The Impact of Adversity Quotient on Students' Problem-Solving Skills Based on Bransford-Stein's Theory

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Abstract *- Problem-solving ability is an important cognitive skill in learning. The aims to analyze students' problem-solving ability based on Bransford-Stein theory by considering the Adversity Quotient (AQ) factor. The research method used is a quantitative method with simple linear regression analysis. Data were collected through problem-solving tests and administering adversity quotient (AQ) questionnaires. The sample was selected using the purposive sampling technique and obtained 100 high school students selected based on different AQ categories (climbers, campers, quitters). The results of the simple linear regression analysis showed that AQ had a significant effect on the level of students' problem-solving ability. Each increase in one unit of AQ will increase the problem solviing by 1,867 units. The R^2 value is 0.5506, which means that 55.06% of the variability of problem solving ability can be explained by AQ. This shows that students with high AQ tend to be more persistent in solving problems systematically. Reviewed Based on the five Bransford-Stein indicators (IDEAL Problem solving), students with high AQ (climbers) have a better level of problem-solving ability compared to students with medium AQ types (campers) and low AQ types (quitters). Students with the climbers type can solve all five problem-solving indicators in the questions very well. Campers type students have fairly good problem-solving abilities, but can only solve questions up to three Bransford-Stein indicators. Quitter type students can only solve one Bransford-Stein indicator well. The results of this study can provide input for educators in designing appropriate learning strategies, so that they can improve students' problem-solving abilities by considering their psychological factors, especially adversity quotient. This study only examines correlation, without testing causal relationships through experimental interventions.*

Kata Kunci: *Problem Solving, Bransford-Stein, Adversity Quotient*

INTRODUCTION

As the world continues to evolve, problem-solving skills in science education, particularly in physics, have become increasingly essential (Tamami et al., 2017). This is closely related to the characteristics of physics material, which is often abstract and requires a high level of conceptual understanding (Juniartina & Erlina, 2024). However, field observations indicate that many students experience difficulties in understanding and applying physics concepts in problem-solving contexts. While students are often able to solve problems modeled directly by teachers, they struggle with extended problems that demand deeper comprehension and more advanced thinking strategies.

This situation suggests that a significant number of students have yet to develop the higher-order thinking skills necessary for effective physics problem-solving. Several factors contribute to the low level of problem-solving skills among students, including difficulties in understanding concepts, the lack of systematic problem-solving strategies, and psychological factors that influence students' persistence in overcoming challenges, particularly adversity quotient (Matondang et al., 2022).

In addition to cognitive factors such as conceptual understanding and strategic problem-solving, psychological aspects play a critical role in students' success in solving physics problems (Hilal & Rumbiak, 2022).

One key psychological factor is the adversity quotient (AQ), a concept introduced by Stoltz to measure an individual's ability to withstand and overcome adversity. AQ is classified into three categories: climbers (those with high resilience and problem-solving capabilities), campers (those who are able to complete some stages of problem-solving but face obstacles midway), and quitters (those who are easily discouraged and have significant difficulty solving problems) (Suhartono, 2016).

Within the context of physics education, AQ plays a vital role in determining how students confront difficulties, persist through the learning process, and seek solutions to complex problems. Students with a high AQ (climbers) demonstrate greater perseverance and perform better in problem-solving tasks compared to those with a lower AQ. Climbers are typically able to complete all stages of problem-solving with strong reliance on conceptual thinking, whereas campers often encounter difficulties at several stages, and quitters struggle to engage meaningfully with the problem-solving process (Na'imah et al., 2022; Lestari et al., 2023).

To address the issue of low problem-solving skills, various instructional models have been developed, one of which is the learning model integrating the IDEAL problem-solving framework introduced by Bransford and Stein (Sahertian & Hidayati, 2022). This model consists of five stages: identifying the problem (Identify the problem), defining goals (Define goals), exploring possible strategies (Explore possible strategies), acting on the strategies (Act on strategies), and evaluating the results (Look back and learn) (Gaffar et al., 2021). This approach aims to assist students in recognizing and understanding the different components involved in the problem-solving process, enabling them to analyze problems more systematically and structurally. By following the Bransford-Stein steps, students are expected to enhance their critical and systematic thinking skills in solving physics problems.

