The Effect of Math Anxiety on Boarding School Students' Mathematics Learning Outcomes during Online Learning

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Abstrak

Sekarang ini siswa menghadapi masalah terkait dengan kurangnya referensi mengenai math anxiety dalam konteks pendidikan sekolah berasrama dan pembelajaran daring selama masa pendemi COVID 19. Penelitian ini bertujuan untuk menganalisis pengaruh math anxiety terhadap hasil belajar matematika dan siswa sekolah berasrama selama pembelajaran daring pada masa pendemi COVID 19. Sampel penelitan ini terdiri dari 182 siswa kelas XII sekolah berasrama. Pemilihan sampel menggunakan teknik simple random sampling. Instrumen yang digunakan berupa angket math anxiety dari Cooke et all dan dokumen hasil belajar matematika. Hasil uji reliabilitas instrumen dengan nilai cronbach alpha 0.968. Analisis data menggunakan analisis deskriptif, uji regresi liner dan uji independet sample t-test. Hasil penelitian ini menunjukkan bahwa (1) tingkat math anxiety sekolah berasrama berada pada kategori rendah, (2) math anxiety berpengaruh signifikan terhadap hasil belajar siswa berdasarkan nilai signifikansi regresi liner sebesar 0,02 yang lebih kecil dari 0,05. (3) terdapat perbedaan yang signifikan antara tingkat math anxiety siswa laki-laki dan perempuan, dimana siswa perempuan memiliki tingkat math anxiety yang lebih tinggi.

Kata Kunci: Kecemasan Matematika, Matematika, Hasil Belajar

Abstract

Currently, students face a lack of references to math anxiety in the context of boarding school education and online learning during the COVID-19 pandemic. This study aims to analyzes the effect of math anxiety on mathematics learning outcomes in boarding school students during online learning during the COVID-19 pandemic. The sample of this research consisted of 182 class XII students in boarding schools. Sample selection uses a simple random sampling technique. The instrument used was a math anxiety questionnaire from Cooke et al. and a mathematics learning outcome document. The results of the instrument reliability test with a Cronbach alpha value of 0.968. Data analysis used descriptive analysis, linear regression test, and independent-sample t-test. The results of this study indicate that (1) the level of math anxiety in boarding schools is in a low category, (2) math anxiety has a significant effect on student learning outcomes based on a linear regression significance value of 0.02 which is a smaller than 0.05, and (3) there is a significant difference between the math anxiety levels of male and female students, where female students have higher math anxiety levels.

Keywords: Math anxiety, Mathematics Learning Outcomes

1. INTRODUCTION

The goal of mathematics instruction was to assist students to gain confidence in their abilities to solve problems mathematically and govern their own success or failure. To put it another way, mathematics education is critical in enabling students to function well in society and solve any difficulties that may emerge (MZ et al., 2017; Vakili & Pourrazavy, 2017). Mathematics is also essential for high school students to continue their studies to a higher level (Shirvani & Guerra, 2015; Ulyah et al., 2021). Therefore students in high school should take mathematics seriously to further their education. However, not all mathematics instruction is booming. One of the variables that influence mathematics learning is math anxiety. Math anxiety is a fearful or tense feeling that affects students' math performance (Dowker et al., 2016; Milovanović, 2020; Muhammad, 2017). According to a previous study, math anxiety is a significant predictor of lower math achievement in students (Agnes &

Mathew, 2019; Dowker et al., 2016; Estonanto, 2018; Milovanović, 2020; Mutlu, 2019; Pantoja et al., 2020; Zhang et al., 2019; Živković et al., 2022).

Various aspects that correlate to math anxiety have been studied by previous researchers such as gender roles, math performance, mathematics ability, learning motivation, and learning style (Al-Shannaq & Leppavirta, 2020; Altakhyneh, 2020; Amam et al., 2019; Milovanović, 2020; Muhammad, 2017; Nyakudya & Nyakudya, 2020). Previous research has investigated the link between gender and math anxiety levels. The previous research findings reveal differences in math anxiety levels between male and female students (Ganley et al., 2021; Nyakudya & Nyakudya, 2020). Meanwhile, the results of other studies show that there are no differences in math anxiety levels between male and female students (Milovanović, 2020). There was no significant gender difference in student performance in mathematics in a previous study that looked at gender differences in math anxiety and mathematics performance (Altakhyneh, 2020; Muhammad, 2017).

