

The correlation between mathematics anxiety and mathematics learning outcomes of upper-grade elementary school students

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Abstract.

Mathematics anxiety is an affective condition that may be associated with students' academic performance in mathematics. This study aimed to examine the relationship between mathematics anxiety and mathematics learning outcomes among upper-grade elementary school students. A quantitative research method with a correlational approach was employed. The participants were 23 fifth-grade students selected from four elementary schools using purposive sampling. Mathematics anxiety data were collected using a questionnaire covering cognitive, somatic, and attitudinal dimensions, while mathematics learning outcomes were obtained from students' mathematics final examination scores. Descriptive and inferential analyses were conducted using IBM SPSS Statistics. The Shapiro–Wilk normality test indicated that the data were not normally distributed. Therefore, Spearman's rank correlation was used as the primary hypothesis-testing procedure. The analysis produced a significant negative correlation between mathematics anxiety and mathematics learning outcomes ($\rho = -0.625$, $p = 0.001$, two-tailed). The findings indicate that students with higher levels of mathematics anxiety tend to obtain lower mathematics learning outcomes. However, the interpretation of the findings should be made cautiously due to the small sample size, non-normal data distribution, and limitations in the reported reliability of the measurement instrument. The findings highlight the importance of supportive and student-centered mathematics learning environments that may help reduce students' anxiety and facilitate their engagement in mathematics learning.

Keywords:

Mathematics anxiety;
mathematics learning
outcomes; elementary
school students

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INTRODUCTION

Mathematics is a fundamental subject imparted in formal educational institutions due to its role in fostering students' logical reasoning, problem-solving capabilities, and overall academic growth (Hidayat & Maharani, 2023). However, a significant number of students perceive mathematics as an arduous subject, which can potentially diminish their interest, engagement, and self-assurance in mathematics learning activities.

Mathematics anxiety encompasses the emotional responses of apprehension, apprehension, and tension experienced by students during mathematical learning or examinations. This condition may stem from various factors, including challenges in comprehending mathematical concepts, insufficient preparation, adverse learning experiences, diminished self-confidence, cognitive limitations, and unsupportive learning environments involving educators or parents (Ekawati, 2015; Zanabazar et al., 2023).

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According to Ikhsan's (2019) research, students frequently experienced anxiety when required to solve mathematical problems in front of their peers. This anxiety stemmed from apprehension about making errors, diminished self-assurance, and apprehensions regarding adverse evaluation from both peers and instructors. Consequently, students became reluctant to engage actively in mathematics learning activities, which may exacerbate their level of mathematics anxiety.

To gain a comprehensive understanding of students' mathematics anxiety, several indicators can be employed to identify the symptoms experienced during mathematical learning activities. According to Niut et al. (2020), mathematics anxiety comprises three primary components: somatic, cognitive, and attitudinal dimensions. The somatic aspect encompasses physical reactions such as sweating, nervousness, or elevated heart rate. The cognitive aspect encompasses challenges in concentration, confusion, and apprehension of making errors when solving mathematical problems. Conversely, the attitudinal aspect pertains to negative attitudes toward mathematics, including diminished self-assurance, avoidance of tasks, and reluctance to engage in classroom activities. These components are frequently utilized as indicators for assessing students' levels of mathematics anxiety in educational research.

In their research article, Cavanagh and Sparrow (2010) proposed indicators for developing a math anxiety instrument through the application of Modern Measurement Theory (MMT) using measurement models, specifically Item Response Theory (IRT) and the Rasch model. The IRT model necessitates that test items measure a latent psychological construct (such as math anxiety) that is not directly observable but is assumed to possess a continuous (graded) level of intensity and is measured through a series of interrelated indicators. Conversely, the Rasch model elucidates the relationship between individual ability and test item difficulty, wherein an individual's likelihood of agreeing with or responding to an item is determined by the disparity between the individual's level of latent attribute and the item's difficulty.

Mathematics anxiety can adversely impact students' learning processes and academic performance. Students who experience anxiety during mathematics learning frequently encounter challenges in maintaining concentration, comprehending concepts, and solving problems effectively. Consequently, anxiety may diminish students' confidence and participation in classroom activities, ultimately influencing their mathematics learning outcomes (Wicaksono & Saufi, 2013; Artama et al., 2020).

