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THE IMPACT OF ADVERSITY QUOTIENT AND SELF-EFFICACY ON STUDENTS' STATISTICAL REASONING ABILITIES: A PILOT STUDY

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Abstrak

Kemampuan penalaran statistik penting dalam berbagai bidang karena melibatkan kemampuan menafsirkan fenomena, memecahkan masalah, dan menarik kesimpulan berdasarkan data. Namun, siswa menunjukkan tingkat penalaran statistik yang beragam, dan perbedaan ini penting karena memengaruhi efektivitas mereka dalam pembelajaran berbasis data. Variasi tersebut dapat dipengaruhi oleh faktor individu seperti adversity quotient dan self-efficacy. Penelitian ini menguji pengaruh kedua variabel tersebut terhadap kemampuan penalaran statistik siswa. Sebanyak 38 siswa SMA di Jambi berpartisipasi dalam penelitian korelasional ini. Data dikumpulkan melalui kuesioner adversity quotient dan self-efficacy serta tes penalaran statistik. Hasil regresi linear berganda menunjukkan bahwa adversity quotient dan self-efficacy berkontribusi positif secara signifikan terhadap penalaran statistik. Persamaan regresi $Y = 2.909 + 0.152X_1 + 0.046X_2$ menunjukkan bahwa peningkatan adversity quotient terkait dengan kenaikan 0.152 poin pada skor penalaran statistik, sementara peningkatan self-efficacy terkait dengan kenaikan 0.046 poin. Nilai $R^2 = 0.595$ menunjukkan bahwa kedua variabel menjelaskan 59.5 persen variansi penalaran statistik siswa. Temuan ini menunjukkan bahwa pendidik perlu mengembangkan adversity quotient dan self-efficacy siswa, misalnya melalui tugas statistik yang menantang, umpan balik konstruktif, serta lingkungan belajar yang mendorong ketekunan. Selain itu, guru perlu mempertimbangkan variabel lain yang mungkin turut memengaruhi hasil belajar.

Kata kunci: Adversity Quotient; Kemampuan Penalaran Statistik; Penelitian Kolerasional; Self-Efficacy

Abstract

Statistical reasoning skills are essential across various disciplines, as they involve the ability to interpret phenomena, solve problems, and make logical inferences based on statistical data. However, students exhibit varying levels of statistical reasoning, ranging from basic understanding to the ability to interpret and justify conclusions, and these differences are important because they affect how effectively students participate in data-driven learning. Such variation may be shaped by individual factors, including their capacity to manage challenges (adversity quotient) and their confidence in their own abilities (self-efficacy). This study investigates the impact of adversity quotient and self-efficacy on students' statistical reasoning performance. A total of 38 high school students in Jambi, Indonesia, participated in this correlational study. Data were gathered through questionnaires measuring adversity quotient and self-efficacy, along with a statistical reasoning test. The multiple linear regression analysis showed that both adversity quotient and self-efficacy made significant positive contributions to students' statistical reasoning. The regression equation $Y = 2.909 + 0.152X_1 + 0.046X_2$ indicates that an increase in adversity quotient is associated with a 0.152-point rise in statistical reasoning scores, while an increase in self-efficacy corresponds to a 0.046-point rise. The coefficient of determination ($R^2 = 0.595$) suggests that these two variables together explain 59.5 percent of the variance in students' statistical reasoning. These findings suggest that educators should foster both adversity quotient and self-efficacy to enhance students' statistical reasoning skills, For example, through challenging statistics assignments, constructive feedback, and a learning environment that encourages persistence. In addition, teachers need to consider other variables that may influence learning outcomes.

Keywords: Adversity Quotient; Correlational Study; Self-Efficacy; Statistical Reasoning Abilities

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INTRODUCTION

Mathematics is a discipline characterized by logical, systematic, and precise structures, encompassing clear rules, coherent reasoning patterns, and well-defined procedures that play a crucial role in equipping individuals with the ability to understand and solve everyday life problems. Mathematics also plays an important role in developing students' reasoning, logical thinking, and creativity (Muslimin et al., 2020; Salami, 2020). The study of mathematics extends beyond learning formulas and procedures to cultivating higher-order thinking skills, including critical reasoning, reflective analysis, and creative problem-solving (Nurfadilah, 2019; Zainal, 2022). Furthermore, mathematics fosters analytical competencies that are essential for evidence-based decision-making (Listiati, 2022; Malikah et al., 2022).

