answer sheets, an Adversity Quotient (AQ) questionnaire, and interview results. The answer sheets and interviews were used to identify students' mathematical representation abilities, while the Adversity Quotient (AQ) questionnaire was used to identify the Adversity Quotient (AQ) possessed by students (Soegiyono, 2015).

### Research Findings and Discussion

Based on the results of the Adversity Quotient (AQ) questionnaire filled out by 27 students, the data obtained for class XI MIPA Serba Bakti students is shown in the following Table 4.

**Table 4. Adversity Quotient (AQ) Questionnaire Results**

Category	Many Students
<b>Adversity Quotient (AQ)</b>	
<i>Climbers</i>	1
<i>Campers-Climbers</i>	15
<i>Campers</i>	9
<i>Quitters-Campers</i>	2

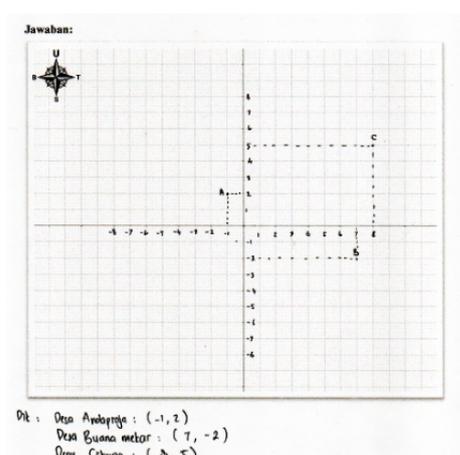
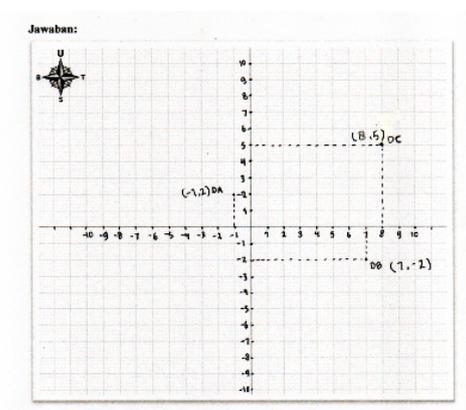
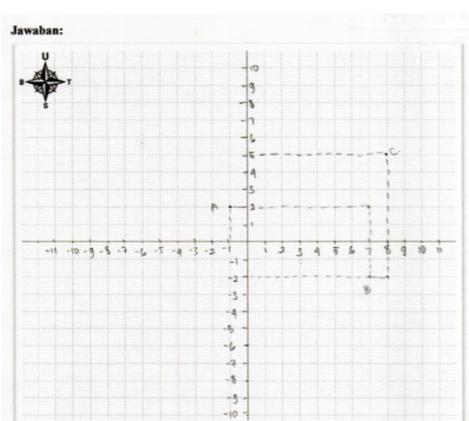
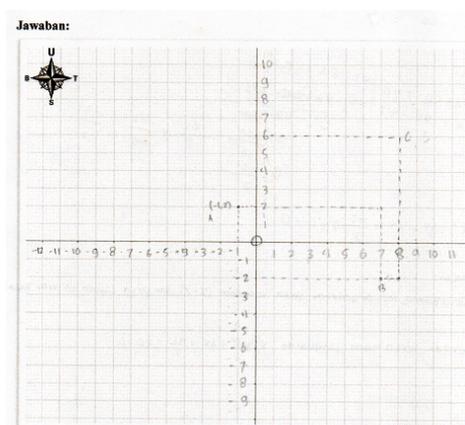
Subjects were selected purposively, based on the results of the Adversity Quotient (AQ) questionnaire and on subjects who had completed the mathematical representation ability test. Subjects were also able to provide clear and complete information through direct interviews. Based on the analysis of mathematical representation ability and the results of the AQ questionnaire, the following subjects were obtained.

**Table 5. Research Subjects**

No.	Subject	Category
1	S-14	<i>Climbers</i>
2	S-8	<i>Campers-Climbers</i>
3	S-7	<i>Campers</i>
4	S-9	<i>Quitters-Campers</i>

### Description of Students' Mathematical Representation Ability Reviewed from the Adversity Quotient on the Visual Representation Indicator

In the visual representation indicator, the subject drew Cartesian coordinates to determine the coordinate points of Andapraja Village, Buanamekar Village, and Cikupa Village. More detailed and clear information regarding the subject's work results is as follows.

