Linking Adversity Quotient to Reflective Thinking in Mathematics: A Qualitative Analysis of Student Problem-Solving Behavior

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Abstract. This study analyzes students' reflective thinking abilities in solving mathematical problems concerning their Adversity Quotient (AQ). Reflective thinking is essential for students to understand problems, explore solution strategies, and evaluate outcomes, while AQ reflects a student's resilience in facing challenges. This qualitative descriptive research involved three students representing each AQ category—climber, camper, and quitter—determined using the Adversity Response Profile (ARP) questionnaire. Data were collected through written tests and semi-structured interviews and then analyzed based on three reflective thinking indicators: reacting, comparing, and contemplating. The findings revealed that climber-type students fulfilled all reflective thinking indicators with minor errors, indicating high persistence and cognitive flexibility. Camper-type students showed moderate reflective thinking, partial fulfillment of indicators, and occasional errors. Quitter-type students demonstrated limited reflective thinking and struggled with problem-solving processes. These results highlight the influence of AQ on students' reflective thinking and suggest the need for instructional approaches that build resilience and metacognitive skills.

Keywords: reflective thinking, mathematical problem solving, adversity quotient, metacognition.

1 Introduction

Mathematics is not merely a subject to be learned but a tool for shaping one's thinking. Thinking critically and systematically is essential for understanding mathematical concepts[1]. Mathematics fosters a logical, structured, and precise mindset, fundamental for solving problems effectively[2]. People frequently encounter mathematical problems for which solutions are not immediately apparent[3], [4]. Solving such problems requires strong thinking skills for accurate and meaningful solutions. Decision-making, in particular, involves a sequence of cognitive processes, including idea generation, clarification, and evaluation[5], [6].

A study classifies thinking into four levels: essential thinking, critical thinking, reflective thinking, and creative thinking[7]. The latter three fall under the category of higher-order thinking skills, which emphasize reasoning and deep cognitive engagement[8], [9]. In 21st-

ACIE 2024, October 14-15, Jember, Indonesia

DOI 10.4108/eai.14-10-2024.2355561

century education, higher-order thinking skills are essential for preparing students to face complex real-life challenges[10], [11]. These skills enable learners to be more analytical, innovative, and responsive to multifaceted situations.

One such crucial higher-order thinking skill is reflective thinking. It plays a pivotal role in solving mathematical problems[12]. Reflective thinking develops during the problem-solving process and is not solely dependent on a student's prior knowledge but also on how that knowledge is utilized to formulate solutions[13]. When students can apply previously acquired knowledge to new problems, they demonstrate reflective thinking capabilities.

Students must be routinely engaged in solving contextual mathematical problems to enhance reflective thinking, such as story-based problems that simulate real-life situations. This approach not only trains students to solve practical problems but also deepens their understanding of the relevance of mathematics in everyday life. However, students often struggle to identify the appropriate mathematical concepts to apply when solving these problems[14], [15]. In addressing such difficulties, students exhibit varying responses depending on their internal resilience. This ability to persist and adapt in the face of challenges is called the Adversity Quotient (AQ).

AQ represents an individual's capacity to endure, process, and transform adversity into opportunities for growth and success[16], [17]. AQ becomes a critical factor in students' problem-solving persistence in mathematics learning. Stoltz introduced AQ as a complement to the more commonly known Intelligence Quotient (IQ) and Emotional Quotient (EQ), arguing that AQ is a better predictor of success in overcoming challenges[18], [19]. He categorizes individuals into three types based on AQ levels: Quitters, who tend to give up easily; Campers, who show some resilience but settle with minimal progress; and Climbers, who demonstrate high levels of perseverance and are consistently driven to achieve success despite obstacles[20], [21].

AQ can be assessed using the Adversity Response Profile (ARP), a standardized instrument designed to measure individuals' responses to adversity. Considering the important roles of both reflective thinking and AQ in mathematics learning, this study aims to explore the relationship between these two constructs. Specifically, this research investigates students' reflective thinking abilities in solving mathematical problems based on their Adversity Quotient levels. The findings of this study are expected to contribute to the development of more personalized and effective mathematics learning strategies by considering students' cognitive processes and resilience levels, thus supporting educators in fostering higher-order thinking skills in diverse learning environments.

2 Method

2.1 Research Design

This study adopted a qualitative descriptive approach to explore students' reflective thinking abilities in solving mathematical problems concerning their Adversity Quotient (AQ) levels. A qualitative design was deemed appropriate to gain in-depth insights into students' thought processes and problem-solving strategies based on their AQ profiles.

