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Critical Thinking Process Of Junior High School Students In Solving Social Arithmetic Problems Reviewed From Adversity Quotient

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Abstract

Critical thinking is an essential competency in mathematics learning because it enables students to analyze information, justify reasoning, and evaluate problem-solving processes. However, students demonstrate different critical thinking characteristics when solving mathematical problems, particularly when facing challenging situations. This study aimed to describe junior high school students' critical thinking processes in solving Social Arithmetic problems based on the FRISCO indicators in terms of their Adversity Quotient (AQ). This study employed a qualitative descriptive approach conducted at a public junior high school in Gresik Regency, Indonesia. Six participants were selected through purposive sampling, consisting of two students representing each AQ category, namely climber, camper, and quitter. Data were collected using the Adversity Response Profile (ARP) questionnaire, Social Arithmetic problem-solving tasks, and semi-structured interviews. The collected data were analyzed using the interactive model of Miles, Huberman, and Saldaña through data condensation, data display, and conclusion drawing, while the credibility of the findings was ensured through method triangulation. The findings revealed that climber students consistently fulfilled all FRISCO indicators throughout Polya's problem-solving stages by identifying relevant information, applying appropriate strategies, providing logical justification, drawing evidence-based conclusions, and evaluating their solutions. Camper students demonstrated adequate critical thinking but showed limitations in providing comprehensive reasoning and reflective evaluation. In contrast, quitter students experienced

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difficulties from the initial stages of problem solving, resulting in incomplete reasoning, inaccurate conclusions, and limited self-evaluation. These findings indicate that students' resilience, as reflected by their Adversity Quotient, influences the quality of their critical thinking processes in mathematical problem solving. Therefore, mathematics instruction should integrate cognitive and non-cognitive aspects to foster students' critical thinking and resilience when solving contextual mathematical problems.

Keywords: Adversity Quotient; critical thinking; FRISCO; Polya's problem-solving; Social Arithmetic

INTRODUCTION

Critical thinking is one of the essential competencies that students must develop in mathematics education in the twenty-first century. It enables students to analyze information, evaluate alternative solutions, draw logical conclusions, and reflect on the decisions they make. According to Ennis (1996), critical thinking is reasonable and reflective thinking focused on deciding what to believe or what action to take. In mathematics learning, critical thinking plays a fundamental role because students are expected not only to obtain correct answers but also to justify their reasoning, select appropriate solution strategies, and evaluate the validity of their problem-solving processes.

Despite its importance, Indonesian students' critical thinking skills remain relatively low. The results of the Programme for International Student Assessment (PISA) 2022 indicate that many Indonesian students still encounter difficulties in solving mathematical problems requiring reasoning, problem-solving, and the application of mathematical concepts to real-life situations (OECD, 2023). These findings suggest that mathematics instruction should place greater emphasis on developing higher-order thinking skills, particularly critical thinking. Students with limited critical thinking abilities tend to rely on memorized procedures rather than conceptual understanding, making them less capable of solving non-routine problems that require analysis, reasoning, and decision-making.

One mathematical topic that provides meaningful opportunities to develop critical thinking is Social Arithmetic. This topic is closely related to everyday economic activities, including buying and selling prices, profit and loss, discounts, taxes, gross weight, net weight, and tare. Solving social arithmetic problems requires more than computational skills; students must interpret contextual information, identify relevant data, select appropriate mathematical strategies, and

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justify each step of their solutions. However, based on the researcher's experience as a junior high school mathematics teacher, many students experience difficulties in understanding word problems, identifying relevant information, selecting suitable mathematical concepts, and organizing systematic solution procedures. Consequently, students frequently make errors in choosing solution strategies and drawing conclusions, indicating that their critical thinking processes have not yet developed optimally.