**Figure 1. S-14 worksheet****Figure 2. S-8 worksheet****Figure 3. S-7 worksheet****Figure 4. S-9 worksheet**

The results of the study showed differences in visual representation abilities between AQ categories. Subjects in the Climbers category were able to present a picture of the village location with a proportional sketch and clearly provide coordinates. This representation demonstrates the connection between conceptual understanding and visual representation, as

emphasized by [NCTM \(2000\)](#) that visual representation plays an important role in connecting abstract ideas with concrete objects. This finding is in line with the results of research [Nuraini et al. \(2024\)](#) which shows that students with good visual representation skills are able to describe geometric relations in problems accurately, while students with low abilities have difficulty presenting accurate visual representations.

Subjects in the Campers-Climbers category were also able to produce relevant images, even though the coordinates were only written in the form of village initials. While calculation errors occurred, the subjects demonstrated initiative in checking and correcting the errors, reflecting self-regulation and persistence. This is in accordance with the research findings [Rif & Imama \(2024\)](#) which states that variations in visualization difficulty impact the clarity of the presentation of graphic elements in solving mathematical problems. Meanwhile, Campers were able to create drawings with coordinates in the form of village initials, but the final results did not support the correct answer. For Quitters–Campers, visual representations tended to be imprecise and could not accurately depict the problem. This condition is supported by the findings [Heng \(2024\)](#) which shows that less effective visual representations are often related to poor conceptual understanding of a problem and errors in interpreting visual data.

The results of interviews with subjects in the Climbers category stated that the subjects could represent questions into visual representations based on instructions obtained from analyzing the questions.

- P* : Why did you draw this diagram so confidently??  
*S-14* : So that I can see the location of each village so that I can determine the coordinates of villages B and C.  
*P* : Are the coordinate points you specified correct?  
*S-14* : That's because the picture I made is the clues in the question, miss  
*P* : What clues did you find?  
*S-14* : Andapraja Village is located at point  $(-2,1)$ , Buana Mekar Village is shifted 8 km to the east or to the right and 4 km to the south or downward from Andapraja Village, so the point is at  $(7,-2)$ , and Cikupa Village is 1 km to the east or to the right and 7 km to the north or upward from Buanamekar Village, so it is at  $(8,5)$ .

By creating, comparing, and using mathematical representation skills, students can improve and deepen their understanding of a concept and the relationships between concepts or understanding experiences that they already have ([Mataheru, 2024](#)). These findings suggest that the quality of visual representations correlates with AQ levels. Subjects with higher AQ tend to produce more complete, thorough, and reflective representations. This can be explained through metacognitive aspects, where students with high striving power or subjects with AQ Climbers are better able to monitor and evaluate their work. Students with low AQ tend to stop at partial representations. Thus, teachers need to design adaptive learning strategies that integrate gradual visualization exercises and provide specific scaffolding for students with low AQ, so that their representation skills can develop more optimally.

### **Description of Students' Mathematical Representation Ability Reviewed from the Adversity Quotient on the Symbolic Representation Indicator**

In the symbolic representation indicator, the subject can create mathematical equations by reanalyzing the problems and images they have created. More detailed and clear information regarding the subject's work results is as follows.

\* Desa Andoprojo : substitusi ke bentuk umum  
 Titik (-1, 2)  
 $x^2 + y^2 + Ax + By + C = 0$   
 $(-1)^2 + (2)^2 + A \cdot (-1) + B \cdot 2 + C = 0$   
 $1 + 4 + (-A) + 2B + C = 0$   
 $5 - A + 2B + C = 0$   
 $-A + 2B + C = -5 \rightarrow \text{persamaan 1}$

---  
 \* Desa ... : substitusi ke bentuk umum  
 Titik (8, 5)  
 $x^2 + y^2 + Ax + By + C = 0$   
 $(8)^2 + (5)^2 + A \cdot 8 + B \cdot 5 + C = 0$   
 $64 + 25 + 8A + 5B + C = 0$   
 $89 + 8A + 5B + C = 0$   
 $8A + 5B + C = -89 \rightarrow \text{persamaan 3}$

Figure 5. S-14 worksheet

Based on the answers and interviews, S-14 was able to create mathematical equations and use mathematical symbols to solve them. The subject provided explanations for each equation, making the answers clearer and more structured.