2.2 Participants

This study's subjects were ninth-grade students of a Junior High School in East Java, Indonesia, with a population of ninth-grade students in the odd semester of the 2024/2025 academic year. The research subjects were determined using a purposive sampling technique.

2.3 Instruments

Data were collected using three main instruments:

1. Adversity Quotient Questionnaire – to classify students into high, medium, or low AQ categories based on their responses.
2. Mathematical Problem-Solving Test – designed to assess students' reflective thinking abilities through structured problem-solving tasks.
3. Semi-structured interviews explored the students' reasoning processes, thought strategies, and reflections during and after solving mathematical problems.

2.4 Data Collection

The data collection process began with the administration of the AQ questionnaire to determine student categories. Students were then given mathematical problem-solving tasks relevant to their grade level. Following task completion, individual interviews were conducted to delve deeper into each student's reflective thinking process while solving the problems.

2.5 Data Analysis

The data were analyzed using the Miles and Huberman interactive model, which involves the following steps:

1. Data Reduction: Selecting, focusing, and simplifying data from the tests and interviews.
2. Data Display: Organizing the data systematically using matrices and descriptions for more straightforward interpretation.
3. Conclusion Drawing and Verification: Identify patterns and draw conclusions based on the reflective thinking indicators demonstrated by students with varying AQ levels.

3 Result

The research began with administering the Adversity Quotient test to 18 students. Based on the Adversity Quotient questionnaire test results, the researcher categorized the students according to their Adversity Quotient. The Adversity Quotient of students is presented in the following table:

Table 3.1 Adversity Quotient of Students

N.	Initials	Adversity Quotient Types
1	ARP	Camper
2	ADM	Quitter
3	AAM	Camper
4	ARP	Camper

5	DA	Camper
6	IF	Quitter
7	IH	Camper
8	KAR	Camper
9	KL	Quitter
10	LLK	Climber
11	MAI	Camper
12	MDNS	Quitter
13	MIA	Camper
14	MSR	Camper
15	MSA	Camper
16	MTD	Camper
17	MFA	Climber
18	MDA	Camper
Description		
Climber (High)		2
Camper (Medium)		12
Quitter (Low)		4

Based on these results, 3 subjects were selected, one each from the Adversity Quotient types of quitter, camper, and climber. The selection of subjects was based on recommendations from the mathematics teacher.

The selected subjects were then given a reflective thinking ability test and interviewed. After analyzing the reflective thinking ability test data and interviews, as well as data triangulation for each subject in terms of Adversity Quotient, the following data were obtained:

Table 3.2 Adversity Quotient Data of Class IX Students

Reflective Thinking Stages	**Subject Characteristics Based on Adversity Quotient**		
	Mdns (Quitter)	**Mtd (Camper)**	**Llk (Climber)**
Reacting	√	√	√
Comparing	-	√	√
Contemplating	-	√	√

Description:

√ : Qualified

\- : Unqualified

This study explores students' reflective thinking ability in solving mathematical problems, viewed from their Adversity Quotient (AQ) level: high, medium, and low. Based on data analysis, the students' responses were categorized into four indicators of reflective thinking: identifying problems, analyzing problems, formulating strategies, and drawing conclusions.

3.1 Students with High AQ

Students with high AQ demonstrated strong reflective thinking in all four indicators. They could identify the given problem, analyze it by breaking it down into smaller components, and choose appropriate mathematical concepts to apply. During interviews, these students showed persistence and adaptability, even when initially encountering difficulties. They reevaluated

their strategies and refined their approach to arrive at the correct solution. A high level of metacognition and resilience characterized their reflective thinking.

3.2 Students with Moderate AQ

Students with moderate AQ exhibited satisfactory reflective thinking. They could identify and analyze the problem, though occasionally needed guidance to clarify the concepts. While they could plan a problem-solving strategy, they were sometimes unsuccessful. Their interview reflections revealed a tendency to settle for partial solutions, especially under pressure. They demonstrated moderate perseverance and were able to learn from their errors, but their problem-solving process was less structured than that of high-AQ students.

3.3 Students with Low AQ

Students with low AQ struggled to engage in reflective thinking across most indicators. They often failed to identify the key problem or misapplied mathematical concepts correctly. Their approach lacked in-depth analysis, and they exhibited uncertainty when formulating strategies. During interviews, these students expressed frustration and a desire to abandon the problem when faced with obstacles. Their lack of confidence and low perseverance were evident, suggesting that their AQ level significantly influenced their limited reflective thinking.

