



Math Anxiety and Self-Efficacy Toward Student Relational Understanding Ability

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Abstrak

This research aims to determine the influence of math anxiety and self-efficacy on relational abilities. This research is quantitative research with correlational methods. The research population included all class XI students at one of the vocational high schools in Metro City. The study consisted of 29 students using a cluster random sampling technique. The instruments for math anxiety and self-efficacy use questionnaires, while the instruments for relational understanding abilities use tests. The data analysis technique uses multiple linear regression. The analysis shows that math anxiety and self-efficacy significantly influence 79% of relational understanding abilities. Math anxiety has a negative but insignificant influence on relational abilities ($r = -0.053$ sig. = 0.60), while self-efficacy has a positive and significant influence ($r = 0.655$ sig. = 0.00). This research implies that it is essential to increase the self-efficacy of each student. Teachers must strive for activities supporting students' self-efficacy, such as providing motivation and guidance during mathematics lessons.

Keywords—Math Anxiety, Self-Efficacy, Relational Understanding Ability.

Introduction

Mathematics is a vital lesson in system education worldwide and is underlying universal science development in modern technology. However, in reality, there are still lots of students who do not like lesson mathematics. This can be seen from the achievement results of study students. During the odd mid-semester summative assessment, the average score of students in mathematics at one of the State Vocational High Schools in Metro City had not yet met the completion criteria. These results are relevant to previous findings that the mathematics achievements of students in Indonesia at the secondary school level are still not optimal (Ningsih & Hayati, 2020).

Achievement of learning outcomes is influenced by various factors, including psychological factors (Budiningsih, 2001; Ningsih et al., 2023). Psychological factors are factors that come from within students which can have an impact on students' academic achievement. Education providers must consider these factors to help the learning process run smoothly.

Math anxiety is a feeling of fear, anxiety, or anxiety that arises when someone is faced with a mathematical task or situation (Sriyanto, 2017). Furner and Berman (Hamimah & Andriani, 2023) describe math anxiety as an "I cannot" syndrome, and math anxiety usually arises due to a person's experience of embarrassing mathematics lessons or inability to apply and use mathematical concepts. Students who experience math anxiety tend to avoid situations where they must study and work on math problems. This anxiety can affect students' performance and concentration when solving problems. Anxiety regarding

mathematics subjects must be given great attention because the inability experienced by students to adapt to mathematics can cause difficulties and even phobias towards mathematics subjects, ultimately impacting learning outcomes and student achievement.

According to Istikomah and Wahyuni (Julya & Nur, 2022), Math anxiety consists of three aspects: the cognitive aspect, which includes self-efficacy, self-confidence, difficulty concentrating, and fear of failure. Affective aspects include feeling anxious, tense, nauseous, and sweating more and physiological aspects include increased heart rate and headaches. Research results (Ikhsan, 2019) show a negative influence between math anxiety and students' mathematics learning outcomes. Other research (Auliya, 2016) shows that math anxiety significantly affects students' mathematical understanding abilities. Mathematics anxiety has a harmful direct and indirect influence on mathematical understanding abilities.

Self-efficacy is the psychological factor that is influential in the results of the study of mathematics. Self-efficacy is a feeling of confidence and trust in one's potential and how much effort and sincerity one needs to face moderate problems (Auliya & Munasiah, 2016). Hackett and Betz (1989: 262) describe mathematics self-efficacy as a situation or problem-specific assessment of an individual's belief in his ability to successfully carry out or complete tasks or problems in mathematics (Moma, 2014). According to Betz & Hackett (in Muhammad Gilar Jatisunda, 2017), self-efficacy.

According to Badura, 1997 (in Indahsari et al., 2019), self-efficacy indicators are divided into magnitude, strength, and generality. The magnitude aspect here measures how students can overcome difficulties in learning. The strength aspect is students' confidence in handling their achievements well. Meanwhile, the general aspect is the belief in oneself to maintain one's abilities in any condition or situation.

The research results (Fitriani & Pujiastuti, 2021) significantly influence self-efficacy and mathematics learning outcomes. Self-efficacy also correlates positively with mathematics learning outcomes by contributing 65.3%, where the remaining 34.7% is influenced by other variables not included in this study. Furthermore, research results (Zaini et al., 2023) show self-efficacy positively influences students' relational understanding abilities. The higher the students' self-efficacy, the higher their relational understanding ability level in working on mathematics problems.