Several previous studies have examined the influence of adversity quotient on problem-solving abilities. However, prior research has mainly focused on the correlation between AQ and students' problem-solving skills without exploring the specific characteristics and strategies employed by students with different AQ types (Climbers, Campers, and Quitters). Furthermore, there has been no in-depth investigation into how adversity quotient impacts students' levels of problem-solving ability using specific indicators based on the Bransford-Stein model.

Based on these considerations, this study aims to examine how adversity quotient influences students' problem-solving abilities and to describe their problem-solving skills according to the Bransford-Stein framework. It is hoped that this research will offer new insights into the factors affecting students' problem-solving skills and provide more targeted recommendations for designing effective instructional strategies in physics education.

RESEARCH METHODS

This study employed a quantitative method involving two variables: adversity quotient (AQ) as the independent variable (X) and students' problem-solving ability (PSA) as the dependent variable (Y). The population consisted of all eleventh-grade students at SMA MTA Surakarta. The sample included 100 respondents selected using purposive sampling, where participants were chosen based on predefined criteria: they had to come from classes that had already been taught the topic

of work and energy and had varying levels of AQ and self-efficacy.

The research procedure began with the development of instruments, which included an AQ questionnaire containing 32 statements and a problem-solving test consisting of 10 open-ended questions. The AQ questionnaire was designed based on the dimensions of AQ, namely control, origin and ownership, reach, and endurance.

The criteria for AQ classification were determined using the Criterion-Referenced Assessment (CRA) approach proposed by Asrul et al. (2015), as shown in Table 1.

Table 1. AQ Classification Criteria Based on CRA by Asrul et al. (2015)

Score Range	Classification
$x \leq \bar{x} - 1.SD$	Quitters
$\bar{x} - 1.SD < x \leq \bar{x} + 1.SD$	Campers
$x \geq \bar{x} + 1.SD$	Climbers

Note: $\bar{x}$ represents the mean score, and SD represents the standard deviation.

After the instruments were developed, the next step was to test the instruments for validity and reliability. Validity was assessed using the Product Moment correlation formula, while reliability was evaluated using Cronbach's Alpha. The validity test yielded an average r_calculated = 0.61, which was greater than the r_table = 0.51, indicating that the instrument was valid. Reliability testing showed that the instrument was reliable, with a Cronbach's Alpha score of 0.8303.

The data collection phase involved administering the questionnaires and the problem-solving ability test to all participants. The data collected were then analyzed using SPSS software through a series of statistical tests, which included prerequisite data tests (Kolmogorov-Smirnov normality test, multicollinearity test, and linearity test) as well as hypothesis testing. The hypothesis test involved multiple linear regression analysis to examine the direct effect of the independent variable (X) on the dependent variable (Y). A t-test was subsequently conducted to determine the significance of the effect of the independent variable on the dependent variable.

RESULTS AND DISCUSSION

Results

Prerequisite tests are used in regression analysis to ensure that the regression model meets certain assumptions, so that the estimation results are valid and unbiased. The prerequisite tests applied include normality and linearity tests. The normality test ensures that the data is normally distributed and sufficiently represents the entire dataset. The normality of the data was tested using the Kolmogorov-Smirnov test, with a significance value > 0.05. Based on the calculations, the normality test for each variable showed a significance value of 0.200, which is greater than 0.05, indicating that the data is normally distributed.

Next, the linearity test was conducted to determine whether the relationship between X and Y is linear or follows another pattern (such as exponential or polynomial). The linearity of the data was tested using the deviation from linearity test with a significance level > 0.05. The results of this test are shown in Table 2.

Table 2. Linearity Test Results

Variable	Sig.
PSA*AQ (X_1)	0.534

Based on Table 2, the results indicate that the relationship between adversity quotient (X) and problem-solving ability (Y) has a significance value of 0.534, which is greater than 0.05, meaning that the relationship between X and Y is linear.

A simple linear regression analysis was conducted to determine the extent of the effect of adversity quotient on students' problem-solving ability. The results of the analysis are shown in Table 3.

