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The Effect of Mathematics Anxiety and Mathematics Self-Efficacy on Mathematics Academic Achievement

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Abstract

The students' mathematics achievement at SMA Negeri 2 Tarakan remains relatively low, as indicated by the documented results of their daily mathematics tests. This issue can be attributed to several factors, including mathematics anxiety and mathematics self-efficacy. This study examines the influence of mathematics anxiety and self-efficacy on the mathematics achievement of 11th-grade students at SMA Negeri 2 Tarakan, both partially and simultaneously. The research employed a quantitative ex post facto causal model. The sample consisted of 188 students, selected through cluster random sampling, with the sample size determined using the Slovin formula. The research instruments included questionnaires measuring mathematics anxiety and self-efficacy and documenting the students' mathematics achievement. The collected data were analyzed using descriptive and inferential statistics with the help of Jamovi software. The partial analysis results showed that mathematics anxiety significantly negatively affected students' mathematics achievement, with the obtained linear regression equation being $\hat{Y} = 119{,}471 - 0{,}811X_1$. *Additionally, mathematics self-efficacy significantly positively affected students' mathematics achievement, with the linier regression equation being* $\hat{Y} = 15{,}617 + 0{,}786X_2$. *Simultaneously, the analysis revealed that mathematics anxiety and mathematics self-efficacy had a significant combined effect on students' achievement, accounting for 24.8% of the variance, with the multiple linear regression equation being* $\hat{Y} = 62{,}704 - 0{,}494X_1 + 0{,}551X_2$. *Based on the analysis, it can be concluded that both mathematics anxiety and self-efficacy significantly influence students' mathematics achievement, individually anf collectively.*

Keywords: Academic Achievement, Mathematics Anxiety, Mathematics Self-Efficacy.

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INTRODUCTION

Education has a very important role in creating a high-quality younger generation. Education is an effort to provide deliberate and systematic guidance by educators to create a generation with good quality. In the world of education, there will be a learning process that takes place, so learning is the main activity in education (Arfani, 2016). Learning is an activity carried out by students that causes permanent changes in student behavior after participating in training and gaining experience during the learning process (Akhiruddin, Sujarwo, Atmowardoyo & Nurhikmah, 2020, p. 12; Arfani, 2016; Sain, 2014; Wardani, 2022). The purpose of learning is to bring about changes in behavior and actions that can be seen in a student's skills, abilities, attitudes, and competencies so that the expected learning achievements are attained (Akhiruddin et al., 2020, p. 17). Based on the purpose of learning, it can be concluded that learning is closely related to academic achievement.

Academic achievement are the results obtained by students in the form of changes within themselves, including changes in cognitive, affective, and psychomotor aspects after participating in the learning process (Nabillah & Abadi, 2019; Nadeak, 2022; Ravena & Sholih, 2022). Based on the academic achievement obtained by students, teachers can determine the level of ability and development that has occurred in students and see whether the learning objectives that have been formulated have been achieved. It is hoped that student academic achievement in learning will be maximized so that the formulated learning objectives are achieved. However, in reality, student academic achievement in Indonesia are still far from optimal, one of which is in the subject of mathematics. There are several factors that cause low student learning outcomes in mathematics, one of which is psychological factors. Alifa, Hasbi, and Usman (2022) revealed that students' negative perceptions of mathematics are a factor in their low academic achievement. Students' negative perceptions can cause anxiety and fear in students and result in students' doubts about their mathematical abilities.

In line with the results of observations obtained by researchers during preliminary studies at SMA Negeri 2 Tarakan, many students have negative perceptions of mathematics lessons, resulting in anxiety and fear when participating in mathematics lessons. This can be seen when students are asked to come to the front of the class to solve problems; they appear nervous and anxious while working on the problems. Some students also appeared stressed during mathematics lessons. Furthermore, during lessons, many students were unsure of their mathematical abilities, believing that they were incapable of learning and solving problems related to mathematics. During the learning process, many students think that the material being studied is difficult, so they choose to give up on understanding it. Students also often give

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up on doing the assigned tasks and choose to wait for other students to finish so they can see the answers to the assigned tasks rather than having to do them themselves.

The feelings of anxiety, tension, and fear experienced by students during mathematics lessons are commonly referred to as mathematics anxiety. Nurjanah and Alyani (2021) argue that mathematics anxiety is a condition in which students feel anxious, tense, and fearful when participating in lessons or solving problems related to mathematics. Students' memory and inability to use information to solve test questions are among the effects of mathematics anxiety that interfere with their performance in mathematics (Alifa et al., 2022). Several factors cause students to experience mathematics anxiety. Yanti and Yunita (2020) state that the factors causing mathematics anxiety are categorized into three types: personality factors, such as students' fear of their abilities; environmental or social factors, such as the learning models and methods used by teachers and families who force students to be smart in mathematics learning; and intellectual factors, such as students' talents or mathematical intelligence.