In this study, students' critical thinking processes are analyzed using the FRISCO framework proposed by Ennis (1996), which consists of Focus, Reason, Inference, Situation, Clarity, and Overview. These six indicators comprehensively describe how students focus on the problem, provide logical reasoning, draw conclusions, identify relevant information, explain their solution processes, and evaluate the accuracy of their answers. The analysis is integrated with Polya's four stages of problem solving—understanding the problem, devising a plan, carrying out the plan, and looking back. Combining the FRISCO framework with Polya's problem-solving stages provides a systematic approach for examining students' critical thinking processes throughout each stage of mathematical problem solving.

In addition to cognitive ability, students' critical thinking processes are influenced by non-cognitive factors, one of which is Adversity Quotient (AQ). Stoltz (2000) defines AQ as an individual's capacity to respond to, manage, and overcome difficulties. Based on this theory, individuals are classified into three categories: climbers, campers, and quitters. Students classified as *climbers* tend to persist in overcoming challenges and continue seeking solutions despite obstacles. *Campers* generally make efforts to solve problems but are easily satisfied once they reach a certain level of achievement. In contrast, *quitters* tend to avoid challenges and give up more readily when encountering difficulties (Suttrisno, et al. 2026). These differences in perseverance and resilience are expected to influence how students engage in critical thinking while solving mathematical problems.

Previous studies have reported that students' critical thinking skills in mathematics, particularly in providing logical reasoning, drawing conclusions, and evaluating solution processes, still require improvement. Other studies have also shown that students with higher levels of Adversity Quotient demonstrate greater perseverance and resilience when solving mathematical problems than those with lower AQ. Nevertheless, most previous research has examined critical thinking and Adversity Quotient as separate constructs. Studies that integrate the FRISCO critical thinking framework, Polya's problem-solving stages, and Adversity Quotient categories in the context of Social Arithmetic problem solving remain limited. Such integration is important because

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it provides a more comprehensive understanding of students' thinking processes when solving contextual mathematical problems.

Therefore, this study aims to describe junior high school students' critical thinking processes in solving Social Arithmetic problems based on the FRISCO indicators, viewed from the perspective of Adversity Quotient (AQ). The findings are expected to enrich the literature on students' critical thinking characteristics across different AQ categories and provide practical implications for mathematics teachers in designing learning activities that foster critical thinking while considering students' resilience in facing mathematical challenges.

RESEARCH METHODS

This study aimed to describe junior high school students' critical thinking processes in solving Social Arithmetic problems based on the FRISCO indicators in terms of their Adversity Quotient (AQ). The study employed a qualitative descriptive approach because it focused on exploring and describing students' critical thinking processes during mathematical problem solving.

The research was conducted during the second semester of the 2025/2026 academic year at a public junior high school in Gresik Regency, Indonesia. The research participants were selected using purposive sampling. Initially, all students completed the Adversity Response Profile (ARP) questionnaire developed by Stoltz (2000) to classify them into three AQ categories: climber, camper, and quitter. Based on the questionnaire results and the teacher's recommendations regarding students' communication abilities, six participants were selected, consisting of two students from each AQ category.

The research instruments included the researcher as the primary instrument, an Adversity Quotient questionnaire (ARP), a Social Arithmetic problem-solving test, and semi-structured interview guidelines. The ARP questionnaire was used to determine students' AQ categories. The problem-solving test was designed based on Polya's problem-solving stages, while the interview protocol was used to explore students' reasoning and clarify their written responses. All research instruments were validated by experts before being administered to the participants.

Data collection was carried out in four stages. First, students completed the ARP questionnaire to determine their AQ categories. Second, selected participants worked individually on the Social Arithmetic problem-solving tasks. Third, semi-structured interviews were conducted immediately after the written test to investigate students' thinking processes during problem solving. Finally, the written responses and interview transcripts were compiled as the primary data

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for analysis.