\* Substitusi :

$$x^2 + y^2 + Ax + By + C = 0$$

1.  $(-1)^2 + 2^2 + A(-1) + B(2) + C = 0$   
 $= 1 + 4 + -1A + 2B + C = 0$   
 $= 5 + -A + 2B + C = 0$   
 $= \underline{-A + 2B + C = -5}$

2.  $7^2 + (-2)^2 + A(7) + B(-2) + C = 0$   
 $= 49 + 4 + 7A + -2B + C = 0$   
 $= 53 + 7A + -2B + C = 0$   
 $\underline{7A + -2B + C = -53}$

3.  $8^2 + 5^2 + A(8) + B(5) + C = 0$   
 $= 64 + 25 + 8A + 5B + C = 0$   
 $= 89 + 8A + 5B + C = 0$   
 $= \underline{8A + 5B + C = -89}$

Figure 6. S-8 worksheet

Based on the results of the S-8 answers, you are able to create mathematical equations and involve mathematical symbols in solving them.

Dik:  $A(1,2)$   $B(2,-2)$   $C(8,5)$

$$(x-a)^2 + (y-b)^2 = r^2$$

$$P^2 + 2Pq + q^2$$

$$(x^2 - 2ax + a^2) + (y^2 - 2by + b^2) = r^2$$

$$x^2 + y^2 - \frac{2ax}{A} - \frac{2by}{B} + \frac{a^2 + b^2}{C} = r^2 = 0$$

Substitusi

Orto A

$$x^2 + y^2 + Ax + By + C = 0$$

$$-1^2 + 2^2 + A(-1) + B(2) + C = 0$$

$$1 + 4 - 1A + 2B + C = 0$$

$$5 - A + 2B + C = 0$$

$$-A + 2B + C = -5$$

Detero B

$$x^2 + y^2 + Ax + By + C = 0$$

$$7^2 + (-2)^2 + A(7) + B(-2) + C = 0$$

$$49 + 4 + 7A - 2B + C = 0$$

$$53 + 7A - 2B + C = 0$$

$$7A - 2B + C = -53$$

Detero C

$$x^2 + y^2 + Ax + By + C = 0$$

$$8^2 + 5^2 + A(8) + B(5) + C = 0$$

$$64 + 25 + 8A + 5B + C = 0$$

$$89 + 8A + 5B + C = 0$$

$$8A + 5B + C = -89$$

Eliminasi "C"

$$-A + 2B + C = -5$$

$$7A - 2B + C = -53$$

$$\hline 8A + B = 48$$

Figure 7. S-7 worksheet

Based on the results of the answers and interviews, S-7 was able to create mathematical equations and use mathematical symbols in solving them.

Dik:  $A(-1,2)$   $B(2,-2)$   $C(8,6)$

$$(x-a)^2 + (y-b)^2 = r^2$$

$$P^2 + 2Pq + q^2$$

$$(x^2 - 2ax + a^2) + (y^2 - 2by + b^2) = r^2$$

$$x^2 + y^2 - 2ax - 2by + a^2 + b^2 - r^2 = 0$$

(A)  $x^2 + y^2 + Ax + By + C = 0$

$$-1^2 + 2^2 + A(-1) + B(2) + C = 0$$

$$1 + 4 - 1A + 2B + C = 0$$

$$5 - A + 2B + C = 0$$

$$-A + 2B + C = -5$$

(B)  $x^2 + y^2 + Ax + By + C = 0$

$$7^2 + (-2)^2 + A(7) + B(-2) + C = 0$$

$$49 + 4 + 7A - 2B + C = 0$$

$$53 + 7A - 2B + C = 0$$

$$7A - 2B + C = -53$$

(C)  $x^2 + y^2 + Ax + By + C = 0$

$$8^2 + 6^2 + A(8) + B(6) + C = 0$$

$$64 + 36 + 8A + 6B + C = 0$$

$$100 + 8A + 6B + C = 0$$

$$8A + 6B + C = -100$$

Eliminasi "C"

$$-A + 2B + C = -5$$

$$7A - 2B + C = -53$$

$$\hline 8A + 6B = -48$$

Figure 8. S-9 worksheet

Based on the results of the answers and interviews, S-9 can create mathematical equations and involve mathematical symbols in solving them. The results of the interview with the Campers-Climbers category stated that the subjects were able to represent the questions in symbolic representations. The subjects interpreted the coordinate points of each village into equations formed through the general form of the equation of a circle. In addition, the subjects reflected the Campers-Climbers character who tried to make the answers look systematic by giving several marks on parts of the equation so that it gave the impression that these were important parts that needed to be remembered.