Table 3. Results of Linear Regression Analysis

Variable	regression coefficient	t_{calc}	*p-vallue*
Constant	-107.689		
AQ (X)	1.8764	7.917	0.000

F calculated = 120.048
R Square (R^2) = 0.5505

The results of the regression model feasibility test showed an F_calculated value of 120.048, which is much greater than the F_table value, indicating that the regression model is appropriate for explaining the relationship between adversity quotient (AQ) and problem-solving ability (PSA). The t_calculated value of 7.917 is greater than the t_table, suggesting that AQ significantly influences PSA individually. The p-value for the independent variable (X) is 0.000, which is smaller than the significance level ($\alpha = 0.05$), indicating that the probability of AQ affecting problem-solving ability by chance is very low.

The R Square (R^2) value of 0.5505 suggests that 55.05% of the variance in problem-solving ability is influenced by the AQ variable, while the remaining 44.95% is influenced by factors outside the scope of this study. The regression coefficient test revealed that AQ has a regression coefficient of 1.876 with a p-value of 0.000, meaning that for every one-unit increase in AQ, problem-solving ability increases by 1.876 units. The very small p-value indicates that AQ has a significant effect on problem-solving ability.

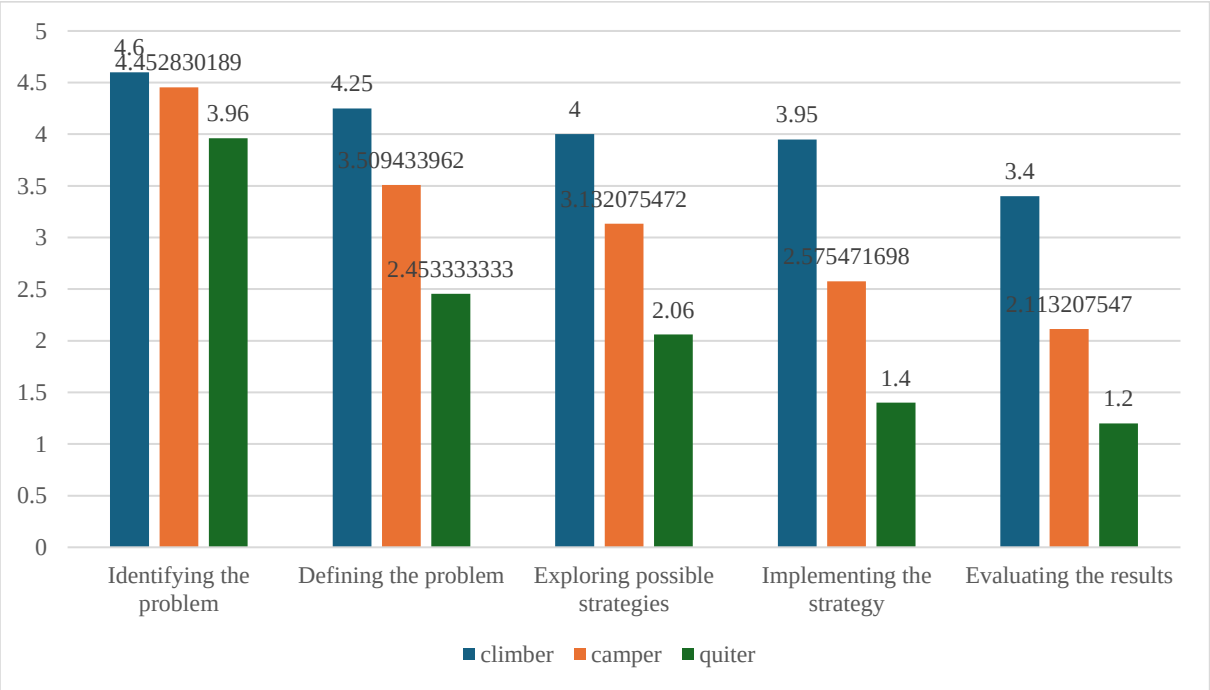

Figure 1. The average score for each AQ category

Figure 1 shows the average scores based on adversity quotient (AQ) types in solving problems. Students with the Climbers AQ type were able to solve problems across all five Bransford-Stein indicators effectively, as indicated by the average score for each indicator being above 3 points, with an overall average final score of 82.5. Students

with the Campers AQ type exhibited moderate resilience in problem-solving. These students were able to solve problems up to the third Bransford-Stein indicator effectively, with average scores for each indicator above 3 points, resulting in an overall final score of 65.9. Students with the Quitters AQ type could only solve two problems based on the first Bransford-Stein indicator effectively. This was reflected by their average score for the first indicator being above 3 points, with an overall final score of 46.8.