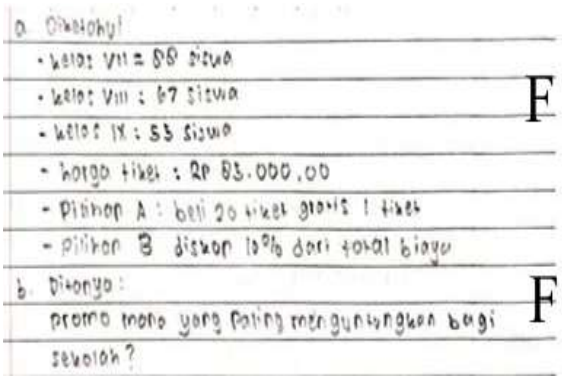
The collected data were analyzed using the interactive model proposed by Miles, Huberman, and Saldaña (2014), consisting of data condensation, data display, and conclusion drawing/verification. Students' critical thinking processes were analyzed according to the FRISCO indicators (Focus, Reason, Inference, Situation, Clarity, and Overview) integrated with Polya's four stages of problem solving, namely understanding the problem, devising a plan, carrying out the plan, and looking back. The analysis focused on identifying similarities and differences in the critical thinking characteristics of students across the three Adversity Quotient categories.

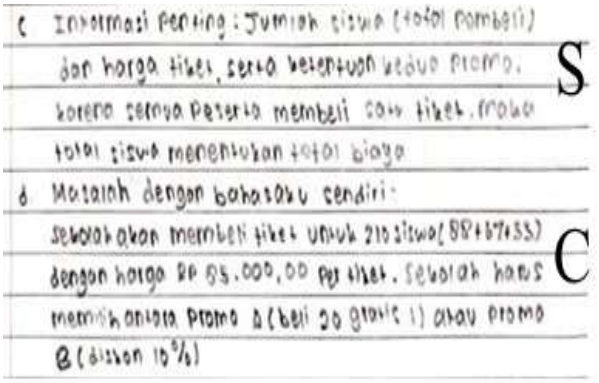
To ensure the trustworthiness of the findings, method triangulation was employed by comparing data obtained from students' written responses and interview results. The consistency of information from both data sources was used to verify the credibility of the findings and to obtain a comprehensive description of students' critical thinking processes.

RESEARCH RESULTS

Polya Stage	Climber	Camper	Quitter
Understanding the Problem	F ✓ S ✓ C ✓	F ✓ S ✓ C ✓	F ± S ± C -
Devising a Plan	R ✓ S ✓ C ✓	R ✓ S ✓ C ±	R ± S ± C -
Carrying Out the Plan	R ✓ I ✓ C ✓	R ✓ I ± C ✓	R - I - C -
Looking Back	O ✓ I ✓ R ✓	O ± I ✓ R ±	O - I - R -

Critical Thinking of Climber Students





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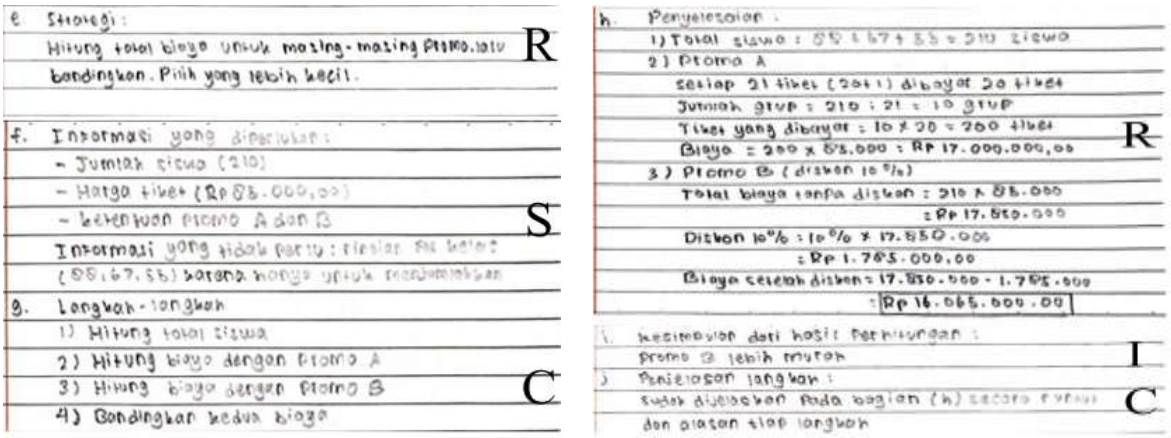


Figure 1. Written solution of Climber student in solving the Social Arithmetic problem.