Mathematics anxiety can cause students to avoid participating in mathematics learning activities due to feelings of discomfort, fear, or a lack of confidence when confronted with mathematical tasks (Prasetyo & Dasari, 2023). This condition can adversely impact students' concentration, motivation, and academic performance, making mathematics anxiety a significant concern in educational research.

Previous studies have investigated mathematics anxiety in various educational settings. Zanabazar et al. (2023) examined the correlation between mathematics anxiety and mathematics achievement among undergraduate students in Mongolia. Lubis et al. (2025) analyzed mathematics anxiety among lower-grade elementary students and its impact on the learning process. Mira et al. (2024) focused on challenges encountered in vocational mathematics learning. Furthermore, Febryliani et al. (2021) explored students' anxiety in solving linear programming problems within virtual classrooms. While these studies have contributed to the understanding of mathematics anxiety, most research has concentrated on secondary school, university, or specific learning contexts. Research investigating the relationship between mathematics anxiety and mathematics learning outcomes among upper-grade elementary school students remains limited, particularly in the context of Indonesian elementary education.

Consequently, this study aims to address this gap by investigating the correlation between mathematics anxiety and mathematics learning outcomes among upper-grade elementary school students. The originality of this research lies in its focus on elementary students and the examination of mathematics anxiety through cognitive, somatic, and attitudinal dimensions within the context of mathematics achievement. The findings are anticipated to provide valuable insights

for educators and educational institutions in the development of more supportive and student-centered mathematics learning environments.

METHOD

Research Design

This study employed a quantitative research method utilizing a correlational approach. The correlational design was chosen due to the study's objective to investigate the statistical relationship between students' mathematics anxiety and their mathematics learning outcomes without manipulating either variable. Mathematics anxiety was designated as the independent variable, while mathematics learning outcomes were designated as the dependent variable. Given the study's purpose of examining association rather than determining a causal effect, the findings are interpreted in terms of relationships between variables rather than causal influences.

Participants

The population comprised fifth-grade students from four elementary schools: SD Negeri Putat, SD Negeri Balonggabus, SD Negeri Kalidawir, and SD Al-Islamiyah Putat. Participants were selected using purposive sampling based on predetermined criteria, including students who had completed the mathematics final examination and were willing to participate in the study. The final dataset consisted of 23 students. The relatively small sample size was considered when selecting and interpreting the statistical procedures.

Instruments and Data Collection

Mathematics anxiety was assessed using a modified version of the Mathematics Anxiety Rating Scale (MARS), specifically adapted for elementary school students. The questionnaire comprised 20 items that encompassed three dimensions of mathematics anxiety: cognitive, somatic, and attitudinal aspects. A two-point response scale ("Yes" and "No") was employed. Higher scores indicated elevated levels of mathematics anxiety.

The mathematics anxiety questionnaire was designed to evaluate students' emotional, cognitive, and physiological responses during mathematical activities. The instrument was developed based on the mathematics anxiety indicators proposed by Hamimah and Andriani (2023), which conceptualize mathematics anxiety as a multidimensional construct comprising three interrelated dimensions: attitude, cognitive, and somatic responses.

The attitude dimension reflects students' emotional dispositions toward mathematics, encompassing feelings of apprehension when performing mathematical tasks, reluctance to engage in mathematics-related activities, and expectations that mathematical tasks will be challenging. The cognitive dimension captures the mental processes associated with anxiety, such as excessive concern about the evaluation of one's mathematical abilities, experiencing a blank mind during problem-solving, and feelings of confusion when confronted with mathematical tasks. Conversely, the somatic dimension represents the physiological manifestations of anxiety, including difficulty breathing, an elevated heart rate, and physical discomfort experienced during mathematics learning.

The mathematics anxiety questionnaire was administered to all participants prior to the intervention to ascertain their initial levels of mathematics anxiety. Based on the total scores obtained, students were categorized into three levels of mathematics anxiety: high, moderate, and low. The indicators utilized to measure each dimension of mathematics anxiety are presented in Table 1.

