The Effect of Student Adversity Quotient on Mathematics Test Scores Using PISA Questions

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ARTICLE INFO	ABSTRACT
  	This research aimed to determine the effect of student adversity quotient (AQ) on mathematic test scores of 12th-grade students in Pademawu High School, Pamekasan for geometry material. The questions used in the mathematic tests were PISA questions. The type of research was quasi-experimental research applying a quantitative method, and the populations selected were all students of class XII MIPA, as many as 115 people. By using a purposive sampling technique, the sample members were 90 people. Data was collected using questionnaires and tests. The questionnaire used contained 30 daily events, where each event had 2 questions. The math test contained 2 geometry questions. Furthermore, data collected was analysed using descriptive statistical and simple linear regression analysis. It was obtained that the regression model $Y = 24,328 + 0,373X$ with Y was math test scores and X was AQ scores. From the model, the result showed that there was a significant positive interaction of AQ on the results of mathematic tests at 12th-grade students in Pademawu High School. ***Keywords:*** *Adversity Quotient; Mathematics Test; PISA Questions*

1. Introduction

In formal education, the effectiveness of learning is often measured by the positive changes it instills in students, manifesting in acquired skills, abilities, and knowledge by the end of the educational journey. These outcomes are typically evaluated through report cards or test scores, reflecting the culmination of a student's efforts and dedication to their studies. The learning process is a critical aspect of individual development, enabling students to understand and adapt to their environment [1], fostering behavioral changes across various facets of life [2]. As Skinner posited, learning is a progressive process of behavioral adaptation, with optimal results achieved through reinforcement [3].

Assessment plays a pivotal role in gauging the extent of change brought about by learning. Teachers routinely assess student learning outcomes to gauge their achievement of learning objectives, thereby determining the success of the learning process. However, the learning process is subject to influence from various external and internal factors, encompassing family, school, community, as well as psychological, physical, and societal factors within students [4].

Slameto posits that success in learning is influenced by two primary factors: external and internal [5]. External factors encompass elements such as family, school, and community, while internal factors comprise psychological, physical, and an individual's active engagement within society. Among these internal factors, the Adversity Quotient (AQ) stands out as a significant determinant of learning success. AQ represents an individual's ability to intelligently navigate and overcome challenges. It is frequently associated with one's resilience and capacity to confront difficulties head-on [6].

The student's success in the learning process depends on how they can overcome their difficulties. In this life, including the world of education, the AQ of students cannot be equated. A person's ability to survive in life's difficulties whether consciously or not is a benefit arising from the adversity quotient itself [7]. So, the AQ is considered to be very supportive in improving learning achievement. Someone who has a good AQ will be able to face difficulties. On the other hand, someone who has a bad AQ will experience great difficulties with their problems. AQ is a toughness ability or intelligence in the form of how an individual is resilient in facing the trials experienced and how the individual's ability can overcome them [8].

The research related to AQ was still being carried out by several authors. Parvathy and Praseeda investigated the correlation between AQ and academic problems, highlighting a significant negative relationship with self-esteem among students and teachers [9]. Hulaikah et al. explored the impact of experiential learning and AQ on problem-solving ability in accounting students, noting significant differences in problem-solving abilities based on instructional methods and AQ levels [10]. Pangma et al. analyzed factors influencing AQ, including dominance, self-esteem, enthusiasm, self-confidence, and achievement motivation, although their study did not directly measure students' problem-solving abilities [11]. Muhayana et al. focused on the effect of AQ on mathematics learning outcomes in junior high school students, finding a significant relationship through simple linear regression analysis [12].

Assessment of student learning achievement typically relies on standardized measures, with the Programme for International Student Assessment (PISA) often serving as a benchmark for mathematics learning outcomes [13]. PISA assesses students' skills and competencies acquired from school, applicable to everyday life and various situations, making it a valuable tool for evaluating learning outcomes [14]. However, previous research has not extensively utilized PISA standardized test questions in assessments, which are essential for a comprehensive evaluation of students' skills [15]. This research aims to bridge this gap by exploring the causal relationship between AQ and student learning outcomes using PISA standardized test questions.

Success in learning hinges on the ability to navigate challenges, particularly in subjects like mathematics that require continuous practice and understanding of foundational concepts [16]. This structured nature of mathematics often leads students to encounter difficulties. Variations in students' attitudes towards these challenges are apparent [12].