4 Discussion

Based on the analysis of reflective thinking above, several findings related to the reflective thinking of subjects based on each type of Adversity Quotient based on the stages of reflective thinking from Surbeck, Han, and Moyer (1991)[22]. The findings are as follows:

4.1 Students' Reflective Thinking Ability in Solving Mathematical Problems Based on AQ Quitter Type (Low)

The analysis of students classified within the quitter category of the Adversity Quotient (AQ) framework reveals significant limitations in their reflective thinking abilities when solving mathematical problems. These students could only demonstrate competence in the initial stage of reflective thinking—reacting—which involves identifying and articulating known information from a problem. Although they could verbally explain what was known and asked during interviews, this skill did not extend meaningfully to more profound analytical or problem-solving capacities.

Specifically, the quitter-type subjects failed to fulfill the comparing indicator, which requires students to connect prior experiences or problems to the current task, draw relationships, and formulate mathematical models accordingly. Their inability to articulate and apply prior knowledge to new contexts indicates a lack of schema-building and transfer—critical components of reflective and higher-order thinking[23]. The difficulty translating problem comprehension into a coherent mathematical model suggests cognitive and motivational barriers, consistent with the literature on low-AQ individuals who tend to exhibit avoidance behaviors when faced with challenging tasks[24].

Further, these students could not engage in the contemplating stage, which involves solving problems correctly and drawing meaningful conclusions. Their confusion about where to begin and what strategies to apply suggests an absence of structured metacognitive strategies.

This finding aligns with previous studies that identify low-AQ learners as having minimal persistence and limited self-regulation[25], often leading to disengagement from the problem-solving process[26].

Overall, the reflective thinking profile of students in the quitter group is characterized by surface-level engagement, lack of strategic planning, and low resilience when encountering complex mathematical problems. That highlights the need for targeted instructional interventions to enhance cognitive skills and foster students' motivational and emotional resilience. Educators may consider incorporating explicit training in reflective thinking and metacognitive strategies, combined with growth mindset interventions, to support students with low AQ in becoming more confident and capable problem-solvers.

This finding is in line with the research conducted by Hidayah and Prayitno, which found that quitter subjects are only able to mention the information in the problem[27]. It is also in line with the research of Amalia and Manoy that the subject feels reluctant and easily breaks up working on a problem[28], so the quitter subject does not pass the contemplating stage.

4.2 Students' Reflective Thinking Ability in Solving Mathematical Problems Based on Adversity Quotient Type Camper (Medium)

The findings reveal that students categorized as camper-type Adversity Quotient demonstrate reflective thinking abilities across all three key indicators: reacting, comparing, and contemplating. However, the completeness and depth of their responses vary between written assessments and interview-based observations, indicating inconsistencies in cognitive articulation and metacognitive awareness.

On the reacting indicator, camper-type students generally can identify known and unknown elements of a problem, establish relationships between these elements, and assess the adequacy of the given information to proceed with problem-solving. Although the written responses did not explicitly mention what was being asked in the problem, this was compensated during the interview session, where students demonstrated a more complete understanding. This discrepancy suggests that camper-type students may possess the necessary reflective insight but may not consistently externalize it in writing—a finding supported by previous studies revealing the process of reflective thinking in students' problem-solving abilities from the perspective of adversity quotient [29].

For the comparing indicator, students could state their planned strategies in written form. However, during interviews, they displayed uncertainty when asked to recall or evaluate previously used strategies. This gap highlights a limitation in their metacognitive retrieval and strategy evaluation skills. The confusion observed might stem from shallow processing or a lack of rehearsal of prior problem-solving experiences. Nonetheless, the ability to articulate a new or intended strategy suggests that these students are capable of prospective planning, a critical component of reflective thinking, even if retrospective evaluation remains underdeveloped. This finding aligns with prior research noting that camper-type learners often exhibit potential but require support to deepen reflective practices[30].

In the final indicator, contemplating, camper-type students demonstrated the ability to apply correct methods and arrive at accurate solutions. Their ability to conclude and justify answers confirms the presence of procedural fluency and conceptual understanding. That suggests that

when scaffolded appropriately, camper-type students are capable of productive engagement in higher-order thinking[31]. However, they may still benefit from structured reflection tools to reinforce and consolidate their learning process.

In summary, students with camper-type AQ meet all criteria for reflective thinking, albeit with varying levels of precision and depth. Their performance suggests a transitional cognitive state: they are no longer passive recipients like quitter-types but have not fully reached the autonomous, strategic competence of climber-types. Targeted interventions—such as reflective journaling, think-aloud protocols, or peer dialogue—could further support these students in refining their reflective thinking and self-regulatory skills.

