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The Effect of Anxiety on Students' Numeracy Score: A Case Study of PISA 2022

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Abstract

PISA is a triennial international assessment administered to 15-year-old students from countries participating in the OECD. It measures students' reading literacy, mathematics (numeracy), and science competencies. In addition to academic achievement, PISA also assesses various contextual factors at both the school and student levels that may influence student performance. One psychological factor measured in PISA that may affect students' numeracy outcomes is anxiety. This study aims to analyze the effect of anxiety on Indonesian students' numeracy achievement. A simple linear regression model was employed to explain the nature of this effect. The results indicate that anxiety has a statistically significant negative effect on numeracy achievement. However, this factor explains only a small proportion of the variance in students' numeracy outcomes.

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1. INTRODUCTION

The Programme for International Student Assessment (PISA) released the results of the 2022 literacy and numeracy assessment conducted in OECD-participating countries, including Indonesia. This triennial assessment evaluates the literacy and numeracy competencies of 15-year-old students while simultaneously surveying various contextual factors that may influence student achievement. PISA results serve as an important benchmark for educational policy, as the assessment links learning outcomes with students' backgrounds, attitudes toward school learning, and key factors shaping how students learn both inside and outside school (OECD, 2022). This view aligns with Li et al. (2025), who argue that examining the impact of PISA on educational reform provides valuable insights into global education systems and supports reflective policy development.

A notable phenomenon emerged from the PISA 2022 results. The OECD reported an unprecedented decline in average scores, with a 15-point decrease in numeracy and a 10-point decrease in reading literacy. According to the OECD (2022), this decline is attributed to two main factors: the global impact of the COVID-19 pandemic and unresolved long-term structural issues. Although Indonesia improved its ranking to 69th place—rising five to six positions compared to the previous cycle—it still experienced a substantial decline in average scores. These findings suggest that Indonesia's education system requires significant improvement. Beyond measuring literacy and numeracy achievement, PISA also surveys factors influencing students' learning processes, one of which is student anxiety.

Gao (2023) defines academic anxiety as a negative emotional state frequently experienced by students in academic contexts, including anxiety related to the school environment and academic activities such as learning specific subjects and taking examinations. Similarly, Rahmawati et al. (2024) describe academic anxiety as an emotional response characterized by fear, tension, and worry triggered by unpleasant academic situations. Anxiety is an indicator of poor mental health and, if left unaddressed, can negatively affect individuals' quality of life and academic outcomes (Mofatteh, 2020).

Anxiety is a common human experience that influences performance across various situations. At moderate levels, anxiety may motivate individuals to work harder and take responsibility for their tasks. However, excessive anxiety has detrimental effects, including reduced academic performance, increased procrastination, dependence on smartphones, and emotional distress such as depression (Canup, 2016; Niazov et al., 2022; Jiang et al., 2021).

A survey conducted in China revealed that more than 70% of adolescents experienced anxiety and were reluctant to return to school after pandemic-related disruptions (Gao, 2023). This finding indicates that anxiety can emerge even at the most fundamental levels of the education system. Students' success as learners is strongly influenced by their anxiety levels; therefore, schools, as the closest educational environment, are expected to support students in regulating anxiety.

Indonesia, as a Southeast Asian country, also faces challenges related to academic anxiety at the foundational level of its education system. Despite numerous policy reforms and curriculum changes, the issue persists. Mathematics is consistently identified as the subject that induces the highest levels of anxiety. Many students perceive mathematics as difficult, a belief that has been perpetuated across generations. Students often struggle to concentrate in mathematics lessons and view mathematical problems as overly complex (Ratna & Yahya, 2022).

This study is motivated by evidence indicating that academic anxiety negatively affects students' academic performance in Indonesia. Accordingly, this research examines the effect of anxiety on Indonesian students' numeracy achievement based on the PISA 2022 results. The findings are expected to contribute to broader efforts to improve educational quality by incorporating students' psychological factors into educational policy and practice.

2. METHOD

This study utilized secondary data from the PISA 2022 assessment. The analysis focused on the effect of anxiety on Indonesian students' numeracy achievement; therefore, the dataset was first subsetted to include only Indonesian students. Missing data were removed prior to analysis.

Anxiety was treated as an independent student-level variable obtained from questionnaire responses using a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree". The anxiety variable was derived from statements assessing students' emotional regulation, test-related stress, and general nervousness, including items such as: "I get nervous easily," "I worry about many things," "I panic easily," and "I feel nervous about approaching exams."