Table 1. Mathematics anxiety indicators

Math Anxiety Level	Attitude	Cognitive	Somatic
High Anxiety	Feeling afraid to do something	Worried about what people think of him/her	Difficulty breathing
Moderate Anxiety	Not wanting to do what	Blank mind	

Math Anxiety Level	Attitude	Cognitive	Somatic
	he/she has done		Heart rate increases from normal
Low Anxiety	Expecting difficulty	Feeling confused	Feeling uncomfortable during learning

Each student's responses were evaluated based on the Mathematics Anxiety Questionnaire using a five-point Likert scale. The scores for all questionnaire items were aggregated to derive an overall Mathematics Anxiety Score for each participant. The total score was subsequently utilized to categorize students into one of three levels of Mathematics Anxiety—low, moderate, or high—in accordance with the predetermined score intervals. This categorization facilitated the researchers in elucidating the distribution of students' Mathematics Anxiety and in investigating its correlation with Mathematics Learning Outcomes. The score classification employed in this study was adapted from Hakim et al. (2021), as illustrated in Table 2.

Table 2. Classification of students' mathematics anxiety scores

Score	Mathematics Anxiety Level	Description
40–50	Low Anxiety	Students demonstrate positive attitudes toward mathematics and experience minimal emotional, cognitive, and physiological symptoms of mathematics anxiety.
30–39	Moderate Anxiety	Students occasionally experience anxiety-related symptoms when learning mathematics but are generally able to participate in mathematical activities.
10–29	High Anxiety	Students frequently experience emotional, cognitive, and physiological symptoms of mathematics anxiety that may interfere with their engagement and performance in mathematics learning.

Mathematics learning outcome data were obtained from students' official mathematics final examination scores for the odd semester of the 2025 academic year. These scores served as the indicator of students' mathematics achievement because they were derived from standardized school assessments administered under uniform procedures. Prior to data analysis, the mathematics anxiety questionnaire was subjected to validity and reliability testing to ensure the quality of the measurement instrument. Item validity was evaluated using the Pearson product-moment correlation, whereas the internal consistency of the questionnaire was assessed using Cronbach's alpha coefficient. The results indicated that all questionnaire items met the predetermined validity criteria and that the instrument demonstrated satisfactory internal consistency, indicating that it was appropriate for measuring students' mathematics anxiety in the present study.

Data Analysis

Utilizing IBM SPSS Statistics, the data underwent analysis. Initially, descriptive statistics were employed to elucidate the distribution of the variables, encompassing the number of observations, mean, and standard deviation. Given the sample size of 23 observations, the Shapiro–Wilk test was employed to ascertain normality. The null hypothesis of the Shapiro–Wilk test posits that the data exhibit a normal distribution. A significance value below 0.05 signifies evidence against normality. The normality test revealed that the variables did not conform to the normality assumption. Consequently, Spearman's rank correlation emerged as the primary inferential analysis. Spearman's correlation serves as a nonparametric measure of association, suitable when the assumptions requisite for parametric correlation are not adequately met.

The significance level was set at $\alpha = 0.05$. A two-tailed significance test was employed, as the analysis sought to determine whether a statistically significant relationship existed between mathematics anxiety and mathematics learning outcomes without pre-imposing a directional

hypothesis. The magnitude and direction of the correlation coefficient were considered in interpreting the relationship. A negative coefficient indicates that higher values of mathematics anxiety tend to be associated with lower values of mathematics learning outcomes.

To provide pertinent data and facilitate conclusion drawing, data reduction involves simplification, classification, or categorization, as well as the elimination of extraneous data. Post-data reduction, researchers can draw conclusions without initially presenting the data (Fauziah & Pujiastuti, 2020).

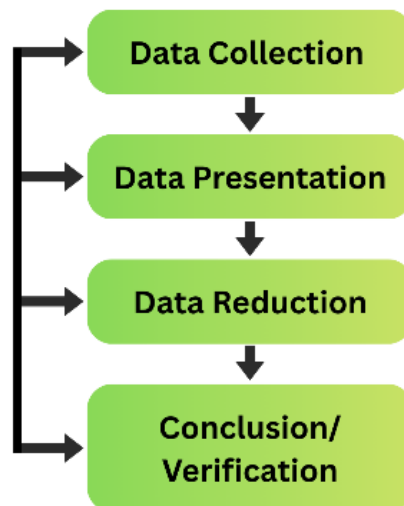


Figure 1. Interactive data analysis techniques

RESULTS AND DISCUSSION

Descriptive Statistics

The raw data comprised 23 observations. Descriptive statistics are presented in [Table 3](#).