The analysis of the written work showed that the climber student demonstrated a systematic problem-solving process throughout all stages of Polya's framework. At the stage of understanding the problem, the student correctly identified the known and required information and restated the contextual problem using his own words. During the planning stage, the student selected an appropriate mathematical strategy by relating the given information to the concept of profit and selling price. The solution procedure was implemented consistently, and all calculations were performed accurately. Finally, the student reviewed the obtained result and confirmed that the answer was consistent with the problem context.

These findings indicate that the climber student consistently fulfilled the Focus, Situation, Reason, Clarity, Inference, and Overview indicators. The student was able to focus on relevant information, justify the selected strategy logically, communicate each solution step coherently, formulate conclusions based on the obtained results, and evaluate the correctness of the final answer. The fulfillment of all FRISCO indicators suggests that the student's critical thinking process was comprehensive and well organized.

The interview data further strengthened the findings obtained from the written responses. The following excerpt illustrates the student's reasoning when selecting the solution strategy.

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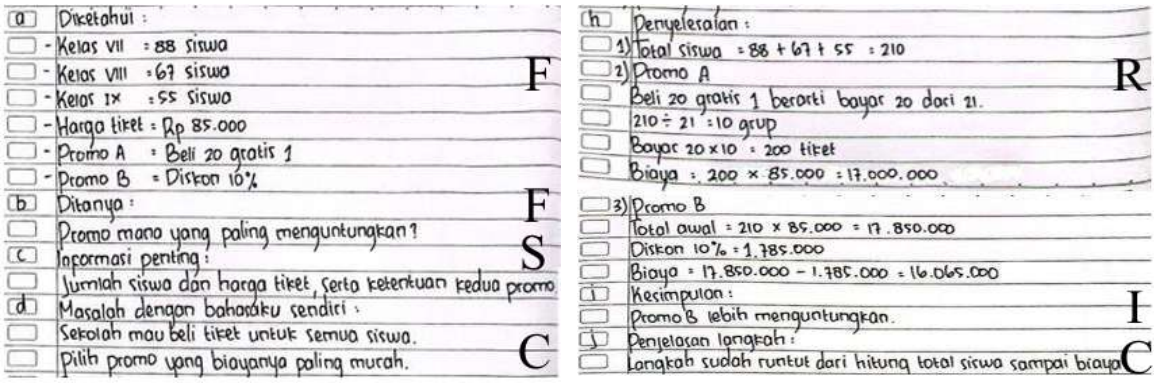
Table 1. Interview Transcript of Subject with AQ Climber

Interview Transcript
Researcher: *Why did you choose this method to solve the problem?*
Subject: *I first identified the information given in the problem and determined what was being asked. Then I calculated the profit before finding the selling price because I thought this was the most logical sequence. After obtaining the answer, I checked my calculations to make sure there were no mistakes.*

The interview excerpt demonstrates that the student consciously analyzed the problem before performing calculations and evaluated the final solution after completing the task. This behavior reflects the Reason and Overview indicators proposed by Ennis (1996), showing that the student did not rely solely on procedural calculations but also considered the appropriateness of the chosen strategy and the validity of the final answer.

These findings are consistent with Stoltz's (2000) theory, which states that individuals with the climber category possess high perseverance and resilience when facing challenges. Such characteristics enable students to persist throughout every stage of mathematical problem solving and to evaluate their own thinking processes. The findings also support Rahman (2023), who reported that students with high Adversity Quotient exhibit stronger mathematical persistence, allowing them to analyze problems more carefully, explore appropriate strategies, and verify the accuracy of their solutions. Therefore, the integration of the FRISCO indicators and Polya's problem-solving stages demonstrates that students with the climber category exhibit the most complete critical thinking profile among the three AQ categories.

Critical Thinking of Camper Students



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Figure 2. Written solution of Camper student in solving the Social Arithmetic problem.