Statistics is widely acknowledged as a fundamental discipline for collecting, analyzing, presenting, and drawing conclusions from data. Its application transcends the classroom, extending to critical fields such as health, economics, psychology, sociology, and environmental studies (Herawati et al., 2020; Lubis, 2021). Consequently, statistics is not only a component of mathematics education but also an interdisciplinary tool that strengthens scientific literacy across STEM and social science domains. Mastery of statistics requires more than computational accuracy; it requires *statistical reasoning ability*. This involves understanding data representations, interpreting empirical evidence, and drawing logically consistent conclusions. Unlike rote memorization, statistical reasoning relies on higher-order cognitive processes such as inductive and deductive thinking, abstraction, and problem interpretation.

However, numerous studies have reported that students' statistical reasoning ability remains low (Muslimin et al., 2020; Dores et al., 2023). This condition is often attributed to a lack of motivation and limited interest in learning mathematics, particularly in the field of statistics. Without sufficient interest, students tend to view statistics as a burdensome subject rather than a meaningful tool for real-life problem solving (Woli et al., 2023). This suggests that cognitive skills alone may not be sufficient to support students in developing strong statistical reasoning. Increasing attention has therefore been directed towards psychological and behavioural factors that influence students' engagement and performance in statistics.

In recent years, increasing attention has been given to non-cognitive factors that shape students' learning experiences, among which Adversity Quotient (AQ) and Self-Efficacy (SE) have emerged as particularly influential constructs. Both are closely related to students' capacity to handle challenges and regulate their learning processes (Nielsen, 2020; Astiantari et al., 2022). Research in STEM education has increasingly highlighted the relevance of such non-cognitive skills in enhancing problem-solving, persistence in scientific inquiry, and resilience when confronted with complex learning tasks (Wulandari & Istiani, 2021; Ismawati & Andriyani, 2022). However, despite the expanding literature, research examining the combined role of AQ and SE in students' statistical reasoning remains limited, and this study aims to fill that gap.

Adversity Quotient (AQ) refers to an individual's capacity to endure challenges, respond effectively to difficulties, and learn from adverse situations (Baharullah et al., 2022; Silvatama et al., 2023). This construct is commonly described through four key dimensions. Control reflects a person's ability to maintain influence over outcomes even when facing obstacles. Origin and ownership relate to the willingness to accept responsibility for dealing with difficulties. Reach concerns the extent to which a challenging situation affects other areas of a person's life. Endurance represents the strength to continue putting forth effort despite demanding circumstances (Thapa, 2020). These dimensions align closely with the requirements of statistical reasoning, which demands not only logical interpretation of data but also persistence when problems become increasingly abstract. For example, students with high AQ are more likely to persevere when confronted with confusing data sets, whereas those with low AQ may quickly give up and disengage from the reasoning process (Wulandari et al., 2022).

Self-Efficacy (SE) refers to individuals' belief in their capability to successfully perform specific tasks and achieve targeted outcomes (MZ & Muhandaz, 2019; Lestari et al., 2021), academic contexts, SE influences students' motivation, their approach to problem-solving, and their willingness to persist through difficulties. Recent studies in mathematics and STEM education have consistently demonstrated that students with strong SE exhibit better problem-solving skills, higher resilience, and greater adaptability when engaging with complex concepts (Wulandari & Istiani, 2021). In the context of statistics, SE directly affects students' confidence to interpret data, confront uncertainty, and construct meaningful conclusions from empirical evidence.

Although AQ and SE have been investigated separately in various mathematical contexts, the literature presents fragmented insights. Studies on AQ have primarily examined its role in persistence and creative reasoning (Rahayu & Alyani, 2020; Nuraisyah et al., 2021), while SE has been widely studied in relation to mathematical reasoning and problem-solving (Lestari et al., 2021). Systematic evidence on how AQ and SE jointly shape *statistical reasoning* a higher-order and domain-specific competence remains scarce. Furthermore, research tends to emphasize academic achievement outcomes rather than explaining the cognitive mechanisms through which AQ and SE exert their influence (Rovan et al., 2021: Hofifah et al., 2023).