The study of the relationship between math anxiety and math performance shows that there is a significant relationship between math anxiety and student performance and hat math anxiety has a negative influence on student performance in learning mathematics (Estonanto, 2018; Milovanović, 2020; Muhammad, 2017; Mutlu, 2019; Orbach et al., 2019). However, other studies have shown no significant relationship between math anxiety and student performance in mathematics (Escarez Jr. & Ching, 2022; Milovanović, 2020; Orbach et al., 2019). Previous research examining the relationship between math anxiety and math skills shows that math anxiety is an essential foundation of math skills in the future (Mutlu, 2019; Pantoja et al., 2020; Sorvo et al., 2017). Other research shows math anxiety is related to arithmetic skills starting in grade 2 elementary school (Sorvo et al., 2017). Another study found a link between state math anxiety and a worse Level of intelligence (Orbach et al., 2019; Shirvani & Guerra, 2015).

In order to overcome math anxiety, a study on the relationship between motivation and math anxiety found that different motivational tactics must be used depending on the gender of students (Estonanto, 2018; Milovanović, 2020; Pantoja et al., 2020). Previous research has also raised concerns about the function of the teacher in overcoming math anxiety (Zhang et al., 2019). To boost student accomplishment in mathematics, teachers must consider not only individual aspects such as self-concept but also the role of the instructor as a learning motivator (Milovanović, 2020; Oda et al., 2021). According to previous research on the association between learning styles and math anxiety, children with kinesthetic learning styles had more math anxiety than students with auditory and visual learning styles (Shirvani & Guerra, 2015). Previous research has examined math anxiety at different levels of education; elementary school, middle school, high school, and university (Caglar & Senol, 2021; Mutlu, 2019; Pantoja et al., 2020; Sorvo et al., 2017). There has not been much research done on math anxiety in a boarding school context so far. Therefore, this study seeks to fill the gap in research on math anxiety for high school students, specifically in boarding schools.

The difference between this study and previous research is in the context of the research conducted on online learning in schools with a boarding system during the COVID-19 pandemic. During the pandemic is carried out using information technology as a learning medium (Ganley et al., 2021; Orbach et al., 2019). Online learning is done either synchronously or asynchronously. Based on the information above, this study aims to analyze the levels of math anxiety among boarding school students participating in online learning during the pandemic, including the impact of math anxiety on boarding school students' achievement.

2. METHODS

This research uses a quantitative approach with an ex post facto type. The variables studied were math anxiety (X) as the independent variable and learning outcomes (Y) as the dependent variable. Instrument creation, instrument validation, and sampling are the first steps in the research process. The population of this study is class XII students for the academic year 2021/2022, totaling 335 students divided into 8 study groups. The sampling technique used is a simple random sample. By using the Slovin formula, a sample of 182 students was determined.

The data collection instruments used were questionnaires and documentation. The questionnaire was filled out by students who became the research sample. Domains the math anxiety questionnaire include 1) somatic, 2) cognitive, 3) attitude, and 4) knowledge/understanding of mathematics (Cooke et al., 2011). The grid of the questionnaire are presented in Table 1.

Table 1. Grid of Questionnaire

No	Domain	Indicator	Question
1	Somatic	Body Shaking	1
		Difficult to breathe	2
		Heart beating fast	3
		Sweat out	4,5
		Weak Body	6
2	Cognitive	Worry	7,15
		Feeling Threatened	8
		Unable to control emotions	9,12
		Can not think straight	10
		Easily Frustrated	11
		Easily Confused	13
		Difficult to Concentrate	14
3	Attitude	Fear	16
		Uncomfortable feeling	17
		Feeling restless	18
		Feeling unsure	19
		Feeling afraid of what to do	20
		Not confident	21
4	Mathematical understanding	Feeling less knowledgeable about mathematics	22
		Feeling afraid of making mistakes	23
		Difficult to concentrate	24
		It is hard to make a decision	25

The questionnaire validity was tested using product-moment correlation. The results of the validity test prove that the 25-question items are valid. The questionnaire's internal consistency was tested using Cronbach Alpha, as shown in Table 2**.**

Table 2. Cronbach's Alpha Result

Subscale	No. of Items	Cronbach's Alpha	Internal Consistency
Math Anxiety	25	0.968	Excellent

Data on student questionnaire answers scores were grouped using a Likert scale consisting of five answer options, namely strongly agree (SS) with a score of 5, agree (S) with a score of 4, doubt (R) with a score of 3, disagree (TS) with a score of 2, strongly disagree (STS) with a score of 1. The Math anxiety level is classified into five categories using ideal mean (Mi) and deviation standard (SDi) with rules where Mi = ½ (highest score + lowest score) and SDi = 1/3 (Mi). The criteria are presented in Table 3.