This needs to be considered, given that mathematics anxiety affects students' mathematics academic achievement. Based on research conducted by Novia et al. (2020), it was found that mathematics anxiety has a significant negative effect on student academic achievement. The higher the level of mathematics anxiety experienced by students, the lower their mathematics academic achievement will be. Furthermore, research conducted by Irawan, Prayitno, Lu'luilmaknun, and Soeprianto (2023) obtained results stating that mathematics anxiety has a negative influence with a strong level of correlation on students' mathematics academic achievement.

In addition to feelings of anxiety, tension, and fear among students, students' belief in their mathematical abilities, commonly referred to as mathematical self-efficacy, is also a factor contributing to their lack of mathematical ability. Students' belief in their ability to find solutions to mathematical problems is referred to as mathematical self-efficacy (Umaroh, Yuhana & Hendrayana, 2020). Students with high mathematical self-efficacy feel that they are capable of solving the mathematical problems given to them, in contrast to students with low mathematical self-efficacy who feel that they will not be able to solve the mathematical problems given to them and choose to give up. There are several factors that influence students' mathematical self-efficacy. According to Bandura (1997, pp. 79-106), a person will acquire self-efficacy through four main sources, namely: mastery experience, which refers to the experience of students in seeing success in completing the mathematical tasks they face; vicarious experience, which refers to the experience of students in seeing the success of others in completing the mathematical tasks they are facing together; verbal persuasion, which refers to the confidence

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students gain from others to be able to complete the mathematical tasks they are facing; and finally, physiological and affective states, which refer to the physical condition and attitude of students when facing mathematical tasks. Therefore, mathematical self-efficacy has an impact on the mathematics academic achievement that students will achieve.

Based on research conducted by Jamilah and Amin (2023) on the influence of self-efficacy on mathematics academic achievement, the results obtained show that there is a significant influence between self-efficacy and student learning outcomes, where the higher the self-efficacy of students, the higher their learning outcomes, but if the self-efficacy of students is low, their learning achievement will also be low. In addition, in a study conducted by Fitriani and Pujiastuti (2021) on the influence of self-efficacy on mathematics academic achievement, the results obtained showed that there is a significant influence between self-efficacy and student academic achievement.

Based on the results of observations and open interviews conducted by researchers in a preliminary study, students at SMA Negeri 2 Tarakan appear to experience mathematics anxiety and have low mathematical self-efficacy. These two factors need to be considered, given that the low mathematics academic achievement of students at SMA Negeri 2 Tarakan may be caused by these two factors, because students who have high mathematics anxiety and low mathematical self-efficacy are unable to follow the lessons and complete the test questions well. Therefore, the researcher was interested in conducting research on the Effect of Mathematics Anxiety and Self-Efficacy on the Academic Achievement of Grade XI Students at SMA Negeri 2 Tarakan. There are three objectives of this study, namely: to determine the effect of mathematics anxiety on mathematics academic achievement, the effect of mathematics self-efficacy on mathematics academic achievement, and the effect of mathematics anxiety and mathematics self-efficacy on the mathematics academic achievement of grade XI students at SMA Negeri 2 Tarakan.

METHOD

This study used a quantitative approach with an ex post facto causal model method to determine the effect of mathematics anxiety and mathematics self-efficacy on students' mathematics academic achievement. The population in this study was all 11th-grade students at SMA Negeri 2 Tarakan, consisting of ten classes with a total of 355 students. The sampling technique used in this study was cluster random sampling, with the sample size determined using the Slovin formula, resulting in a sample of 188 students from 6 selected classes. To obtain data for this study, the researcher used questionnaires and documentation as data collection

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techniques. The questionnaire used in this study was a closed questionnaire with a Likert scale, with answer options consisting of strongly agree (ST), agree (S), disagree (TS), and strongly disagree (STS). The questionnaire sheet to obtain data on mathematical anxiety was modified from a questionnaire previously used by Cooke and Hurst (2012) in their research, whose indicators were grouped into four aspects, namely mathematical ability (mathematics knowledge), somatic, cognitive, and attitude The questionnaire to obtain data on mathematical self-efficacy in this study was compiled in accordance with the indicators determined by the researcher based on the opinion of an expert, namely Ermannudin (2021), which were grouped into three aspects, namely the task difficulty aspect (magnitude), the task scope aspect (generality), and the confidence and strength aspect (strength). The data analysis technique used in this study employed descriptive statistics consisting of means and standard deviations to determine the levels of mathematics anxiety, mathematical self-efficacy, and mathematics academic achievement of students.