Grounded in social-cognitive and resilience theories, this study conceptualizes the link between AQ, SE, and statistical reasoning. AQ fosters persistence in managing complex or ambiguous data, while SE strengthens confidence, self-regulation, and problem-solving, creating a synergistic foundation for higher-order thinking. Statistical reasoning specifically requires resilience to cope with uncertainty and confidence to regulate problem-solving processes. However, existing studies have rarely examined AQ and SE within an integrated framework, particularly in the domain of statistical reasoning. Unlike the study by Rahmayanti & Marlena (2025), which focused on the influence of AQ and SE on students' ability to understand mathematical concepts using essay-based assessments, the present research investigates statistical reasoning, a broader and more complex cognitive construct involving interpretation of data, recognition of patterns, evaluation of arguments, and formulation of evidence-based conclusions. While Rahmayanti & Marlena used a larger sample (95 students) to examine conceptual understanding, this study addresses the unexplored theoretical gap by analysing how AQ and SE jointly contribute to students' statistical reasoning skills. Addressing this gap, the present study aims to empirically investigate the impact of Adversity Quotient and Self-Efficacy on students' statistical reasoning skills.

METHOD

Research Design

This study used a correlational approach, which allows researchers to identify predictive relationships among AQ, SE, and students' statistical reasoning, making it suitable for exploring how these variables vary together in natural classroom settings. Although appropriate for this purpose, the method requires careful attention to key issues such as measurement accuracy, sample size adequacy, and the limitations of non-experimental designs.

Participants

The population of this study include all students from senior secondary schools in Jambi Province, Indonesia. The participants were 38 students aged 14 to 16 years representing a mix of grade levels and academic backgrounds. This range includes students at different stages of cognitive and academic development, which may lead to differences in their statistical reasoning performance and should be considered when interpreting the results. Moreover, the small sample size raises concerns. For multiple regression with two predictors, methodological literature typically recommends a minimum ratio of 10–15 participants per predictor, with some suggesting 20–30 as a more robust standard (Tabachnick & Fidell, 2019). Thus, a sample of 38 participants is at the lower threshold and may compromise statistical power and model stability. No formal power analysis was conducted to determine whether this sample size was adequate.

To address this limitation, two approaches are suggested. First, future studies should recruit additional participants across multiple schools to enhance statistical power and ensure sufficient representativeness. Second, if expansion is not feasible, this study should be positioned as a pilot investigation, offering preliminary evidence and guiding larger-scale follow-up research.

Sampling Strategy

Participants were recruited using a convenience sampling method from a single geographic region, limiting the generalizability of findings. The lack of stratification by grade level, prior academic achievement, or socioeconomic background further constrains interpretation. Future research should employ stratified random sampling to ensure that students from different grade levels, age groups, and academic tracks are proportionally represented, which would reduce sampling bias and allow for clearer comparisons across subgroups. Alternatively, a multi-site design could be used to capture broader variations in student characteristics and learning environments. Moreover, demographic variables such as gender, school type (public/private), prior mathematics performance, and socioeconomic indicators should be systematically collected and reported. These variables may serve as potential confounders and should be statistically controlled in future analyses to strengthen internal validity.

Instruments

Adversity Quotient (AQ) Questionnaire

The AQ questionnaire was developed based on Stoltz (2004) four core components: Control, Origin and Ownership, Reach, and Endurance and was adapted to the school context through a systematic validation process to ensure its relevance and appropriateness for the target population. The adaptation involved reviewing the original items, rephrasing them to suit the linguistic and cultural context of secondary school students, and aligning them with typical academic challenges encountered in classroom settings. To establish content validity, two subject-matter experts: both holding postgraduate qualifications in educational psychology and having more than five years of experience in psychological assessment and instrument development were selected as validators. They were chosen based on their expertise in non-cognitive constructs, familiarity with adversity quotient research, and prior experience in validating student-based questionnaires. Following expert validation, a pilot study involving 15 students was conducted to examine item readability, clarity, and preliminary psychometric properties. The pilot sample was intentionally limited to avoid exposing the main research participants to the instrument beforehand, which could compromise the study's internal validity. Therefore, the pilot was carried out in a different school with similar demographic characteristics to ensure the suitability of the instrument without influencing the actual research sample of 38 students. From this process, 24 items were identified as valid and were retained for the final instrument (Table 1). Cronbach’s Alpha for the final instrument was r = 0.932, indicating a high level of internal consistency and demonstrating that the items reliably measured the intended construct.