Table 3. Descriptive statistics

Variable	N	Mean	SD
Mathematics anxiety	23	10.48	9.30
Mathematics learning outcomes	23	11.04	2.76

The average mathematics anxiety score was 10.48 (standard deviation = 9.30), while the average mathematics learning outcome score was 11.04 (standard deviation = 2.76). The significantly larger standard deviation of mathematics anxiety suggests greater variability in students' anxiety scores. The raw data also indicate substantial differences in students' mathematics anxiety scores. Several students achieved a score of 0, while others attained scores ranging from 6 to 20. In contrast, the learning outcome data exhibited a narrower range of scores. This disparity in variability is pertinent when interpreting the correlation between the two variables.

Normality Test

The Shapiro–Wilk test was conducted due to the sample size of 23 students. The results are presented in [Table 4](#).

Table 4. Shapiro–Wilk normality test

Variable	W	p	Decision
Mathematics anxiety	0.733	< .001	Not normally distributed
Mathematics learning outcomes	0.843	.002	Not normally distributed

The findings reveal that mathematics anxiety data exhibited a non-normal distribution, with a W value of 0.733 and a p -value less than 0.001. Similarly, mathematics learning outcome data also demonstrated a non-normal distribution, with a W value of 0.843 and a p -value of 0.002. Both significance values fell below the threshold of 0.05, indicating that the assumption of normality was not met. Given the study's relatively small sample size and the non-normal distributions of both variables, the primary hypothesis test was conducted using Spearman's rank correlation instead of Pearson's Product Moment correlation.

Correlation Analysis

Table 5. Spearman's rank correlation between mathematics anxiety and learning outcomes

Variables	Spearman's rho	Sig. (2-tailed)	N
Mathematics anxiety – Mathematics learning outcomes	−0.625	.001	23

The Spearman correlation analysis yielded a coefficient of $\rho = -0.625$, with a significance value of $p = .001$. Given that $p < .05$, the null hypothesis of no statistically significant association was rejected. The negative coefficient suggests an inverse association between mathematics anxiety and mathematics learning outcomes in the observed sample. In practical terms, students with higher mathematics anxiety exhibited lower mathematics learning outcome scores, while those with lower mathematics anxiety demonstrated higher learning outcome scores.

The magnitude of the coefficient ($\rho = -0.625$) indicates a relatively strong negative association. Nevertheless, this result should be interpreted as an association rather than evidence that mathematics anxiety directly causes lower mathematics achievement. For comparison, the Pearson correlation calculated from the same raw data was $r = -0.610$, $p = .002$. The similarity in direction and statistical significance between Pearson's and Spearman's results provides additional evidence that the observed association is consistently negative. However, due to the violation of the normality assumption and the small sample size, Spearman's correlation was retained as the primary inferential result.

Interpretation of the Findings

The findings reveal a statistically significant negative correlation between mathematics anxiety and mathematics learning outcomes among the participating upper-grade elementary school students. This suggests that students who reported higher levels of mathematics anxiety tended to achieve lower mathematics learning outcomes. This result aligns with the prevailing belief that mathematics anxiety may be associated with difficulties during mathematical learning. Students who experience fear, tension, or apprehension when dealing with mathematics may encounter challenges in maintaining concentration and confidence when completing mathematical tasks. Such experiences may be linked to less effective engagement in mathematics learning.

The findings are consistent with Artama et al. (2020), who investigated the relationship between mathematics anxiety and mathematics learning outcomes. Cahyani and Wulandari (2021) similarly reported an association between anxiety and mathematics learning outcomes among fifth-grade students. Pratama and Affandi (2023) also reported a negative relationship between mathematics anxiety and mathematics learning outcomes among upper-grade elementary school students. The present finding is also broadly consistent with Barroso et al. (2021), whose meta-analysis reported a negative relationship between mathematics anxiety and mathematics achievement across studies. Caviola et al. (2022) likewise reported an association between academic anxiety and mathematics performance across a substantial body of research.