Some persevere tirelessly, refusing to give up until they succeed. Others, however, may falter midway, feeling defeated by the complexity of the problems. Then, there are those who actively avoid facing these difficulties altogether.

This scenario is evident at Pademawu 1 High School in Pamekasan, where students have shown good abilities but easily get discouraged when faced with difficulties. While the infrastructure and learning environment are conducive to improving student achievement, some students still fall below the minimum completeness criteria, set at 80. Exam results indicate that 94% of 12th-grade students did not meet the criteria. Therefore, this study aims to investigate the influence of AQ on the mathematics test results of 12th-grade students at Pademawu 1 High School, focusing on geometry material. PISA questions are used in the mathematics tests as they relate to students' everyday activities and the application of mathematical knowledge in social life [13].

2. Methods

The method in this research was quantitative. The type of research was quasi-experimental research which were carried out from November 2022 to December 2022 at Pademawu 1 High School. This research took implementation time in odd semester of 2022/2023. It was 2 variables, namely adversity quotient as an independent variable (Y) and test result as a dependent variable (X). The population were all students of class XII MIPA with a total of 115 students spread over 4 classes. The determination of the sample in each class was done by using a purposive sampling technique, namely a sampling technique with certain considerations. Meanwhile, the size of the sample was determined by the Solvin technique. These two techniques were used because they provided a simple size that could represent the population. Therefore, this research that was conducted at Pademawu 1 High School had the total sample of 90 students, where each class was represented by 21 to 23 students.

The data collection was carried out using instruments in the form of tests and questionnaires. The instruments used in this study were an AQ questionnaire and a test about geometry for class XII. The AQ questionnaire was a questionnaire that had been used by 7.500 people with various professions [6]. The results showed that the AQ questionnaire was a valid instrument for measuring people's responses to adversity. This questionnaire had been used in school or company research [17]. The score and categorization of adversity quotient questionnaires were presented in Table 1 below.

Table 1. Adversity quotient category

Score	Student Category
< 60	Quitter
60 − 94	The transition from quitter to camper
95 − 134	Camper
135 − 165	The transition from camper to climber
> 165	Climber

Source: [6]

Meanwhile, the questions used in this test were adopted from the international standard PISA questions as in [18]. This PISA test was a test used to measure cognitive abilities that could be achieved by students [19]. In this research, the author used an essay test in the form of PISA test which consists of 2 geometry questions. Furthermore, the student test results were categorized into the value category as in Table 2.

After the data was collected, the author used the descriptive and inferential statictical analysis with the significant level of 5%. In descriptive statistical, author determined the value of mean, median, mode, standard deviation, range, max and min data. This analysis tool was used to describe the conditions and distribution of research variables. Meanwhile, the inferential statistical was applied to analyze the sample data, and then the results were used to describe the populations. This was conducted to look the causal relationships between independent and dependent variables. Previously, we did the prerequisite test like normality test and linearity test. Finally, we did the hypothesis test using correlation and simple linear regression analysis.

Table 2. The results of the PISA test category

Score	Student Category
< 40	Very low
$41 - 60$	Low
$61 - 70$	Medium
$71 - 80$	High
$81 - 100$	Very high

Source: [20]

3. Results

3.1. Data from the PISA test

Based on the result of the PISA test on 90 students, we get that the maximum data is 100 and the minimum data is 61. Thus, the range of data is 39. Meanwhile, the other results obtained are mean 72,01, median 73, mode 73, and standard deviation 6.482. Therefore, the average of PISA test results is high, and not many variations.

3.2. Data from the Adversity Quotient Questionnaire

Based on the result of the adversity quotient questionnaire on 90 students, we obtained a maximum data of 169, a minimum data of 103, and a range of 66. Moreover, we get other results like mean 127,78, median 127, mode 127, and standard deviation 12.414. Thus, the average of AQ results falls into the camper category and there are not many variations.

3.3. Normality Test

The normality test in this research is solved using Kolmogorov-Smirnov formula using SPSS. Based on the value of asymp. sig., it was found that the value of asymp. sig. on all data is greater than the significant level of 5%, namely $0,200 > 0,05$. Therefore, it can be concluded that the data is normally distributed.

3.4. Linearity Test

The linearity test of AQ and the results of the PISA test is conducted to find out whether the data is linear or not. The linearity test results of AQ to the results of the PISA test can be seen in Table 3. Based on the sig. value of deviation from linearity, we get that the sig. value of deviation from linearity on all data is greater than the significant level of 5%, that is $0,787 > 0,05$. This proves that there is a linear relationship between the variable AQ and the results of the PISA test. Next, analysis can be continued on a simple linear regression analysis.