However, several methodological concerns remain:

1. The pilot sample (n=15) was too small for robust psychometric evaluation.
2. Reliance solely on expert judgment without factor analysis limits construct validity.
3. Extremely high reliability may indicate item redundancy rather than true internal consistency.

Future research should incorporate exploratory and confirmatory factor analysis, assess convergent and discriminant validity, and conduct test-retest reliability to ensure stability of the instrument.

Table 1. AQ Indicators and Questionnaire Items

Adversity Quotient Indicators	Questionnaire Items
Control	1, 3, 7, 11, 15, 17
Origin and Ownership	2, 6, 9, 12, 16, 21
Reach	4, 8, 13, 18, 22, 24
Endurance	5, 10, 14, 19, 20, 23
Total	24 items

Furthermore, scoring was carried out with a Likert scale (1-5) and identified a tendency to be high and low in the AQ variable. Data student AQ was obtained as interval data for further analysis.

Self-Efficacy (SE) Questionnaire

The SE questionnaire was developed based on several core indicators, including belief in success, the ability to overcome problems, courage in facing challenges, awareness of personal strengths and weaknesses, adaptability, perspectives on mathematics, and persistence. To ensure that the items were appropriate for the target population, the questionnaire was adapted to the school context through a structured review of item wording and conceptual alignment with students' learning experiences in mathematics. Content validity was established through evaluation by two subject-matter experts, who assessed the relevance, clarity, and representativeness of each item in measuring students' self-efficacy. A pilot study involving 15 students was also conducted to examine readability and preliminary item functioning. From this process, 28 items were retained for the final instrument (Table 2). Cronbach's Alpha for the instrument was r = 0.927, indicating a high level of internal consistency and demonstrating that the items reliably captured the intended construct.

As with AQ, concerns arise regarding limited pilot testing, lack of factor validation, and possible item redundancy. A more rigorous psychometric evaluation with a larger pilot sample is recommended.

Table 2. Blueprint of the SE Questionnaire and Item Statements

Self-Efficacy Indicators	Questionnaire Items
Belief in One's Own Success	1, 8, 15, 22
Ability to Overcome Current Problems	2, 9, 16, 23
Courage to Face Challenges	3, 10, 17, 24
Awareness of Strengths and Weaknesses	4, 11, 18, 25
Ability to Communicate and Adapt	5, 12, 19, 26
Perspective on Mathematics	6, 13, 20, 27
Persistence	7, 14, 21, 28
Total	28 items

Then, SE questionnaire has been filled out with a Likert scale (1-5). The SE scor is obtained as interval data.

Statistical Reasoning Ability Test

Students' statistical reasoning ability was assessed using seven open-ended items addressing indicators such as: identifying statistical terms, describing and organizing data, representing and analyzing data, interpreting results, drawing conclusions, and applying statistical knowledge to real-world contexts (Wulansari et al., 2019). The time provided to solve the test is about 90 minute. Content validity was established through evaluation by two subject-statistical matter experts, who assessed the relevance, clarity, and representativeness of each item in measuring students' statistical reasoning ability.

Nevertheless, the absence of construct validity testing or item response analysis limits confidence in the instrument's robustness. Future studies should employ scoring rubrics with inter-rater reliability checks, as well as item analysis to evaluate task difficulty and discrimination.

Data Analysis

Data were analyzed using multiple linear regression to evaluate the extent to which AQ (X_1) and SE (X_2) predict statistical reasoning ability (Y), as this method is appropriate for assessing the simultaneous contribution of multiple independent variables to a single outcome. IBM SPSS Statistics (Statistical Package for the Social Sciences) software new version is used to process data and obtain multiple linear regression models. The regression model was specified as:

$$Y = a + b_1X_1 + b_2X_2$$

While regression is an appropriate analytic technique, several issues must be highlighted:

1. Assumption testing (linearity, independence, homoscedasticity, multicollinearity, and normality of residuals) was not comprehensively reported.
2. Outlier detection and influence diagnostics (e.g., Cook's distance, leverage values) were not performed.
3. The absence of cross-validation or bootstrapping raises concerns about model stability with a small sample.

Future research should report assumption checks explicitly, calculate and interpret effect sizes, and perform sensitivity analyses. Where sample sizes are small, alternative approaches such as partial least squares regression or Bayesian methods may be preferable.