This study also uses inferential statistics consisting of prerequisite tests, which include three tests, namely normality test, linearity test, and multicollinearity test, as well as hypothesis tests consisting of t-tests and simple regression analysis to see the partial effect and f-tests and multiple regression analysis to see the simultaneous effect between mathematical anxiety and mathematical self-efficacy on the mathematics academic achievement of grade XI students at SMA Negeri 2 Tarakan.

RESULTS AND DISCUSSION

Based on research conducted at Tarakan State Senior High School 2, the data obtained by the researcher was then analyzed to obtain the results of the research that had been carried out. Before analyzing the data, the raw data obtained by the researcher was converted into quantitative data. The data scores for the variables of mathematics anxiety and self-efficacy were then converted to a scale of 0–100 to standardize the type of data variables with the mathematics academic achievement variables, where the converted data scores were assumed to be interval data. Next, descriptive statistical analysis was performed so that the researchers obtained the results of the categorization of mathematics anxiety experienced by grade XI students at SMA Negeri 2 Tarakan, as shown in the following table:

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Table 1. Categorization of Mathematics Anxiety and Mathematics Self-Efficacy

Categorization	Mathematics Anxiety		Mathematics Self-Efficacy	
	Frequency	Percentage	Frequency	Percentage
Very High	7	4%	13	7%
High	31	16%	40	21%
Moderate	117	62%	118	63%
Low	33	18%	16	9%
Very Low	0	0%	1	1%

Based on Table 1 above, it is known that there are 7 students or 4% of students who have very high mathematics anxiety, 31 students or 16% of students who have high mathematics anxiety, 117 students or 62% of students who have moderate mathematics anxiety, 33 students or 18% of students who have low mathematics anxiety, and no students or 0% students with very low mathematics anxiety, so it can be concluded that most students in class XI of SMA Negeri 2 Tarakan have moderate mathematics anxiety. It is known that there are 13 students or 7% of students who have very high mathematics self-efficacy, 40 students or 21% of students have high mathematics self-efficacy, 118 students or 63% of students have moderate mathematics self-efficacy, 16 students or 9% of students have low self-efficacy, and 1 student or 1% of students have very low mathematics self-efficacy, so it can be concluded that most students in grade XI at SMA Negeri 2 Tarakan have moderate self-efficacy. Furthermore, the results of the categorization of student mathematics academic achievement variables are shown in Table 2 below:

Table 2. Categorization of Mathematics Academic Achievement

Categorization	Mathematics Academic Achievement	
	Frequency	Percentage
Very Good	24	13%
Good	37	20%
Fair	44	23%
Low	82	44%

Based on Table 2 above, it is known that there are 24 students, or 13% of students, who have excellent mathematics academic achievement, 37 students, or 20% of students, have good mathematics academic achievement, 44 students or 23% of students have adequate

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mathematics academic achievement, and 82 students or 44% of students have low mathematics academic achievement. It can therefore be concluded that most students in grade XI at SMA Negeri 2 Tarakan have low mathematics academic achievement.

After categorization, the researcher conducted inferential statistical analysis consisting of prerequisite tests and hypothesis tests. The results of the prerequisite tests conducted by the researcher showed that the data obtained were normally distributed, formed a linear regression model, and there was no multicollinearity between the independent variables. Next, partial and simultaneous hypothesis tests were conducted, consisting of simple and multiple regression analysis, t-tests (partial) and f-tests (simultaneous), as well as coefficient of determination tests. The results of the partial hypothesis test for the mathematics anxiety variable are shown in Table 3 below:

Table 3. t-test and Simple Linear Regression Analysis on Mathematics Anxiety

Variable	Prediction of Mathematics Academic Achievement		
	Regression Coefficient	t_{count}	*P-value*
Constant	119,471	14,40	0,001
Mathematics Anxiety	-0,811	-6,31	0,001

Based on Table 3, the simple linear regression equation formed is:

$$\hat{Y} = 119{,}471 - 0{,}811X_1$$

and the value t_{count} obtained was -6.31 with a P-value of 0.001. The value t_{count} was smaller than the predetermined t_{table} value, which was $-6{,}31 < -1{,}97287$, and the P-value was smaller than the predetermined significance level, which was $0{,}001 < 0{,}025$. Therefore, it H_0 was rejected, and the conclusion obtained was that there was a significant effect of the mathematics anxiety (X_1) variable on mathematics academic achievement (Y). The results of the hypothesis test for the mathematics self-efficacy variable are shown in Table 4 below:

Table 4. t-test and Simple Linear Regression Analysis on Mathematical Self-Efficacy

Variable	Prediction of Mathematics Academic Achievement		
	Regression Coefficient	t_{count}	*P-value*
Constant	15,617	2,02	0,045
Mathematical Self-Efficacy	0,786	6,83	0,001