The analysis of the camper student's written work indicated that the student was able to complete the problem-solving task by following most of Polya's problem-solving stages. During the problem understanding stage, the student correctly identified the known and required information. At the planning stage, the student selected an appropriate mathematical strategy and applied the relevant Social Arithmetic concepts. However, several solution steps were not explained in sufficient detail, and the student provided limited justification for the chosen procedures. Although the final answer was correct, the student did not thoroughly verify the accuracy of the calculations or evaluate the reasonableness of the obtained result.

These findings suggest that the camper student fulfilled the Focus, Situation, and Clarity indicators, while the Reason, Inference, and Overview indicators were only partially demonstrated. The student was capable of identifying relevant information and communicating the solution process; however, the logical justification for selecting a strategy and the evaluation of the final answer were not consistently evident. This indicates that the student's critical thinking process was adequate but lacked depth in reflective reasoning and self-evaluation.

The interview results further supported the analysis of the written responses. The following excerpt illustrates the student's reasoning during problem solving.

Table 2. Interview Transcript of Subject with AQ Camper

Interview Transcript
Researcher: *Did you check your answer after completing the calculation?*
Subject: *I looked at it once, but I did not calculate it again because I thought my answer was already correct.*

The interview excerpt indicates that the student tended to stop the problem-solving

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process after obtaining an answer without conducting a comprehensive verification. This behavior reflects only partial fulfillment of the Overview indicator and demonstrates limited reflective thinking. Furthermore, the student's explanation for selecting the solution strategy was relatively brief, suggesting that the Reason indicator had not been fully achieved.

These findings are consistent with Stoltz's (2000) description of camper individuals, who generally demonstrate persistence in solving problems but tend to stop once they reach a satisfactory result rather than striving for the best possible solution. Consequently, camper students are able to complete mathematical tasks successfully but often omit reflective evaluation and detailed justification of their reasoning. This finding also supports Ennis (1996), who emphasized that critical thinking requires not only obtaining a correct solution but also providing logical reasoning and evaluating the validity of the problem-solving process. Similarly, Rahman (2023) reported that students with moderate Adversity Quotient tend to demonstrate sufficient persistence to solve mathematical problems but exhibit less consistency in evaluating and refining their solutions compared with students in the climber category.