Discussion

Problem-solving ability is a crucial cognitive skill in various aspects of life, both in academic and professional contexts (Cynthia & Shihotang, 2023). One psychological factor that plays a role in improving this ability is Adversity Quotient (AQ). In physics learning, AQ refers to an individual's ability to face, endure, and find solutions to problems presented in questions (Napis, 2018). In general, individuals with high AQ (climbers) tend to face challenges proactively, seek creative solutions, and do not give up easily when encountering obstacles. In contrast, individuals with low AQ (quitters) are more likely to experience stress, lose motivation, and struggle to find solutions to problems.

The regression analysis results show that Adversity Quotient (AQ) significantly influences students' problem-solving abilities. High AQ makes students more resilient in facing the challenges presented in questions. Students with high AQ (climbers) view difficult problems as a challenge to explore more solution alternatives. On the other hand, students with low AQ tend to become stressed, hesitate in making decisions, and struggle to find the right solution. The results of this study reinforce the findings of Napis (2018) that adversity quotient has a direct positive effect on students' problem-solving abilities.

When viewed through the Bransford-Stein indicators, students with the AQ climbers type tend to exhibit conceptual thinking, which aligns with research by Na'imah et al. (2022) and Lestari et al. (2023). Climbers can solve all problem-solving indicators optimally. They can clearly identify the problem, analyze it deeply, and distinguish relevant from irrelevant factors. These students can formulate specific goals based on the problems presented. Climbers are always solution-oriented when faced with problems, enabling them to quickly, accurately, and realistically formulate solutions. This is because climbers tend to think conceptually and have a strong understanding of physics concepts, allowing them to find precise solutions. Climbers also remain calm and are not easily stressed when facing difficulties. Furthermore, they reflectively evaluate their answers, not only being satisfied when they have solved the problem, but also double-checking each step to identify possible errors.

Students with the AQ campers type can solve problems, but they tend to stay in their comfort zone, are less exploratory, and give up more easily when faced with greater difficulties. This aligns with findings from Putra & Roza (2020). In terms of identifying problems, campers can identify the issues well. They can pinpoint the problem accurately and differentiate between relevant and irrelevant factors in problem-solving. Campers can define problem-solving goals correctly, but some of them fail to fully read the questions, so they miss parts of the problems. Students with AQ campers can explore possible solutions, but when a solution does not immediately yield an answer, they tend to skip the question and are reluctant to try alternative solutions.

Campers are able to carry out problem-solving strategies well, but they often lack attention to detail during calculations or unit conversions. They feel more comfortable working on problems they already understand and lack confidence when facing new or challenging problems. When evaluating, campers often only check whether the final answer is correct or incorrect, without reviewing the steps to identify possible mistakes made earlier.

In identifying problems, students with the AQ quitter type are generally able to recognize the problem well. However, if the question contains complex information that they have not previously studied, quitters tend to struggle. This is because low AQ makes students less persistent in solving problems, making them less able to identify key factors in solving problems. As a result, they find it difficult to determine which physics concepts or laws are relevant. When quitters find a question too difficult, they prefer to skip it rather than break the problem down into simpler parts. Quitters are less proactive in seeking alternative solutions and tend to rely solely on methods that were previously taught to them. Many of them merely memorize formulas without understanding their application, so when faced with problems that require conceptual understanding, they find it challenging. Quitters tend to avoid the problem rather than attempting it when their current strategy does not immediately yield an answer. Evaluating solutions is often done passively, or not done at all. If they receive an incorrect answer, they do not make an effort to understand the cause of the error (Hilal & Rumbiak, 2022).