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Based on Table 4, the simple linear regression equation formed is:

$$\hat{Y} = 15{,}617 + 0{,}786X_2$$

and the value t_{count} obtained was 6.83 with a P-value of 0.001. The value t_{count} was greater than the predetermined t_{table} value of $6{,}83 > 1{,}97287$ and the P-value was smaller than the predetermined significance level of $0{,}001 < 0{,}025$, so that H_0 was rejected and the conclusion obtained was that there was a significant effect of the variable of mathematical self-efficacy (X_2) on mathematics academic achievement (Y). Furthermore, the results of the simultaneous hypothesis test of mathematical anxiety and mathematical self-efficacy are shown in Table 5 below:

Table 5. t-test and Multiple Linear Regression Analysis

Variable	**Prediction of Mathematics Academic Achievement**			
	Regression Coefficient	t_{count}	*P-value*	**F_{count}**
Constant	62,704	4,00	0,001	30,5
Mathematics Anxiety	-0,494	-3,42	0,001	
Mathematical Self-Efficacy	0,551	4,20	0,001	

Based on the table, the multiple linear regression equation formed is:

$$\hat{Y} = 62{,}704 - 0{,}494X_1 + 0{,}551X_2$$

and the value F_{count} obtained was 30.5 with a P-value of 0.001. The value **F_{count}** was greater than the predetermined F_{table} value, which was $30{,}5 \geq 2{,}996$, and the P-value was smaller than the predetermined significance level, which was $0{,}001 < 0{,}05$, so H_0 was rejected and the conclusion obtained was that there was a simultaneous significant effect between mathematical anxiety (X_1) and mathematical self-efficacy (X_2) on mathematics academic achievement (Y).

The analysis of the coefficient of determination obtained shows that the value R^2 for the effect of mathematics anxiety (X_1) on mathematics academic achievement (Y) is partially 0.176, so that the coefficient of determination obtained is 17.6%. For the effect of self-efficacy (X_2) on

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mathematics academic achievement (Y), the partial R^2 value obtained is 0.201, so the coefficient of determination obtained is 20.1%. and for the simultaneous or combined effect of mathematics anxiety (X_1) and self-efficacy (X_2) on mathematics academic achievement (Y), the value obtained is 0.248, resulting in a coefficient of determination of 24.8%.

Based on the inferential statistical analysis conducted by researchers to determine the effect of mathematics anxiety on the mathematics academic achievement of 11th-grade students at SMA Negeri 2 Tarakan, a value of t_{count} -6.31 with a P-value of 0.001 was obtained. These results indicate that the value t_{count} obtained is smaller than the predetermined value of t_{table} was $-6{,}31 < -1{,}97287$, and the P-value is smaller than the predetermined significance level of $0{,}001 < 0{,}025$. Based on the decision-making criteria, H_0 is rejected, and H_a is accepted. Therefore, the conclusion is that mathematics anxiety has a significant effect on the academic achievement of 11th-grade students at SMA Negeri 2 Tarakan. The regression equation obtained is $\hat{Y} = 119{,}471 - 0{,}811X_1$. The meaning of this regression equation shows that a one-unit increase in students' mathematics anxiety will cause a decrease in students' mathematics academic achievement by 0.811 units. This shows that mathematics anxiety has a significant negative effect on the academic achievement of grade XI students at SMA Negeri 2 Tarakan. In line with the research conducted by Novia et al. (2020), the results obtained in their study show a significant negative effect of mathematics anxiety on students' mathematics academic achievement. Students who experience mathematics anxiety will show anxious, fearful, and tense attitudes that can disturb them during the math learning process or when solving math-related problems, thus affecting their academic achievement. The higher the students' mathematics anxiety, the lower their mathematics academic achievement will be. These analysis results are in line with the results of research conducted by Wardani (2022), which states that mathematics anxiety has a negative impact on student academic achievement. If students' mathematics anxiety is high, it will result in low academic achievement. Conversely, if students' mathematics anxiety is low, their academic achievement will be high.

CONCLUSION

The results obtained by researchers after analyzing the data show that mathematics anxiety has a significant partial negative effect on the mathematics academic achievement of 11th-grade students at SMA Negeri 2 Tarakan, with the simple linear regression equation obtained being $\hat{Y} = 119{,}471 - 0{,}811X_1$. In addition, mathematical self-efficacy also has a significant partial positive effect on the mathematics academic achievement of grade XI students at SMA Negeri 2 Tarakan with the linear regression equation obtained, namely $\hat{Y} = 15{,}617 +$

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$0{,}786X_2$.

Furthermore, the results of the research on the data analyzed simultaneously or together by the researcher show that mathematics anxiety and mathematical self-efficacy have a simultaneous or combined significant effect on the academic achievement of 11th-grade students at SMA Negeri 2 Tarakan of 24.8% with the multiple linear regression equation obtained, namely $\hat{Y} = 62{,}704 - 0{,}494X_1 + 0{,}551X_2$.

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