Anxiety scores were computed by summing responses across all questionnaire items. Students' numeracy achievement was represented by their average mathematics score. A simple linear regression model was employed to examine whether anxiety significantly affected numeracy achievement. Hypothesis testing was conducted using the t-statistic, and statistical significance was

determined based on p-values. All analyses were performed using R software. The regression equation can be expressed as follows:

$$\hat{y} = a + b\hat{x} \quad (1)$$

where $\hat{y}$ represents students' anxiety, a denotes the intercept, b represents the regression coefficient (slope), and $\hat{x}$ represents students' numeracy achievement. The hypothesis testing was conducted using the t-test statistic, which was calculated using the following formula:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad (2)$$

where t represents the Student's t test statistic, r denotes the correlation coefficient, and n represents the number of respondents. The researcher employed R software to perform the data analysis. This study used the p-value as the basis for decision making, where the null hypothesis (H_0) was rejected if the p-value was less than 5%.

3. RESULTS AND DISCUSSION

The final dataset consisted of 13,204 students from 408 schools. Students' numeracy scores ranged from 188.9 to 644.8, with a mean score of 378.5 and a standard deviation of 61.04, indicating substantial variability in numeracy achievement. Overall, an overview of students' numeracy data from PISA 2022 is presented in Table 1 below.

Table 1. Overview of Students' Numeracy Data

Variable	Minimum	Maximum	Mean (SD)	Median
Students' Anxiety	188,9	644,8	378,5 (61,04)	371,2

In addition to descriptive statistics, this study also infers the effect of anxiety using the predefined statistical test. The analysis of the effect begins by specifying the best-fit model in accordance with Equation (1). This model explains the degree of association between the two variables, the direction of the effect, and the slope of the relationship. Based on the results of the analysis, the linear regression model can be expressed as follows:

$$\hat{y} = 426{,}882 - 0{,}094\hat{x}$$

The model indicates that the intercept of the regression equation is 426.882, which represents Indonesian students' baseline numeracy achievement when the anxiety factor is not taken into account. Furthermore, the model shows that an increase of one point in students' anxiety leads to a decrease of 0.094 points in numeracy achievement.

Anxiety has a statistically significant negative effect on students' numeracy achievement ($p - value = 2{,}2 \times 10^{-16} < \alpha, r = -0{,}12$). This finding indicates that lower levels of anxiety are associated with higher numeracy outcomes. However, the relationship between anxiety and numeracy achievement is relatively weak. This result is consistent with previous studies by Nuraini et al. (2024) and Švecová (2024), which reported a weak negative correlation between mathematics anxiety and students' numeracy performance. Furthermore, the coefficient of determination ($R^2 = 0.144$) indicates that approximately 14.4% of the variance in numeracy achievement can be explained by students' anxiety, while the remaining 85.6% is attributable to other factors. This finding suggests that psychological aspects such as anxiety should not be viewed as simplistic variables in explaining academic outcomes (Nuraini et al., 2024).

Anxiety does not always have detrimental effects. In fact, low to moderate levels of anxiety may encourage students to be more productive and enhance their academic performance. However, high levels of anxiety can hinder learning and even serve as a negative predictor of students' academic outcomes, including numeracy achievement (Fauziah & Pujiastuti, 2020). Mofatteh (2020) identified several academic-related factors associated with anxiety, including fear of receiving poor grades, pressure from academic tasks, examinations and assessment processes, negative relationships with teachers and educational staff, lack of subject mastery, and extended duration of study. These factors are interrelated, and if left unaddressed over a prolonged period, they may intensify students' anxiety. Nevertheless, such factors can be mitigated by educators and school staff, who directly interact with students at the school level.

Putwain et al. (2022) suggested that one effective approach to reducing academic anxiety is the implementation of structured skills-based programs. Such programs may include the development of learning skills, anxiety-coping strategies, and enhanced teacher support. Through scheduled practice, gradual simulations, and reflective activities, these interventions can help reduce academic anxiety. One advantage of this approach is that teachers and school staff do not require extensive prior knowledge of psychology to implement the program; however, expertise in this field may further strengthen and expand its positive impact.

In addition, Kamour and Altakhayneh (2021) reported that school-based counseling programs can effectively reduce anxiety among secondary school students. Schools may integrate counseling programs grounded in five core competencies such as self-awareness, self-management, social awareness, social skills, and responsible decision-making into school counseling services and reinforce these competencies within mathematics classrooms.

4. CONCLUSION

Academic anxiety is a common phenomenon experienced by secondary school students across various countries. This psychological factor has been shown to have a statistically significant negative effect on students' numeracy achievement. Based on the simple linear regression model developed in this study, it was found that for every one-point increase in students' anxiety, numeracy achievement decreases by 0.094 points. Although anxiety is not the dominant predictor of students' numeracy performance, this factor nevertheless needs to be mitigated within school settings. Several approaches may be integrated to reduce academic anxiety, including the implementation of structured skills-based programs and the optimization of school counseling services. Since this study relied on secondary data from the PISA 2022 assessment, future research should consider employing more comprehensive and robust questionnaire instruments, as psychological aspects cannot be adequately captured through surface-level measurement alone.

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