When working on math problems, it is essential to understand how to solve problems. There are two levels of understanding in mathematical concepts: instrumental and relational. Instrumental understanding, namely memorizing concepts or principles without being related to others, being able to apply formulas in simple calculations, and carrying out algorithmic calculations (Santoso, 2017). Meanwhile, relational understanding is a person's ability to apply formulas meaningfully and with reason, relate an idea to other ideas, and prove its truth (Riyani et al., 2017). According to Levana Maharani et al. (2013), relational understanding is the ability to understand and use a mathematical procedure that comes from connecting various relevant mathematical concepts in solving a problem and knowing the reasons for using the procedure.

Students with relational understanding will try to relate new concepts to

concepts they already understand and then reflect on their similarities and differences. According to Skemp (1976) in Prima Mytra and Anggy Heriyanti (2020), indicators of relational understanding include (1) being able to restate a concept correctly, (2) able to clarify objects based on conditions that are met; (3) able to apply the concept and know why the concept is used; (4) able to link several concepts; (5) able to remember and have lots of ideas (Mytra & Heriyanti, 2020).

The results of existing research state that self-efficacy positively influences relational understanding abilities; the higher the self-efficacy a student has, the higher the level of the student's understanding ability in working on mathematics problems (Zaini et al., 2023). Meanwhile, other research results state a direct and indirect influence between mathematics self-efficacy, mathematics anxiety, and mathematical understanding ability. Math anxiety has a harmful direct and indirect influence on mathematical understanding abilities. However, there is not yet research that examines it in a way that joint influences math anxiety and self-efficacy on relational abilities. At the same time, the third variable is vital in mathematics learning. Relational understanding is an essential ability for students, so an analysis of the factors that influence mastery of this ability is needed. Thus, this research will test the influence of math anxiety and self-efficacy on students' relational abilities.

METHODS

This research uses a quantitative approach with correlational methods. The data analysis used is multiple linear regression, namely measuring the level of relationship between two or more variables without any attempt to influence these variables so that there is no variable manipulation. Math anxiety (X_1) and self-efficacy (X_2) are independent variables, whereas the ability to understand relation (Y) is dependent variable. Research design can depicted as follows.

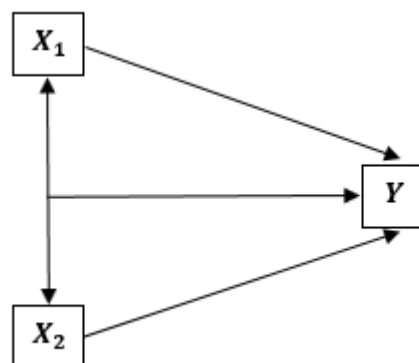


Figure 1. Constellation Problema

The population in this study included all class XI TKJ students in one of the vocational schools in Metro City. The research sample was class XI TKJA students for the 2023/2024 academic year, with a sample of 29 students. The sampling technique uses a cluster random sampling technique, namely a random sampling technique where the entire population can become a research sample. The instruments in this research are questionnaires and tests. The instrument is a

questionnaire consisting of 30 statements each, used to determine how much math anxiety and self-efficacy the students have. Each instrument is prepared based on indicators that have been determined for each variable.

Moreover, its validity and reliability were tested. The results of the validity test for the two variable questionnaire instruments were 1.00, and for the test, it was 0.88 because the V value was more significant than 0.80, so it was in the high category because the instrument was valid. After testing its validity, the instrument was tested. The results of instrument testing for the accepted questions can then be estimated for reliability. The reliability estimation results for the questionnaire had a reliability coefficient of math anxiety (0.72) and self-efficacy (0.80), while the reliability coefficient for relational understanding ability is 0.76. Because it is more than 0.70, it can be concluded that the instrument is reliable. The questionnaire scaling is in the form of a Likert scale whose answer categories consist of five alternatives. The scoring method uses a Likert scale, namely based on positive statements and negative statements, as follows:

Table 1. Alternative Item Scores Answer Respondent

Positive (+)		Negative (-)	
Answer	Score	Answer	Score
Strongly agree	5	Strongly agree	1
Agree	4	Agree	2
Doubtful	3	Doubtful	3
Disagree	2	Disagree	4
Strongly disagree	1	Strongly disagree	5

Test instrument used to know level ability understanding relational student with form test essay consisting of 5 questions about transformation function. Each test instrument is arranged with use indicators assigned to each variable. The research instrument tests the ability to understand relational, questionnaire math anxiety and mathematics self-efficacy. Next, data analysis is carried out quantitatively using multiple linear regression analysis.