- P : After identifying the three village points, what's the next step?
- S-8 : Solve the equation of a circle centered at  $a, b$ .
- P : What results did you get after solving this equation?
- S-8 : General form of the circle equation
- P : After identifying the general form of the circle equation, what did you do?
- S-8 : Continue working on the problem by substituting the points for each village.

Analysis of the symbolic representation indicator revealed differences in solution quality across Adversity Quotient (AQ) categories. Students in the Climbers category displayed the most comprehensive abilities, demonstrated by their correct use of mathematical symbols and the construction of equations accompanied by clear explanations for each solution step. Students in the Campers-Climbers category were also able to write equations correctly, but

their explanations were shorter. In the Campers category, symbolic representations were present, but the minimal explanations made the answer structure less systematic. Meanwhile, students in the Quitters–Campers category only wrote some symbols without supporting explanations, resulting in incomplete solutions. This pattern indicates that the higher the AQ, the more consistent the use of symbols and the regularity in writing the solution steps. This finding aligns with research on mathematical representation profiles, which shows that students with higher levels of symbolic skills are able to produce more complete and accurate symbolic representations (Andriani & Fauziyah, 2024; Atikasuri, A., & Kusari, 2024; Marina & Susanti, 2025). In addition, previous research also found that symbolic skills play an important role in translating the context of problems into mathematical form and are often related to non-cognitive variables such as anxiety or students' cognitive strategies (Andriani & Fauziyah, 2024; Kusgiarohmah & Rahardjo, 2022). These results support this view NCTM (2000) that symbolic representation plays an important role as a means of communicating mathematical ideas. Thus, it can be concluded that the fighting spirit and perseverance inherent in students with high AQa contribute to the quality of symbolic representation, while students with low AQa require further guidance, for example through mathematical modeling exercises that emphasize the consistency of symbols and clarity of argumentation.

### Description of Students' Mathematical Representation Ability Reviewed from the Adversity Quotient on the Verbal Representation Indicator

In the third indicator, the subject's verbal representation can clearly and detailedly write down the steps for solving the problem. The subject also provides a conclusion that accurately aligns with the question. More detailed and clear information regarding the subject's work results is as follows.

- Eliminasi persamaan 1 dan persamaan 2  

$$\begin{array}{r} -A + 2B + C = -5 \\ 7A - 2B + C = -53 \\ \hline -8A + 4B = 48 \quad :4 \\ \hline -2A + B = 12 \end{array}$$
 - Eliminasi persamaan 2 dan persamaan 3  

$$\begin{array}{r} 7A - 2B + C = -53 \\ 8A + 5B + C = -89 \\ \hline -A - 7B = 36 \end{array}$$
 - Substitusikan nilai A dan B ke persamaan 1  

$$\begin{array}{r} -A + 2B + C = -5 \\ -(-8) + 2(-4) + C = -5 \\ 8 + (-8) + C = -5 \\ 8 - 8 + C = -5 \\ C = -5 \end{array}$$
 - Substitusikan ke Bentuk Umum  

$$\begin{array}{r} x^2 + y^2 + (-8x) + (-4y) + (-5) = 0 \\ x^2 + y^2 - 8x - 4y - 5 = 0 \end{array}$$
 Jadi titik B ada di 7, -2 dan C di 8,5 dengan p. lingkaran

Eliminasi persamaan 4 dan 5  

$$\begin{array}{r} -2A + B = 12 \\ -A - 7B = 36 \\ \hline -A + 8B = -24 \end{array}$$
 Eliminasi persamaan 4 dan 5  

$$\begin{array}{r} -2A + B = 12 \quad | \times 1 | \quad -2A + B = 12 \\ -A - 7B = 36 \quad | \times 2 | \quad -2A - 14B = 72 \\ \hline 15B = -60 \\ B = \frac{-60}{15} \\ B = -4 \end{array}$$
 Substitusikan ke persamaan 4  

$$\begin{array}{r} -2A + B = 12 \\ -2A + (-4) = 12 \\ -2A - 4 = 12 \\ -2A = 12 + 4 \\ -2A = 16 \\ A = \frac{16}{-2} = -8 \end{array}$$

Figure 9. S-14 worksheet

Based on the results of the answers and interviews, S-14 is able to write down the steps for solving problems and conclusions using words and can provide answers with confidence and self-assurance.