Conceptual Framework

The conceptual framework guiding this study is illustrated in Figure 1. AQ and SE are treated as independent predictors of statistical reasoning ability, with the expectation that both exert direct and potentially synergistic effects.

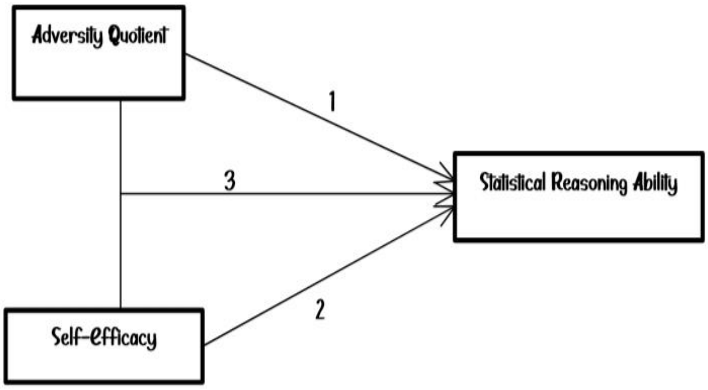

Figure 1. Research Design for Regression Analysis

The Hypothetical mechanisms through which AQ and SE affect statistical reasoning can be summarized as follows: Persistence (from AQ): Students with higher AQ demonstrate endurance and resilience, enabling them to remain engaged with statistical tasks despite setbacks, Confidence (from SE): Students with higher SE believe in their capacity to solve problems, leading them to attempt complex reasoning tasks rather than avoid them, Problem-Solving Strategies (interaction of AQ and SE): AQ sustains effort, while SE directs effort through self-regulated strategies, resulting in more effective reasoning processes.

RESULT AND DISCUSSION

This section presents the descriptive statistics, normality and multicollinearity tests, the multiple regression results, and diagnostic checks used to assess the robustness of the findings. Given the relatively small sample size (n = 38), the results must be interpreted with caution because smaller samples increase the likelihood of overestimated effects and unstable regression coefficients.

Table 3. Results of Normality Test

Variable	*Asymp. Sig. (2-Tailed)*	Significance Level	Decision
Statistical Reasoning Ability	0,061	0,05	Normal
Adversity Quotient	0,869	0,05	Normal
Self-Efficacy	0,739	0,05	Normal

Descriptive Statistics

The distribution of Adversity Quotient (AQ), Self-Efficacy (SE), and statistical reasoning ability is reported to provide a clearer overview of students' characteristics. The AQ scores were categorized into Quitter, Camper, and Climber groups based on Stoltz (2000). Quitters tend to withdraw when facing difficulties, Campers show moderate persistence, and Climbers consistently continue working through challenges. Most students in this study were classified as Campers, with scores between 71 and 76 (30.8 percent), indicating that while they possess some resilience, their ability to sustain effort is not yet strong. For SE, most students scored between 81 and 87 (28.9 percent), placing 17 students in the medium category, 14 in the low category, and 7 in the high category. These categories reflect differences in students' confidence and persistence, which are directly relevant to how they approach tasks requiring statistical reasoning. The statistical reasoning test, consisting of seven open-ended items, produced an average score of 18.16 (SD = 2.07), with scores ranging from 15 to 22. This indicates an overall average level of reasoning performance, where students demonstrate basic understanding but show limited ability to justify conclusions or apply reasoning across contexts.

While descriptive data are useful, simple frequency distributions do not reveal the relationships among variables. Therefore, bivariate correlations were examined to determine the strength and direction of the associations between AQ, SE, and statistical reasoning, which is essential for addressing the research questions. AQ and SE showed a moderate positive correlation ($r = 0.42$, $p < 0.05$), suggesting that students who demonstrate resilience also tend to report higher confidence. Both AQ ($r = 0.61$, $p < 0.01$) and SE ($r = 0.49$, $p < 0.01$) were positively associated with statistical reasoning ability, supporting their roles as potential predictors.