Table 3. Math Anxiety Level Categories

No	Score Interval	Category	Interval Score
1	$X \geq Mi + 1.8\ SDi$	Very High	$X \geq 120$
2	$Mi + 0.6\ SDi \leq X < Mi + 1.8\ SDi$	High	$90 \leq X < 120$
3	$Mi - 0.6\ SDi \leq X < Mi + 0.6\ SDi$	Moderate	$60 \leq X < 90$
4	$Mi - 1.8\ SDi \leq X < Mi - 0.6\ SDi$	Low	$30 \leq X < 60$
5	$\overline{x} \leq Mi - 1.8\ Sbi$	Very Low	$X \leq 30$

The data analysis technique used in this research is descriptive and inferential analysis. Descriptive analysis to thoroughly describe the math anxiety variable and student learning outcomes during the pandemic in terms of the minimum (Min) and maximum (Max) scores, average score (X), and standard deviation (SD). The inferential analysis is a research activity carried out intended to conclude. The data for this case is taken from some population members and then analyzed, and the conclusions drawn are applied to the population. Simple linear regression analysis is an inferential analysis used in this study. An independent sample t-test was used to determine differences in math anxiety levels based on gender.

3. RESULTS AND DISCUSSION

Result

The results of the descriptive analysis obtained for each variable are the minimum value, maximum value, average score, and standard deviation. The descriptive analysis results can describe students' characteristics of students as research samples based on math anxiety variables and learning outcomes in Table 4.

Table 4. Descriptive Statistics

Variable	Min	Max	mean	SD
X	25	117	57.59	21.72
Y	20	100	63.17	17.87

The results of the classification of students' Math anxiety data according to the categories are presented in Table 5.

Table 5. Categories of Students' Math Anxiety Scores

Scoring Criteria	Category	Frequency	Percentage (%)
Score $\geq$ 120	Very High	-	-
$90 \leq$ Score < 120	High	15	8.24
$60 \leq$ Score < 90	Moderate	69	37.91
$30 \leq$ Score < 60	Low	72	39.56
Score $\leq$ 30	Very Low	26	14.29

Categories of student learning outcomes in mathematics subjects during online learning are shown in Table 6.

Table 6. Categories of Students' Mathematics Learning Outcomes

Scoring Criteria	Category	Frequency	Percentage (%)
Score > 80	Very Good (A)	22	12.09
60 < Score 80	Good (B)	87	47.8
40 < Score 60	Enough (C)	46	25.27
20 < Score 40	Not Enough (D)	23	12.64
Score 20	Very less (E)	4	2.2

The results of the classical assumption test, which includes normality, linearity, and heteroscedasticity are presented in Table 7. The test was performed as a prerequisite before the simple linear regression test.

Table 7. The Results of the Classical Assumption Test of Research Data

Classic Assumption Test	Test Used	Results	Conclusion
Normality	Kolmogorov-Smirnov Test	Sig= 0.073	Data is normally distributed
Linearity	Test of Linearity	Sig deviation from linearity= 0.645	There is a linear relationship between variable X and variable Y
Heteroscedasticity	Glejser Test	Sig mathematics anxiety= 0.562	No heteroscedasticity

Hypothesis testing was carried out using linear regression in the SPSS program. The results of hypothesis testing can be seen in Table 8.

Table 8. Regression Analysis

Model	Unstandardized Coefficient		Standardized Coffee	t	sig.
	B	Std. Error			
(Constant)	73,480	3,600		20,414	0.000
Math anxiety	-1.80	0.059	-.233	-3.070	0.002

The t-test of the independent sample was utilized to show the variations in math anxiety levels based on gender. Table 9 below shows the differences.

Table 9. Result of Independent t-Test of Gender and Math Anxiety

Variable	N	Mean	Std Deviation	Levene's Test for Equality of Variances (sig)	t-test for Equality of Means sig. (2-tailed)
Male	88	52.40	20.221	0.441	0.002
Female	94	62.45	22.060		

Based on Table 9, which shows the output of the t-test calculation, it is known that the value of Sig. Levene's Test for Equality of Variances is 0.441. While in the "equal variances assumed" section, it is known that the value of Sig. (2-tailed) of 0.002.