Table 3. The output of the linearity test

ANOVA Table			Sum of Squares	df	Mean Square	F	Sig.
PISA_Results* AQ_Score	Between Groups	(Combined)	2590,189	39	66,415	2,891	0,000
		Linearity	1909,963	1	1909,963	83,129	0,000
		Deviation from Linearity	680,226	38	17,901	0,779	0,787
	Within Groups		1148,800	50	22,976		
	Total		3738,989	89			

3.5. Hypothesis Test

After confirming the normal distribution and linearity of the data, we proceeded with hypothesis testing using correlation and simple linear regression analysis. Initially, we examined the relationship between two variables through the product-moment correlation. The results are presented in Table 4.

Table 4. The output of correlation analysis

Correlations		AQ_Score	PISA_Results
AQ_Score	Pearson Correlations	1	0,715 **
	Sig. (2-tailed)		0,000
	N	90	90
PISA_Results	Pearson Correlation	0,715 **	1
	Sig. (2-tailed)	0,000	
	N	90	90

**Correlation is significant at the 0,01 level (2-tailed).

Based on Table 4, we get that the value of $r_{count} > r_{table}$, namely $0,715 > 0,209$. It shows that H_0 is rejected and H_1 is accepted. Thus, the correlation coefficient is significant. Meanwhile, if we see the value of the person correlation, then we obtain that the person correlation is 0,715. Based on the interpretations of correlation values, we can conclude that the relationship between the two variables is strong and has a positive relationship [21]. It means that if the AQ score is large, then the results of the PISA test are high. Next, the results of simple linear regression can be seen in Table 5.

Table 5. The output of simple linear regression

Coefficients						
Model		Unstandardized	Coefficients	Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	24,328	4,997		4,868	0,000
	AQ_Score	0,373	0,039	0,715	9,586	0,000

a. Dependent Variable: PISA_Results

Based on the description above, we find that $t_{count} > t_{table}$, namely $9,586 > 1,987$. So, H_0 is rejected and H_1 is accepted. This means that AQ affects the results of the PISA test. Next, we get that sig. value is lower than the significant level of 5%, namely $0.000 < 0.05$. Thus, AQ has a significant effect on the results of the PISA test. We also obtain the regression equation as follows: $Y = 24,328 + 0,373X$. From the coefficient of

determination (R^2), we obtain that the influence of AQ on the results of the PISA test is 51.1%. This determination coefficient (R^2) can be shown in Tabel 6 below.

Table 6. The output of determination coefficient

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	$0,715^a$	0,511	0,505	0,4559

a. Predictors: (Constant), AQ_score
b. Dependent Variable: PISA_Results

4. Discussion

This research has an original purpose, namely to understand the impact of AQ on the results of the PISA test for students in Pademawu 1 High School. This effect can be seen in the results of simple linear regression that have been conducted through the prerequisite tests before, where it can be seen from the functional relationship between AQ and the results of the PISA test. The total sample in this study is 90 students who are the students of class XII MIPA in the 2022/2023 academic year. This research was conducted 4 times in class XII MIPA 1 to class XII MIPA 4. The result of the research shows that there is an effect of AQ on the results of the PISA test.

4.1. Description of the Student's Adversity Quotient

Based on the result of the research, we get that 70 students are included in the camper category with a percentage of 70,78%. Moreover, 19 students are included in the transition from camper to climber category with a percentage of 21,1%. Finally, we get that 1 student is included in the climber category with a percentage of 1,1%. The research results show that most of the 12th-grade students in Pademawu 1 High School are included in the camper category.

According to Stoltsz in [6], the camper's students only dare to take safe risks. They are quickly satisfied with what they have achieved. They have some initiative and effort even though their spirit is low. Thus, their potential is not actualized and only limited to that. They are comfortable with current conditions and do not like big changes.

4.2. Description of the Results of the PISA Test

Based on the research results, we obtained that 36 students are included in the medium category with a percentage of 40%. Next, 53 students are included in the high category with a percentage of 58,9%. Finally, a student is included in the very high category with a percentage of 1,1%. Therefore, it is obtained that the average PISA test scores for all students belong to the high category.