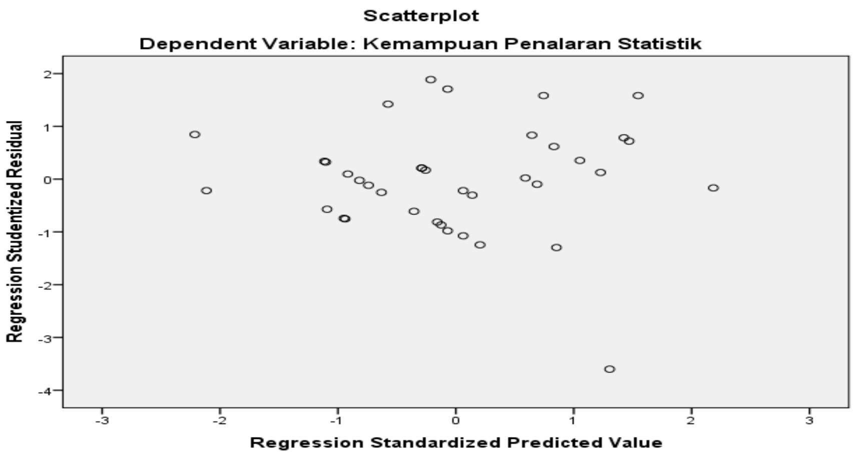

Figure 2. Scatterplot

Assumption Testing

Before regression analysis, several classical assumptions were evaluated:

1. Normality: As shown in Table 3, all three variables met the assumption of normal distribution ($p > 0.05$).
2. Multicollinearity: VIF values for AQ and SE were both 1.806, well below the threshold of 10, indicating no multicollinearity.
3. Heteroscedasticity: The scatterplot (Figure 2) displayed no clear pattern, confirming homoscedasticity.
4. Linearity: Both predictors demonstrated positive linear relationships with statistical reasoning, validating the regression approach.

Regression Analysis

The multiple regression model produced the following results:

$$Y = 2.909 + 0.152X_1 + 0.046X_2$$

Where Y = Statistical Reasoning Ability, X_1= Adversity Quotient, and X_2 = Self-Efficacy

1. Model Fit: $F(2, 35) = 25.704$, $p < 0.001$, indicating that the multiple regression model was statistically significant. This means that students' statistical reasoning abilities can be predicted by knowing the variable of AQ and SE of students.

2. Coefficient of Determination: $R^2 = 0.595$, suggesting that AQ and SE jointly explained 59.5% of the variance in statistical reasoning ability. This coffeicient of determination can indicated that students' statistical reasoning ability good explained by AQ and SE simultanly.
3. Effect Sizes: Standardized coefficients showed that AQ ($\beta = 0.54$, $p < 0.001$) had a stronger predictive effect than SE ($\beta = 0.28$, $p < 0.05$). AQ and SE can predicted students statistical ability with different portion.
4. Confidence Intervals: The 95% CI for AQ ranged from 0.09 to 0.21, and for SE from 0.01 to 0.08, both excluding zero, confirming significance.

While these findings suggest meaningful associations, the high R^2 value with such a small sample raises concerns of inflation. To address this, a simple bootstrap procedure (1,000 samples) was performed, yielding a more conservative R^2 estimate of 0.52, indicating that nearly half of the variance may still be explained by AQ and SE, but with greater caution. The modest sample size ($n = 38$) limits statistical power, inflates the risk of Type I error, and restricts generalizability. Additionally, the absence of cross-validation or outlier diagnostics raises concerns about the model's stability.

The findings of this study indicate that both AQ and SE significantly and positively influence students' statistical reasoning ability. This suggests that resilience and persistence play a central role in mathematics learning and students' capacity to engage with statistical reasoning, which is cognitively demanding and requires sustained effort (Jumiarsih et al., 2020).

The positive relationship between AQ and statistical reasoning aligns with Stoltz's (2000) conceptualization of resilience, where Climber-type students persist in problem-solving despite uncertainty. Students with higher AQ likely approach complex statistical tasks with perseverance, enabling deeper engagement in reasoning processes. Students with Quitter- or Camper-type AQ, by contrast, may disengage more quickly or avoid risk-taking.

Similarly, SE was positively associated with statistical reasoning, consistent with Bandura's social-cognitive theory, which posits that confidence enhances motivation, persistence, and strategy use. Students with higher SE are more willing to attempt challenging problems, regulate their learning, and sustain effort in reasoning task. Social-cognitive theory further emphasizes that SE shapes learners' expectations of success, influencing not only effort but also their choice of strategies (Doll & Song, 2023).