Critical Thinking of Quitter Students

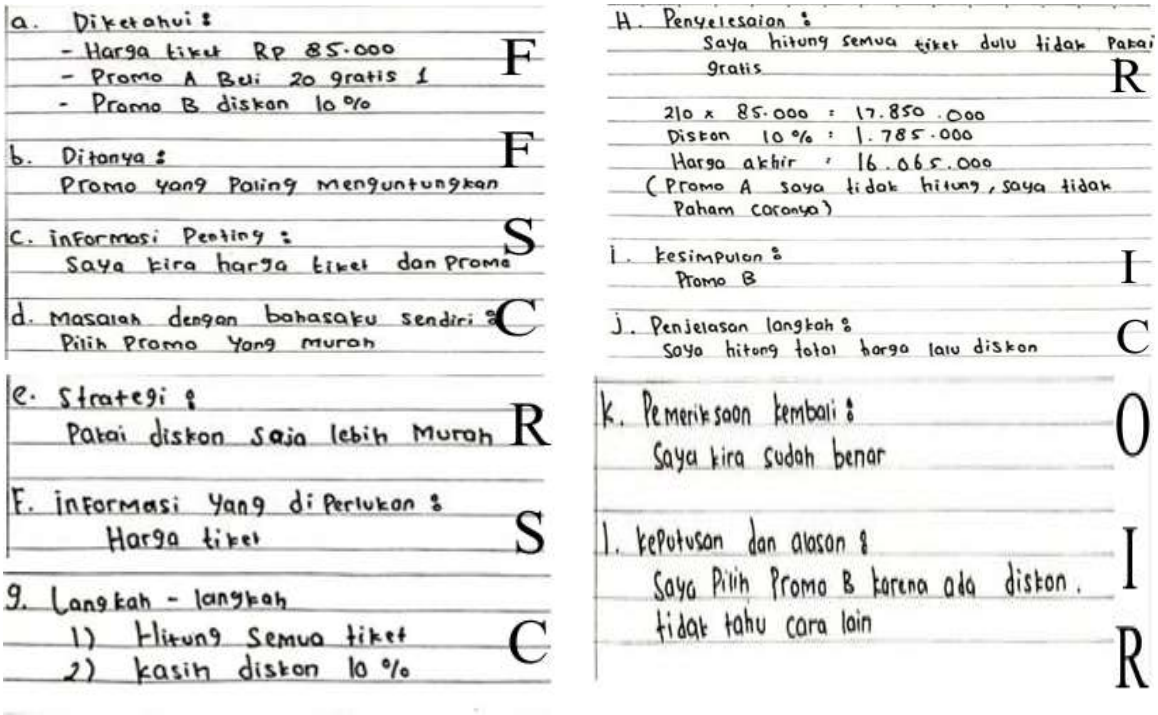


Figure 3. Written solution of Quitter student in solving the Social Arithmetic problem.

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The analysis of the quitter student's written work revealed substantial difficulties throughout the problem-solving process. At the stage of understanding the problem, the student identified only part of the given information and failed to clearly determine what was being asked. During the planning stage, the selected strategy was inappropriate because the student did not correctly relate the contextual information to the relevant Social Arithmetic concepts. As a result, several computational errors occurred during the implementation stage, leading to an incorrect conclusion. Furthermore, the student did not review the obtained answer or attempt to identify and correct the errors made during the solution process.

These findings indicate that the quitter student demonstrated only partial fulfillment of the Focus and Situation indicators, while the Reason, Clarity, Inference, and Overview indicators were largely absent. The student showed difficulty in providing logical justification for the selected strategy, explaining the solution process coherently, drawing conclusions based on mathematical evidence, and evaluating the correctness of the final answer. Consequently, the student's critical thinking process was fragmented and incomplete throughout Polya's problem-solving stages.

The interview data further confirmed the findings obtained from the written responses. The following excerpt illustrates the student's response when encountering difficulties during problem solving.

Table 3. Interview Transcript of Subject with AQ Quitter

Interview Transcript
Researcher: *Why did you stop working on the problem before checking your answer?*
Subject: *I was confused about which formula to use. After trying several times, I was not sure how to continue, so I decided to leave my answer as it was.*

The interview excerpt demonstrates that the student tended to discontinue the problem-solving process after encountering obstacles instead of exploring alternative strategies or verifying the obtained solution. This behavior reflects the absence of the Reason and Overview indicators, as the student neither justified the selected approach nor evaluated the correctness of the final answer. The findings also suggest that limited persistence hindered the student's ability to sustain critical thinking throughout the entire problem-solving process.

These findings are consistent with Stoltz's (2000) theory, which characterizes quitters as individuals who tend to withdraw when facing challenges and are less likely to persist in overcoming difficulties. Such characteristics reduce students' opportunities to engage in reflective

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thinking, evaluate their reasoning, and improve their solutions. The findings also support Ennis (1996), who emphasized that critical thinking requires logical reasoning, evidence-based conclusions, and reflective evaluation. In addition, the results are in line with Rahman (2023), who reported that students with lower Adversity Quotient generally demonstrate weaker mathematical persistence, making them more likely to discontinue the problem-solving process before reaching a well-reasoned and verified solution.

DISCUSSION

The present study demonstrates that students' Adversity Quotient (AQ) is closely associated with the quality of their critical thinking processes when solving Social Arithmetic problems. Although all participants attempted to solve the given tasks, they exhibited distinct critical thinking characteristics across the FRISCO indicators and Polya's problem-solving stages. Students categorized as climbers consistently demonstrated comprehensive critical thinking by identifying relevant information, selecting appropriate strategies, providing logical justifications, drawing evidence-based conclusions, and evaluating the accuracy of their solutions. In contrast, campers generally completed the problem-solving process but demonstrated limited reflective thinking, particularly when evaluating and verifying their answers. Meanwhile, quitters experienced difficulties from the initial stages of problem solving, which subsequently affected their reasoning, conclusion drawing, and self-evaluation.