RESULTS AND DISCUSSION

Model Feasibility Results

This test shows whether A variable is worth included in the regression model or No is known. Testing uses Pearson correlation.

Table 2. Determination Model Candidate

Variable	Math Anxiety	Self-Efficacy	Relational Understanding
Math Anxiety	1	-.751	-.704
Sig.		,000	,000
Self-Efficacy	-0.751	1	,897
Sig.	,000		,000
Relational Understanding	-.704	,897	1
Sig.	,000	,000	

Based on the model feasibility test results, a mark sig. of 0.000 was obtained for the correlation between variable math anxiety and relational. Meanwhile, a sig. of 0.000 correlates self-efficacy and relational. The results show that mark significance observations obtained to both correlation tests are lacking from 0.05. Therefore, That second variable is included in the regression model.

1. Test Assumptions

a. Residual Data Normality Test

Testing normality is testing the data used. to look at the residual data formed by a linear regression model with a normal distribution or no. Based on the data normality test results with the Mente Carlo test statistic, a Sig value of 0.547 was obtained. Because it is more than 0.05, the residual data formed by the linear regression model is normally distributed.

b. Linearity Test

This test is used To see if every variable has a significant linear relationship. This test was carried out twice: the linearity test between worry with relational and efficacy with worry.

Table 3. ANOVA Test Results

			Sum of Squares	Mean Square	F	Sig.
Relational * Anxiety	Between Groups	(Combined)	2204.023	146,935	2,865	,032
		Linearity	1422,564	1422,564	27,740	,000
		Deviation from Linearity	781,459	55,818	1,088	,442
Relational * Efficacy	Between Groups	(Combined)	2651.940	189,424	12,123	,000
		Linearity	2307.733	2307.733	147,695	,000
		Deviation from Linearity	344,207	26,477	1,695	,170

In the deviation from linearity section, we can see that the Sig. both are 0.442 and 0.170, and this value turns out to be more than 0.05, or it can be concluded that math anxiety and relational understanding abilities and self-efficacy and relational understanding abilities have a significant linear relationship.

c. Multicollinearity Test

Multicollinearity testing is carried out to see whether the linear regression model is limited by multicollinearity. In the VIP table, the value obtained is 2.296 (less than 10), and the tolerance value is 0.435 (less than 0.10), so it can be concluded that the linear regression model is free from multicollinearity.

d. Autocorrelation Test

Autocorrelation testing is carried out to see whether the linear regression model is limited by autocorrelation. Based on the Hajj test in the Durbin-Watson table, a value of **1.861 is obtained**. It is known that the number of independent variables (k) = 2 and the number of samples (n) = 29. The DW table shows that the values of dl = 1.270 and du = 1.563. This value is between 1.563 and 2.437 (4 minus 1.563), so it can be concluded that the linear regression model is free from

autocorrelation. In other words, there is no autocorrelation between the first and second independent variables on the dependent variable.

e. Heteroscedasticity Test

Testing heteroscedasticity is done to see whether or not the linear regression model is limited from existing heteroscedasticity. Based on the test results, a sig value of 0.680 for variable math anxiety and a sig was obtained at 0.315 for variable self-efficacy. Because Sig. these two variables are more than 0.05, it can be concluded that the linear regression model is free from heteroscedasticity.

2. Research Hypothesis

Before carrying out research hypothesis tests, researchers also made the regression line equation. The equation of this line is used to make predictions of values variable bound based on values from variable free. Following this study, variables of math anxiety are given a symbol to compile the regression line equation. X_1 , self-efficacy is given a symbol X_2 , and variables' ability to understand relation as variable bound will given the Y symbol.

Based on the test results above, known as the mark to a constant as big as **34,332**, the mark coefficient to $X_1 = -0.053$ and for $X_2 = 0.655$ to coefficient values, math anxiety is insignificant Because the significance he observed is more than 0.05. Meanwhile, the self-efficacy coefficient value is significant because the observed significance is less than 0.05. The regression line equation is $\hat{Y} = -0.053 X_1 + 0.655 X_2 + 34.332$.

3. Coefficient of Determination

Determining coefficient determination can be done using the same procedure as testing for determining coefficient regression. Pay attention to the table **Model Summary**.

If we look at **the Adjusted R-Square**, we get a value of 0.790. This shows that the proportion of influence of the math anxiety and self-efficacy variables on students' relational understanding ability variables is 79%. This means that the two independent variables have a proportion of influence on relational understanding ability of 79% while the remaining 21% (100% - 79%) is influenced by other variables that are not in the linear regression model. Because it is more than 50%, the regression model formed is in the excellent category.