Nonetheless, the relatively smaller regression coefficient for SE compared to AQ suggests that persistence in overcoming challenges may play a more central role in statistical reasoning than confidence alone. This nuance highlights the importance of examining how AQ and SE interact, rather than considering them in isolation.

The results support a dual-theory perspective: resilience theory highlights the role of persistence under adversity, while social-cognitive theory emphasizes the motivational power of belief in one's abilities. Together, AQ and SE provide a complementary framework for understanding how non-cognitive factors underpin higher-order reasoning skills. It suggests that non-cognitive factors may be equally critical as cognitive skills in mastering 21st-century statistical literacy (Asih et al., 2019; Yelland et al., 2023). Based on this, it can be generalized that high school students with high levels of AQ and SE tend to have better statistical reasoning ability (Jumiarsih et al., 2020).

From an educational perspective, the results imply that interventions aimed at strengthening both resilience and confidence may enhance students' ability to engage in statistical reasoning. Strategies such as problem-based learning (PBL) or project-based learning (PjBL) can immerse students in authentic challenges, fostering both AQ and SE (MZ et al., 2021; Upreti et al., 2024). For example, engaging students in analyzing local statistical data, such as school surveys, tourism data, or community demographics can simultaneously foster their AQ through real-life problems and their SE by enabling them to experience incremental success and build confidence in their capabilities (Akbari & Sahibzada, 2020; Al'atif et al., 2023).

Furthermore, schools and education policymakers can design student character-building programs through soft skill training, psychological mentoring, and structured mental coaching to support academic achievement. Prior studies have highlighted that such programs significantly enhance students' academic outcomes by strengthening their non-cognitive capacities (Zynuddin et al., 2023). Embedding character education that emphasizes perseverance, optimism, and confidence may therefore complement curricular goals in mathematics and statistics.

Several critical limitations warrant acknowledgment:

1. Sample Size and Statistical Power: With only 38 participants, statistical power is limited, and effect sizes may be inflated. The coefficient of determination ($R^2 = 0.595$) may overestimate the true predictive strength of AQ and SE due to sample size constraints.
2. Sampling Scope: Data were drawn from a single school in Jambi Province, restricting external validity. The findings may not generalize to students in other regions or with different educational backgrounds.
3. Measurement Concerns: Instruments were validated through expert judgment and a small pilot test ($n = 15$). More rigorous psychometric validation, such as factor analysis, Cronbach's alpha with larger samples, and test-retest reliability is necessary to ensure measurement robustness.
4. Uncontrolled Variables: Other potential predictors of statistical reasoning, such as mathematics anxiety, prior achievement, parental support, or socioeconomic status were not included in the regression model. This omission leaves unexplained variance unaccounted for.
5. Analytical Limitations: The absence of power analysis, confidence intervals, and effect size reporting limits the interpretability of statistical estimates.

Future studies should adopt bootstrapping or cross-validation to assess the stability of results.

Future research should address these limitations by recruiting larger and more diverse samples across multiple regions, applying advanced psychometric analyses such as confirmatory factor analysis and measurement invariance testing, and incorporating additional predictors, including prior mathematical achievement, motivation, metacognitive regulation, and classroom learning environment. Longitudinal designs could track how AQ and SE evolve across grade levels, while experimental studies could test the effectiveness of targeted interventions. Mixed-methods approaches could also provide qualitative insights into students' learning experiences, capturing the nuanced interplay between resilience, confidence, and reasoning strategies. By expanding the scope of inquiry, future studies can better illuminate how non-cognitive factors interact with cognitive processes to shape students' statistical reasoning abilities, thereby informing both theoretical understanding and practical applications in education.

The findings of this study indicate that both AQ and SE significantly and positively influence students' statistical reasoning ability. This suggests that resilience and persistence play a central role in mathematics learning (Jumiarsih et al., 2020; Mujeeb et al., 2021). and students' capacity to engage with statistical reasoning, which is often cognitively demanding and requires sustained effort. This result is consistent with Stoltz's (2000) framework, which classifies students into Quitters, Campers, and Climbers, where students with Climber-type AQ demonstrate higher persistence and better performance when confronted with academic challenges.