Psychologically, AQ plays a role in helping students regulate their emotions and academic stress that may arise from complex problems (Kusumawati, 2018). Emotional regulation and stress management are crucial for maintaining mental clarity when facing academic challenges (Farah et al., 2018). Students with high AQ are more capable of controlling their emotions, making them less likely to panic or give up when they encounter difficulties. Furthermore, AQ contributes to intrinsic motivation and perseverance, where individuals with high AQ view challenges as opportunities for learning and growth, rather than obstacles (Al'atif et al., 2023). AQ also affects cognitive flexibility, which allows students to adapt problem-solving strategies and not be stuck on a single approach. Additionally, AQ is closely related to students' metacognitive abilities (Pebriana et al., 2019). Metacognition refers to the ability to evaluate and reflect on the thinking process involved in problem-solving. Students with high AQ are more likely to reanalyze the strategies they use and correct any errors they made, which helps their problem-solving skills develop continuously. Finally, AQ encourages students to adopt a growth mindset, where they believe their abilities can be improved through consistent effort. Students with this mindset are more likely to persist in the face of academic challenges (Arifudin et al., 2024).

Based on the AQ characteristics in problem-solving described above, it is evident that Adversity Quotient (AQ) plays a significant role in shaping students' mental resilience and perseverance when facing challenges, including problems presented in tests. Students with AQ types Quitters, Campers, and Climbers all conduct an initial analysis of the problems they face, although at varying depths. Furthermore, the three AQ types approach problem-solving differently. Quitters tend to avoid or give up when faced with difficulties because they lack mental resilience and are reluctant to seek further solutions. Campers, on the other hand,

attempt to solve problems but only within safe boundaries. They may find basic solutions but are hesitant to step outside their comfort zone to search for more effective solutions. Meanwhile, Climbers are persistent and determined individuals who continue searching for solutions until the problem is fully solved. They learn from mistakes, evaluate strategies, and try different approaches. Therefore, learning methods in schools need to be adapted to be more challenging and encourage students to confront and solve various problems independently (Putra & Roza, 2020). Challenge-based learning approaches, such as Problem-Based Learning (PBL) or Project-Based Learning (PjBL), can help students build resilience in the face of difficulties while also strengthening their self-confidence in their abilities. Thus, integrating teaching strategies that stimulate AQ not only improves problem-solving skills but also helps develop students' resilience and confidence when facing various future challenges.

Another factor that cannot be explained within this model but also affects students' problem-solving abilities is learning motivation and the learning environment (Santoso et al., 2020). High learning motivation can make students more confident in solving problems, even when faced with complex challenges. Students with strong intrinsic motivation are more likely to demonstrate perseverance and are more motivated to explore various strategies in solving problems. Furthermore, a conducive learning environment, such as a comfortable classroom, teacher support, and access to adequate learning resources, can enhance students' focus and motivation to solve problems independently (Nisrina, 2020). Additionally, a positive social environment, such as collaboration with peers and a learning culture that encourages exploration, can help students develop critical and analytical thinking skills. By creating a learning environment that stimulates curiosity, provides space for discussion, and encourages students to try various problem-solving strategies, schools can help students hone their skills in facing and solving various problems effectively.

CONCLUSION

Adversity Quotient (AQ) has a significant impact on improving problem-solving abilities. AQ fosters perseverance, influences emotional regulation, cognitive flexibility, and the reflective skills necessary for solving problems. Students with high AQ are more resilient under pressure, more creative in finding solutions, and more reflective in evaluating their problem-solving strategies. In contrast, students with low AQ tend to struggle with challenges and are less capable of using effective problem-solving strategies. Students with high AQ are better at facing challenges, remaining calm in difficult situations, and finding effective solutions to problems. Therefore, it is crucial to focus on enhancing this aspect in education by modifying teaching methods and models. This study is limited to examining the impact of Adversity Quotient (AQ) on students' problem-solving abilities, using the Bransford-Stein indicators. Further research could be conducted to explore the effectiveness of modifying teaching methods and models to improve AQ, thereby enhancing students' problem-solving abilities.

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