4.3 Students' Reflective Thinking Ability in Solving Mathematical Problems Based on Adversity Quotient Climber Type (High)

The analysis revealed that students categorized as climber-type in terms of Adversity Quotient (AQ) demonstrated a high level of reflective thinking ability when solving mathematical problems. They consistently met all three core indicators of reflective thinking as identified in this study: reacting, comparing, and contemplating. These findings align with previous research suggesting that individuals with high AQ exhibit more remarkable persistence, cognitive flexibility, and self-regulation when faced with complex tasks[26].

1. Reacting

Climber-type students completed the reacting phase, which involves recognizing what is known and unknown in the problem, identifying relationships between variables, and assessing the sufficiency of given information. Their written responses and interview data confirmed their ability to fulfill all sub-indicators in this category. This suggests that high-AQ students are not only aware of the problem structure but also possess the metacognitive awareness necessary to navigate the initial stages of problem-solving effectively.

2. Comparing

Although not elaborated as deeply in the summary, the comparing indicator evaluates alternative strategies and solutions. Climber-type students were able to demonstrate this skill, though the analysis notes minor imperfections. Nonetheless, their ability to minimize errors compared to camper-type students indicates a more strategic and reflective approach to solution evaluation.

3. Contemplating

In the contemplating stage, which requires drawing accurate conclusions and reflecting on the correctness and efficiency of the solution, climber-type students again showed strong performance. They employed appropriate strategies and could articulate their reasoning clearly in written work and during interviews. That is consistent with the notion that students with high AQ are likelier to persist in solving complicated problems and engage deeply in metacognitive reflection.

It is also in accordance with the results of Melliana Kurniawati's research in 2023 that climber students are also able to fulfill the indicators of reflective thinking ability, namely: 1. Reacting, 2. Comparing, and 3. Contemplating[32]. As for the reacting phase, namely, being able to mention what is known and what is asked and the relationship between what is known

and what is asked. In the comparing phase, students can explain the answer to the problem obtained, explain the method that is considered effective to answer the problem obtained and connect the problem asked with the problem at hand. In the contemplating phase, students can determine the meaning of the problem, detect answer errors, and conclude the answers produced[32].

The results of this study indicate a clear relationship between students' Adversity Quotient (AQ) levels and their reflective thinking abilities in solving mathematical problems. Students with higher AQ demonstrated more effective reflective thinking processes, including identifying problems accurately, critically analyzing components, developing appropriate strategies, and drawing logical conclusions. These findings reinforce the theoretical perspective that AQ predicts how individuals approach and respond to complex challenges[17], [33].

These findings have significant implications for mathematics education. Incorporating AQ in instructional planning can lead to more effective differentiation and support strategies. For example, educators can design problem-solving tasks that challenge students cognitively and nurture their perseverance and resilience. Embedding reflective prompts and encouraging peer discussion also enhance students' capacity to think reflectively and independently.

However, this study is not without limitations. The small sample size limits the generalizability of the findings. Future research with more diverse samples could provide a more comprehensive understanding of the interaction between AQ and reflective thinking. Additionally, longitudinal studies could explore whether AQ can be developed over time through specific instructional interventions.

5 Conclusion

This study explored students' reflective thinking processes in solving mathematical problems concerning their Adversity Quotient (AQ). The findings reveal that students with varying AQ levels—categorized as climbers, campers, and quitters—demonstrate distinct patterns of reflective thinking.

Climber-type students exhibited high levels of reflective thinking across all problem-solving stages, including understanding the problem, devising a plan, carrying out the plan, and evaluating the solution. Their resilience and persistence enabled them to analyze problems thoroughly, consider multiple strategies, and revise their solutions when necessary.

Camper-type students demonstrated moderate reflective thinking abilities. While they could understand problems and devise appropriate strategies, their reflection during the evaluation phase was often superficial. These students tended to follow procedures mechanically without deeply analyzing the correctness or efficiency of their solutions.

Quitter-type students showed limited reflective thinking. They often struggled to understand the problem and lacked perseverance in exploring alternative solutions. Their responses were generally incomplete and rarely engaged in meaningful self-assessment or revision.

These findings underscore the importance of fostering reflective thinking and adversity resilience in mathematics education. Teachers are encouraged to implement instructional

strategies that support metacognitive awareness and perseverance, particularly for students with lower AQ. Future research may consider expanding the participant pool and incorporating intervention-based studies to enhance the development of reflective thinking skills across AQ profiles.

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