4. First Hypothesis

Hypothesis testing is First done to determine if there is a significant or no influence between math anxiety and self-efficacy toward the ability to understand relational students. From the results, testing obtained a sig value for the F test of 0.000. Because it lacks 0.05, the hypothesis is accepted. It can concluded that there is a significant influence between math anxiety and self-efficacy toward the ability to understand relational students.

5. Second Hypothesis

Hypothesis testing was second done to determine if there is a negative and significant or no between worrying about mathematics and students' understanding of relational.

From the test results above, the regression coefficient value for the math anxiety variable is -0.053, which is harmful, and for the test results, the Sig value is obtained. of 0.600. Because sig. is more than 0.05, it can be decided that mathematics anxiety has a negative but insignificant influence on students' relational understanding abilities.

6. Third Hypothesis

The third hypothesis testing is done to know if there is a positive and significant or no difference between self-efficacy and the ability to understand relational students.

It is known as coefficient regression. A variable self-efficacy of 0.655 is a valuable positive, and for the test results, the Sig value was obtained at Because the Sig value. Not enough of 0.05 then decide that there is a positive and significant influence on self-efficacy and the ability to understand relational students.

DISCUSSION

Based on coefficient test results, linear regression is obtained. The mark constant is 34.332, and the value mark coefficient for $X_1 = -0.053$ and to $X_2 = 0.655$. So that we can write it down. The regression line equation is $\hat{Y} = -0.053 X_1 + 0.655 X_2 + 34.332$. From Eq That, can we interpret by marking variable Y or the ability to understand relational students? The same is valid H_0 , and if Mark's self-efficacy increases each unit value, Mark's ability to understand relational will also increase by 0.655 units.

Math anxiety has a negative influence of -0.053; however, it is insignificant Because the mark is more than 0.05. Therefore, math anxiety and the ability to understand relationships have negative relationships —however, No significance. The results of this study are consistent with research conducted by (Auliya & Munasiah, 2016), which states that Mathety in fluids influenced in a way No that is not able to related ility, under understanding mathematic such as Mathemathematics efficacy amounting to 37.1%, while the remaining 62.9% were influenced in a way No that was not.

Self-efficacy has a positive influence of 0.655 and is significant because the mark for sig is more than 0.05. Therefore, variable self-efficacy and understanding relational students have positive and significant relationships. So, if self-efficacy exists in students' values, understanding relationships with students is a high value. If students are already confident in themselves, they will feel that every question given is resolved with an understanding of the material being taught before. Apart from students, teachers also need to strive for self-efficacy. For example, students are tall and provide motivation and guidance during mathematics lessons. This aligns with research (Zaini et al., 2023), which states

that self-efficacy positively influences the ability to understand relationships. The more owned self-efficacy students, the higher the level of understanding relational students in finish question mathematics.

The second variable, free, has influenced significant simultaneity to variable bound by 79%, and variables influence the remaining 21%. Through the linear regression analysis above, it is known that a regression model that is formed by more than 50% is included in the excellent category. This means that math anxiety and self-efficacy are among the factors influencing the ability to understand relationships.

The analysis of multiple linear regression is also purposeful in seeing the connection between dependent and independent variables where variable dependent is more than one. The multiple regression equation in the table above is $\hat{Y} = -0.053 X_1 + 0.655 X_2 + 34.332$. From this equation, we can conclude a linear relationship between math anxiety (X_1) and self-efficacy (X_2) with relational understanding ability (Y), where math anxiety has an indirect negative influence because the sig value is more than 0.05. If the self-efficacy value changes, the relational understanding ability will also change by 0.655 units.

CONCLUSION

Based on the results and discussion above, it can be concluded that math anxiety and self-efficacy simultaneously influence 79% of students' relational understanding abilities. If the self-efficacy value increases per unit value, the relational understanding ability value will also increase by 0.655 units. Therefore, the conclusion of this research obtained from the results of the explanation above is that math anxiety has an indirect negative influence because the Sig value is more than 0.05. Meanwhile, self-efficacy has a positive influence on students' relational understanding abilities. The higher the student's self-efficacy, the higher the student's relational understanding abilities.

Based on the research results, researchers have suggested to students that increasing self-efficacy in each individual is very important because self-confidence can also be a strong foundation when we solve problems, whether in mathematics or other subjects. Apart from students, teachers also need to increase students' self-efficacy, for example, by providing motivation and guidance during mathematics lessons. In this way, students can motivate themselves and eliminate anxiety about facing school assignments or problems in our environment.

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