One possible explanation is that anxiety may occupy cognitive resources that students would otherwise allocate to mathematical reasoning and problem-solving. When students experience fear of making mistakes or excessive concern about their performance, their attention may be divided between the mathematical task and the management of their emotional responses. Consequently, mathematical performance may be associated with students' levels of anxiety. However, the present study does not establish a causal relationship. The correlational design only demonstrates

that the two variables were statistically associated within the observed sample. Other factors may also be related to mathematics learning outcomes, including learning motivation, self-efficacy, prior mathematical experiences, instructional methods, classroom climate, and family support.

Implications for Mathematics Learning

The findings have implications for elementary mathematics learning. Teachers should be attentive not only to students' mathematical achievement but also to their emotional experiences during mathematics learning. Learning activities that emphasize supportive interactions, constructive feedback, opportunities to make mistakes safely, and gradual development of confidence may help create a more positive mathematics learning environment. Students who show signs of mathematics anxiety may benefit from learning activities that provide sufficient preparation, clear explanations, opportunities for guided practice, and encouragement. Interactive learning activities can also provide students with opportunities to participate without excessive fear of negative evaluation.

A supportive classroom environment is particularly important because students' perceptions of classroom experiences and learning control may be associated with mathematics anxiety and subsequent achievement (Putwain & Wood, 2023). Positive learning experiences and teacher encouragement may contribute to students' confidence and engagement in mathematics (Setiani & Lubis, 2024). Nevertheless, these practical implications should not be interpreted as evidence that reducing mathematics anxiety will necessarily cause an increase in learning outcomes. Experimental or longitudinal research would be required to examine causal effects.

Several limitations should be considered when interpreting the findings. Firstly, the study involved only 23 students, which limits the generalizability of the findings to broader populations of elementary school students. Secondly, both variables were found to be non-normally distributed. While Spearman's rank correlation addressed the normality issue for the primary correlation analysis, the non-normal distribution remains an important characteristic of the dataset. Thirdly, the original linearity analysis requires careful interpretation. The reported test showed a significant linear component, but the deviation from linearity was also significant ($p = .000$). Therefore, the result should not be interpreted as evidence of a purely linear relationship between the two variables. Consequently, the present study does not claim that the relationship is linear. Fourthly, the reported reliability results were inconsistent. The first reported instrument had a Cronbach's alpha of 0.991, whereas the second had an alpha of only 0.362. The low reliability value raises concerns about measurement consistency and should be considered when interpreting the correlation result. Lastly, the available analysis does not establish causality. The observed association may be affected by other variables that were not examined in this study. Future research should therefore involve larger and more diverse samples, use instruments with stronger evidence of validity and reliability, and consider additional variables such as mathematics self-efficacy, motivation, instructional practices, classroom environment, and family support. Longitudinal or experimental research could also be conducted to investigate whether changes in mathematics anxiety are associated with subsequent changes in mathematics achievement.

CONCLUSIONS

This study investigated the correlation between mathematics anxiety and mathematics learning outcomes among upper-grade elementary school students. Utilizing data from 23 students, the Shapiro–Wilk test revealed that both variables deviated from normality. Consequently, Spearman's rank correlation was employed as the primary hypothesis-testing methodology. The analysis demonstrated a statistically significant negative association between mathematics anxiety and mathematics learning outcomes ($\rho = -0.625$, $p = .001$). This finding suggests that students exhibiting higher mathematics anxiety tend to achieve lower mathematics learning outcome scores within the observed sample. The results corroborate previous research indicating a link between mathematics anxiety and students' mathematics performance. However, it is crucial to exercise caution in interpreting the findings as causal, given the study's correlational

design. The limited sample size, non-normal distribution, and potential limitations in the reliability of the measurement instruments necessitate caution in generalizing the results. The findings underscore the significance of cultivating supportive and student-centered mathematics learning environments. Teachers can facilitate constructive feedback, provide opportunities for active participation, ensure adequate preparation, and offer learning experiences that foster student confidence when engaging with mathematics. Future research should consider larger sample sizes and more reliable measurement instruments, exploring additional factors potentially associated with mathematics learning outcomes.

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