Based on the answers and interviews with S-7, it appears that the subject was able to write down the steps for solving the problem and the conclusion using words. The subject was also able to complete the problem with some satisfaction, despite feeling uncertain about the final answer, which turned out to be incorrect.

Figure 12. S-9 worksheet

Based on the answers and interviews with S-9, it appears that the subject was able to write down the steps to solve the problem, but they were incomplete because the A and C values were not fully determined. The conclusion written by the subject was in accordance with the question in the problem, but the answer was incorrect and incomplete. The subject was able to demonstrate an effort to solve the problem, although he stopped when he encountered difficulties in calculating fractions. This also indicates that the subject easily gave up and despaired when faced with difficulties.

- P : Are you sure about the answer?  
 S-7 : No, miss, but that's it.  
 P : Why?  
 S-7 : I'm already confused, ma'am, calculating so many fractions.  
 P : Have you double-checked the answer?  
 S-7 : No, ma'am, that's it.  
 P : If there's a difficult math problem, will you work on it until you get the answer, do it to the best of your ability, or won't you work on it at all?  
 S-7 : I'll work on it to the best of my ability. If I'm stuck, I won't continue. I'll just do what I can.

The results of the study on verbal representation indicators indicate differences in quality between Adversity Quotient (AQ) categories. Climbers (S-14) were able to write down the solution steps in a coherent manner using clear written language and confidently convey their conclusions. Campers (S-7) also wrote down the solution steps and provided conclusions, but showed doubts about the final result; this was reflected in errors in their final answers, even though their procedures were largely correct. Quitters–Campers (S-9) only wrote down partial steps and did not complete the search for important values (A and C), resulting in incomplete and incorrect conclusions. These subjects appeared to give up easily when faced with difficulties, particularly in calculating fractions, indicating low persistence in solving problems. Cross-category analysis indicates that students with high AQ were able to develop more systematic and confident verbal representations, while students with low AQ tended to write incomplete or incorrect answers due to a lack of self-regulation in the face of difficulties. These findings are in line with NCTM (2000) which emphasizes verbal representation as an important means of communicating mathematical thinking processes. From a pedagogical perspective, teachers can help students with low AQ through scaffolding strategies, for example by

providing step-by-step guidance in writing solution procedures, so they become accustomed to constructing more complete and accurate verbal explanations.

Based on the analysis of the four research subjects, it can be concluded that there are differences in mathematical representation abilities based on visual, symbolic, and verbal indicators. Subjects in the Climbers category (S-14) demonstrated the most comprehensive, accurate, and systematic problem-solving abilities, both in terms of visualization, use of mathematical symbols, and in-depth verbal explanations. These results align with the findings of the previous study [Lina \(2024\)](#) This indicates that Climber students are able to utilize and maximize their mathematical representation skills to answer questions correctly. The answers presented also appear complex and well-structured. S-14 met all indicators of mathematical representation, namely visual, symbolic, and verbal. This finding aligns with the opinion of [Husain \(2022\)](#) that individuals with AQ Climbers strive to complete tasks correctly and completely. While completing tasks, the subjects demonstrate a calm demeanor, work independently, and do not give up easily. During interviews, the subjects are also confident and explain their answers in detail. Individuals with AQ Climbers tend to approach challenges calmly, persistently, and confidently ([Stoltz, 2005](#)).