These findings support the theoretical perspective proposed by Stoltz (2000), who argued that individuals with higher Adversity Quotient are more resilient when facing challenges and therefore more likely to persist in solving complex problems. Such persistence enables students to remain engaged throughout the entire problem-solving process rather than terminating their efforts after encountering obstacles. The findings also reinforce Ennis's (1996) conception of critical thinking, which emphasizes that critical thinking involves not only reaching correct answers but also applying logical reasoning, evaluating evidence, and reflecting on the validity of one's conclusions. By integrating the FRISCO framework with Polya's problem-solving stages, the present study demonstrates that resilience contributes to students' ability to perform critical thinking consistently across every stage of mathematical problem solving.

The findings are also consistent with previous studies reporting that students with higher levels of Adversity Quotient exhibit greater mathematical persistence and more effective problem-solving performance than students with lower AQ (Rahman, 2023). Similarly, earlier studies have indicated that persistence enables students to explore multiple solution strategies,

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justify their reasoning, and evaluate the correctness of their answers more carefully. However, unlike previous research, which generally examined critical thinking or Adversity Quotient separately, the present study integrates FRISCO critical thinking indicators, Polya's problem-solving framework, and Adversity Quotient categories into a single analytical framework. This integration provides a more comprehensive understanding of how students' resilience influences specific aspects of critical thinking throughout the mathematical problem-solving process.

From a practical perspective, the findings suggest that mathematics instruction should not focus solely on developing students' cognitive abilities but should also promote resilience when confronting challenging mathematical tasks. Learning environments that encourage students to explain their reasoning, justify solution strategies, reflect on errors, and verify final answers may strengthen both critical thinking and persistence. Furthermore, teachers should recognize that students with different AQ categories may require different forms of instructional support. For example, students in the climber category may benefit from more challenging and open-ended problems, whereas campers may require guidance to develop reflective evaluation skills. In contrast, quitters may need structured scaffolding, motivational support, and opportunities to build confidence before engaging in more complex mathematical tasks.

Despite these contributions, this study has several limitations. First, the study involved only three participants representing three Adversity Quotient categories; therefore, the findings cannot be generalized to a broader population. Second, the analysis was limited to Social Arithmetic problems, and students' critical thinking characteristics may differ when solving problems from other mathematical topics. Third, the study employed a qualitative descriptive approach, which provides in-depth insights into students' thinking processes but does not measure the statistical relationship between Adversity Quotient and critical thinking ability. Future research may involve a larger number of participants, incorporate mixed-methods or quantitative approaches, and examine other mathematical topics to obtain a more comprehensive understanding of the relationship between resilience and critical thinking in mathematics education

CONCLUSION

This study revealed that students' Adversity Quotient (AQ) influences their critical thinking processes in solving Social Arithmetic problems. Students categorized as climbers demonstrated the most comprehensive critical thinking profile by consistently fulfilling the FRISCO indicators throughout Polya's problem-solving stages. Campers exhibited adequate critical thinking but

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showed limitations in providing logical justification and evaluating their solutions. In contrast, quitters experienced difficulties from the initial stages of problem solving, resulting in incomplete reasoning, inaccurate conclusions, and limited reflective evaluation. These findings indicate that students' resilience in facing mathematical challenges contributes to the quality of their critical thinking during problem solving.

The findings highlight the importance of integrating cognitive and non-cognitive aspects in mathematics instruction. Teachers should design learning activities that not only promote students' critical thinking but also strengthen their resilience when confronting mathematical challenges. Nevertheless, this study was limited by the small number of participants and its focus on Social Arithmetic problems, which may restrict the transferability of the findings. Future studies are recommended to involve larger and more diverse samples, investigate different mathematical topics, and employ mixed-methods or quantitative approaches to further examine the relationship between Adversity Quotient and critical thinking in mathematics learning.

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