These findings are in line with research by Rahayu (2019) which stated that AQ is positively related to mathematical creative reasoning ability, and supports the findings of Purwasih (2019) which showed that SE affects students' mathematical reasoning. Although previous studies did not directly investigate statistical reasoning, the similarity in context regarding higher-order thinking skills strengthens this study's conclusion about the importance of non-cognitive aspects in achieving students' cognitive abilities (Monica, 2020). Based on this, it can be generalized that high school students with high levels of AQ and SE tend to have better statistical reasoning ability (Bandura, 2020; Jumiarsih et al., 2020; (Mujeeb et al., 2021). Social cognitive theory emphasizes that SE influences students' motivation, persistence, and use of strategies, which explains why students with high SE perform better in problem-solving. Likewise, resilience theory suggests that students with strong coping abilities can withstand academic stressors and adapt effectively, which strengthens their reasoning performance (Adirestuty & Wirandana, 2021). Therefore, teachers need to focus not only on content delivery but also on developing students' resilience in facing difficulties (Goldstein & Brooks, 2023). And building confidence in their own abilities (Yelland et al., 2023).

The implications of this study suggest the need for a holistic approach in mathematics learning, particularly in statistics, that considers students' psychological aspects such as AQ and SE. Teachers can incorporate learning strategies that foster perseverance, risk-taking, and student self-reflection (Gusta et al., 2022; Upreti et al., 2024). Strategies such as problem-based learning (PBL) and project-based learning (PjBL), which involve real-life challenges, are particularly effective because they situate students in authentic problem contexts that require perseverance and collaborative inquiry (MZ et al., 2021). For example, engaging students in analyzing local statistical data (e.g., school surveys, tourism data, or community demographics) can simultaneously foster their AQ through real-life problems and their SE, by enabling them to experience small successes and build confidence in their capabilities (Akbari & Sahibzada, 2020).

Furthermore, schools and education policymakers can design student character-building programs through soft skill training, psychological mentoring, and structured mental coaching to support academic achievement. Prior studies have highlighted that such programs significantly enhance students' academic outcomes by strengthening their non-cognitive capacities (Zynuddin et al., 2023).

Embedding character education that emphasizes perseverance, optimism, and confidence may therefore complement curricular goals in mathematics and statistics.

However, this study has several limitations that influence the interpretation of the findings. First, the sample consisted of only 38 students from Jambi Province, which restricts the generalizability of the results to broader populations and highlights the need for larger and more diverse samples in future research. Second, the study did not account for other variables that may influence statistical reasoning, such as learning motivation, parental support, or classroom environment, which means the observed effects of AQ and SE may be part of a more complex set of contributing factors. Including these variables in future models would provide a more comprehensive understanding. Third, the data were collected through questionnaires and written tests, which may not fully capture students' real-time cognitive and emotional processes during learning. Future studies could incorporate interviews, classroom observations, or performance-based assessments to obtain richer and more holistic data.

Therefore, it is recommended to conduct further research with a larger and more diverse sample to improve generalizability. Future studies could also be developed using a mixed-methods approach to explore qualitative data on students' learning experiences. In addition, longitudinal studies could track how resilience and self-efficacy evolve over time and influence statistical reasoning across different grade levels. Experimental studies can also be conducted to test the effectiveness of AQ- and SE-based learning interventions in improving students' statistical reasoning ability. By expanding the scope of inquiry, future studies can better illuminate how non-cognitive factors interact with cognitive processes to shape students' statistical reasoning abilities.

CONCLUSION

This study concludes that Adversity Quotient (AQ) and Self-Efficacy (SE) make significant contributions to students' statistical reasoning performance.

Students who exhibit stronger resilience when encountering challenges and greater confidence in their ability to complete academic tasks are more likely to demonstrate a higher capacity for interpreting data, drawing conclusions, and solving statistical problems. These findings underscore that the development of statistical reasoning depends not only on cognitive factors such as mastery of mathematical content but also on non-cognitive factors that influence how students' approach and persevere through complex tasks. Specifically, higher AQ supports persistence and problem-focused responses, while higher SE enhances students' willingness to engage with demanding reasoning tasks.

Accordingly, teachers and education policymakers should integrate instructional approaches that explicitly foster resilience and confidence, such as guided problem-solving activities, structured feedback that reinforces students' progress, and learning environments that encourage persistence during difficulty. Incorporating approaches such as growth-oriented feedback, collaborative learning, and reflective practice can help strengthen both AQ and SE, ultimately supporting more robust statistical reasoning outcomes.

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