Discussions

Based on the data, the math anxiety level of students with the highest frequency is in a low category, with a frequency of 72 (39.56%). The second highest frequency was in the moderate category, with a 69 (37.91%) frequency. In the third place, the category is deficient, with a frequency of 23 (12.64%). Next is the high category with a frequency of 15 (8.24%). Based on this information, it can be inferred that most students have low math anxiety (Muhammad, 2017; Vakili & Pourrazavy, 2017; Živković et al., 2022). These results align with several previous studies about the math anxiety performance of 8th-grade junior high school students show that students' math anxiety levels are low (Amam et al., 2019; Huang et al., 2019; Nida et al., 2020).

Then based on the data it is known that the classical assumption test data are normality, linearity, and heteroscedasticity tests. Normality test results with *Kolmogorov-Smirnov Test* obtained a significance value of 0.073 > 0.05. So it can be concluded that the data is normally distributed (Altakhyneh, 2020; Oda et al., 2021). Furthermore, the linearity test with the test of linearity obtained a value of 0.645 > 0.05. Because the significance value is more significant than 0.05, it can be concluded that there is a linear relationship between the variables X and Y. Next, the results of the heteroscedasticity test obtained a significance value of 0.562. It can be concluded that there is no symptom of heteroscedasticity; therefore linear regression test can be performed (Amalia & Surya, 2017; Milovanović, 2020).

Based on the regression calculation data, it is known that the significance value is 0.02 < 0.05. It can be concluded that the Math anxiety variable (X) affects the learning outcome variable (Y). A negative coefficient value means that there is a negative influence between math anxiety on math learning outcomes. An increase in Math anxiety can result in a decrease in mathematics learning outcomes, which is -0.233. Students with high math anxiety levels can have a negative impact, namely decreasing math learning outcomes and vice versa (Agnes & Mathew, 2019; Estonanto, 2018; Shirvani & Guerra, 2015). Although descriptively, most students' math anxiety levels are in the low and moderate categories. The regression calculations show a negative influence between math anxiety levels on learning outcomes. The study's results align with previous research conducted by Estonanto about math anxiety and academic performance in pre-calculus of senior high school in sorsogon state college which shows that math anxiety has a negative effect on the academic performance of students (Estonanto, 2018). The same results are also shown by research conducted by Agnes and Mathew on the impact of math anxiety on student performance in mathematics. This study's results indicate differences in student learning outcomes based on math anxiety levels (Agnes & Mathew, 2019). Likewise, the results of Muhammad's research on math anxiety and math performance of junior high school students show differences in math performance based on math anxiety levels (Muhammad, 2017).

Based on the results of the independent sample t-test, the value of Sig was obtained. Levene's Test for Equality of Variances is 0.441 > 0.05; it can be interpreted that the data variance between the male and the female groups is homogeneous or the same. Value Sig. (2-tailed) of 0.002 < 0.05, so as the basis for decision-making in the independent sample t-test, it can be concluded that H0 is rejected and Ha is accepted. Thus, there is a significant (significant) difference between the average math anxiety level in the male and female groups (Al-Shannaq & Leppavirta, 2020; Ganley et al., 2021; Nyakudya & Nyakudya, 2020).

The findings of gender differences in math anxiety levels from this study further confirm the previous studies. Previous research results show that the effect of math anxiety is

strongest on female students (Milovanović, 2020). Meanwhile, other studies have shown different results. The results on gender differences in math anxiety and math performance of junior high school students showed no significant gender difference in math anxiety levels (Muhammad, 2017). Another research on math anxiety in grade 8 junior high school students showed no difference in math anxiety in terms of gender (Amam et al., 2019). It is supported by other research results showing that there is no significant difference between men and women in math anxiety levels (Altakhyneh, 2020; Guo et al., 2021).

The contribution of this study is to prove that in boarding school students who took part in online learning during the COVID-19 pandemic, the math anxiety level of female students was higher than that of male students. Meanwhile, this research's limitation is that the sample only consists of class XII students. Class XII students take online learning for much longer than other students. Further research can overcome the limitations of this study by involving students of class X and class XI.

4. CONCLUSION

The results showed that during the COVID-19 pandemic, boarding school students took online learning for a relatively long time. Math anxiety significantly influences on the learning outcomes of class XII students in boarding schools. The influence is negative, meaning that the higher the level of math anxiety, the lower the mathematics learning outcomes students obtain. The results of the math anxiety analysis based on gender show that female students have higher math anxiety levels than male students. Based on the findings in this study, it is hoped that educators can conduct a study on student's math anxiety levels. So that teachers can provide assistance and encouragement so students can reduce math anxiety. In the learning process, the teacher should be able to create a fun and contextual mathematics learning atmosphere to reduce students' math anxiety.

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