4.3. The Effect of Adversity Quotient on the PISA Test

In this research, it is obtained that there is a positive influence of AQ on the results of the PISA test for the 12th-grade students in Pademawu 1 High School. We can see it from the correlation coefficient of 0.715. This effect can be described by the regression equation $Y = 24,328 + 0,373X$. This linear regression equation can be accounted for through a significance test. Here, we get that $F_{count} = 91,894 > F_{table} = 3,95$. Thus, it shows that our correlation coefficient is significant. It can be interpreted that AQ influences the

results of the PISA test for the 12th-grade students in Pademawu High School. This result was also supported by Nurhayati [22]. The findings showed that AQ could influence the learning motivation on mathematics learning achievement. If learning achievement was not accompanied by AQ, then learning achievement was not good. Conversely, if learning achievement was accompanied by AQ, then learning achievement would be good.

The analysis results show that the determination correlation (R^2) of 0,511 which that the AQ can affect the results of the PISA test by 51,1%. Meanwhile, 48,9% is influenced by other factors. This can happen because AQ is one factor or not only absolute factor that influences the test results. This statement was justified by Suzana and Jayanto [23], namely student learning outcomes could be affected by internal factors and external factors. For the internal factor, the student learning outcomes were affected by motivation, intelligence, anxiety, attention, observation, and so on [5]. The key to student learning success depends on a balance between intellectual, emotional, and adversity.

If we see the regression equation $Y = 24,328 + 0,373X$, then it can be interpreted that when there is an addition of one X value for AQ of 0,373, then the Y value for PISA test results increases by 0.373. Let $X = 0$, $Y = 24,328 + (0,373 \times 0) = 24,328$. It can be suspected that the PISA test results are not influenced by AQ, namely $Y = 24,328$.

Students will find various difficulties in learning mathematics. The difficulties experienced by students at the high school level can be more challenging than students at a lower educational level. According to D'Souza [24], students for every age group had different difficulties, each problem was unique in time and place. Student problems will become complex every time. Therefore, AQ is needed by every student in facing and responding to problems. AQ can influence student learning processes because, in the learning process, the students are required to solve mathematical problems so they can graduate with the best grades.

During this research, students who were in the climber category obtained very high scores. Students who were in the transition from camper to climber category obtained high scores. Meanwhile, students who were in the camper category obtained medium scores. However, some students who were in the camper also obtained high scores. This could happen because they could do the exam by relying on themselves or they were cheating during the exam. The differences in the AQ level of students produced different exam values.

If students want to learn diligently and understand something that they have not understood, then directly or indirectly, they will instill within themselves to always try and face difficulties. Difficulties that dare to go through and be resolved will become abilities no longer obstacles. Students who have these abilities can be said that students who have AQ. The abilities that are already owned will be the first step in pursuing student goals to achieve the best grades, especially in the field of mathematics.

The description above shows that the learning outcome in mathematics can increase if students have a high AQ. Conversely, students who have less AQ can decrease math exam results. From the effect of the independent variable, the regression equation $Y = 24,328 + 0,373X$ can be used to predict the goals to be achieved, namely to improve the math exam results on Geometry material for the 12th-grade students in Pademawu 1 High School.

AQ as a factor influencing student learning outcomes has to obtain attention at this time. The student's AQ increase, then the student's ability to accept mathematics material also increases. If students have AQ in learning mathematics, especially in learning geometry material, then they will be ready to accept and face difficulties during the process of learning mathematics. So, students who have a high AQ can obtain the achievement of good and satisfying learning outcomes. AQ in learning process can provide an understanding that problems must be faced, not avoided. Thus, the obstacles in work problems can easily be overcome and resolved properly. This is the role of AQ in students, namely they can turn obstacles into opportunities.

In order to support student achievement, the rule of parent and teacher is needed to increase the student's AQ because it is internal and depends on material and media from a person. A teacher as a person who educates students at school or a surrogate parent at school must provide advice to students on how they can improve AQ. As intelligence, AQ had 4 dimensions, namely control, origin/ownership, reach, and endurance [12][25]. These have a role in shaping the student's AQ and determining student success in the learning process. Parents and teachers can touch 4 dimensions. For example, we can cultivate a sense of optimism in students. Thus, they have several ways to solve the problems, especially the problems in learning. A person's success in living life is determined by the level of AQ [6].

5. Conclusion

Based on the results above, we could show that there was a positive correlation of AQ on the results of the PISA test at 12th-grade students in Pademawu 1 High School. This was described through the regression equation $Y = 24,328 + 0,373X$ with the determination correlation of 51,1%. Most students fell into the camper category with a percentage of 70,78%.

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