The Campers–Climbers subject (S-8) began to take the initiative to keep trying when he made a mistake in his calculations. In accordance with the opinion [Stoltz \(2005\)](#), A person in this category begins to demonstrate the ability to take initiative in action, has a desire to understand and correct mistakes that occur, and begins to develop a sense of responsibility for the process being undertaken. Although self-confidence has begun to grow, at this stage, this belief is still not completely stable, so doubts sometimes arise. This condition is reinforced by the findings [Crede et al. \(2017\)](#) which explains that individuals with persistence who are in or are in the transition phase tend to demonstrate sustained effort and a willingness to correct mistakes, but their performance consistency is still influenced by their level of self-confidence and accuracy. This finding is supported by research [Septianingtyas \(2020\)](#) who found that students who were in the transitional category between climbers and campers were generally able to solve problems well, although in some cases there were still errors due to a lack of care.

The Campers (S-7) subjects in this study showed interesting results, technically able to solve problems even if they were incorrect. They also showed doubt and a lack of verification of their work. This finding aligns with the results of other studies [Lina \(2024\)](#) which shows that students at the AQ Camper level can solve the questions but with final answers that are not completely correct. Opinion [Stoltz \(2018\)](#) This explains that individuals with AQ in the Camper category do try to face challenges, but tend to stop when they feel satisfied with what they have achieved. In this study, although S-7 is classified as Camper, the subject has the ability to solve mathematical representation problems because, perhaps the problems given are still at a level of difficulty that the subject can overcome. Thus, it can be concluded that the subject can answer mathematical representation ability questions by fulfilling the three indicators, however, errors were found in working on the questions so that, wrong answers, tend to feel doubtful about the answers and feel satisfied without rechecking the results of the answers. Camper students try to solve problems in the questions as best they can, resulting in errors when answering the problems ([Sugiarti et al., 2022](#)).

The Quitters–Campers (S-9) subjects showed weaknesses in almost all aspects, especially in visual accuracy and completeness of symbolic and verbal processes. This finding is in line with the opinion [Stoltz \(2005\)](#) This indicates that someone in the Quitters-Campers category has begun to show a desire to try, although they still tend to give up easily when faced with challenges. People with this character often haven't maximized their potential, so even small difficulties can cause them to lose motivation. Study by [Septianingtyas \(2020\)](#) also supports this finding, where students in the campers-quitters transition category tend to lack initiative in

finding solutions, and when they encounter difficulties, prefer to stop and move on to the next problem. The research results are also in line with this finding [Kaya & Karakoc \(2022\)](#) that low academic persistence is related to students' difficulty in maintaining effort on challenging math tasks, so they give up more quickly and avoid difficulties. In addition, other research supports that persistence in solving math problems can be improved through learning strategies that encourage students to try again after failure, but in Quitters–Campers this is still not consistently seen in the problem-solving process, ([Joseph et al., 2022](#)).

## Conclusion

The results of the study indicate that the Adversity Quotient (AQ) level is closely related to variations in students' mathematical representation abilities. Students in the Climbers category are able to fulfill all representation indicators (visual, symbolic, and verbal) coherently, completely, and convincingly. In the Campers–Climbers category, representation abilities are relatively good but still accompanied by minor errors that can be corrected through reflection. Campers students can display all three forms of representation, but are less consistent due to frequent doubts and calculation errors. Meanwhile, students in the Quitters–Campers category only show some representation indicators and tend to stop when facing difficulties, resulting in incomplete or incorrect answers. These findings reinforce the view that AQ is a crucial factor influencing the quality of mathematical representation. Theoretically, this study broadens our understanding of the role of striving power in supporting the mathematical representation framework. Practically, teachers need to design adaptive learning strategies that provide greater support for students with low AQ, for example through gradual practice, reflective feedback, and mentoring in developing systematic solutions. Thus, this study contributes to the development of representation theory while also providing concrete implications for improving the quality of mathematics learning.

## Conflict of Interest

The author declares no conflict of interest.

## Authors' Contributions

The first author, T.R.W., conceived the research idea presented and collected the data. I.M. and D.S. were the supervisors in this research who actively participated in the development of theory, methodology, organization and analysis of data, discussion of results, and approval of the final version of the work. All authors declare that the final version of this paper has been read and approved. The total percentage of contributions to the conceptualization, preparation, and correction of this paper are as follows: T.R.W.: 40%, I.M.: 30%, and D.S.: 30%.

## Data Availability Statement

The author declares that the data supporting the results of this study will be made available by the corresponding author, [T.R.W], upon reasonable request.

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