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The Influence of Emotional Intelligence and Inhibitory Control on Mathematical Problem-Solving Ability Mediated by Mathematics Anxiety: A Case Study in a 10th-Grade Class at SMA Kemala Bhayangkari

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ABSTRACT

This study is a study aimed at investigating the influence of emotional intelligence and inhibitory control on mathematical problem-solving ability, with math anxiety as an intervening variable. It is a quantitative, ex post facto research that uses questionnaires and tests as research instruments. The study involved 28 students as subjects. The analytical technique used in this study was path analysis. The study results are as follows: (1) There was no significant influence of emotional intelligence on mathematical problem-solving skills, with a p-value = 0,308. (2) There was no significant influence of inhibitory control on mathematical problem-solving skills, with a p-value = 0,956. (3) There was no significant influence of math anxiety on mathematical problem-solving skills, with a p-value = 0,743. (4) There was no significant influence of emotional intelligence on math anxiety, with a p-value = 0,184. (5) There is no significant influence of inhibitory control on math anxiety, with a p-value = 0,701. (6) There was no significant influence of emotional intelligence on mathematical problem-solving skills through math anxiety, with a p-value = 0,804. (7) There was no significant influence of inhibitory control on mathematical problem-solving skills through math anxiety, with a p-value = 0,914.

INTRODUCTION

Mathematics is one of the subjects taught at every level of education, from elementary to high school. However, in many cases, mathematics is often regarded as a daunting and challenging subject, as well as one that lacks practical relevance for some students (Ernesto et al., 2022; Masduki, 2019; Ningsih et al., 2021; Ratna & Yahya, 2022; Safitri et al., 2015; Sakarti, 2018). This can be observed in several surveys. The first survey was conducted by Opinion Park (2022), involving 500 respondents from various age groups. They were asked to name the subject they disliked the most. The results showed that 51.6% of respondents identified mathematics as their least favorite subject.

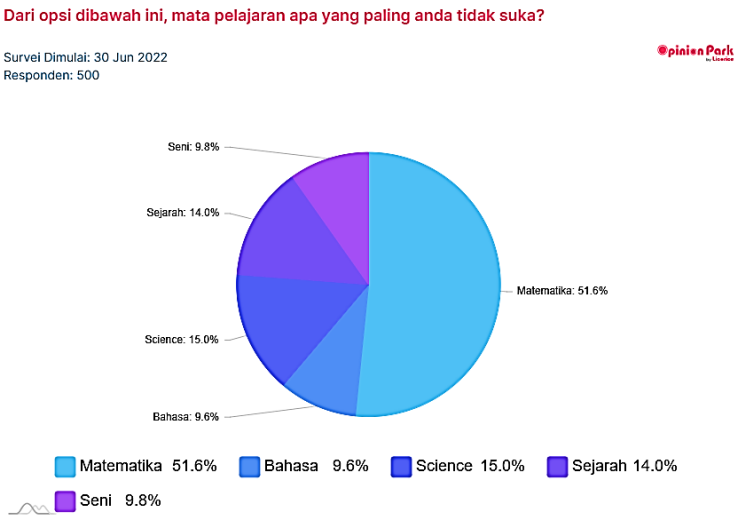

Figure 1. Survey results on the most disliked subjects by respondents
Source: Opinion Park (2022) © 2022 F-plat Inc. All rights reserved.

Similar results were found in a survey conducted by Sinotif (2022), which involved 500 students as respondents. A total of 48.6% of the respondents stated that they liked mathematics. This finding is consistent with the previous survey, confirming that mathematics is often perceived as a challenging subject. Therefore, it can be concluded that there is a significant negative perception of mathematics among students and the public.

This, of course, is a clear indication of a phenomenon known as mathematics anxiety. This phenomenon can be understood as feelings of anxiety, fear, or other negative emotions associated with mathematical activities (Ashcraft, 2002; Harefa et al., 2023; Orabuchi et al., 2013; Sakarti, 2018; Sugiatno et al., 2017). This mathematics anxiety is also evident in the 10th-grade class at SMA Kemala Bhayangkari. Specifically, it is noticeable during the learning process of geometric sequences. Some 10th-grade students have a generally negative response and perception towards mathematics. They feel that mathematics is too difficult, that the math they learned since elementary school was not well understood, and they are unsure about what to ask the teacher. They experience fear and anxiety when asked by the teacher to come up and solve problems, along with various other negative experiences that they have encountered since elementary school.

Similar findings can be seen in a study conducted by Pujiadi (2021) in Central Java, where the results showed that out of 2,240 high school students, 34.51% experienced moderate to high mathematics anxiety. This data certainly provides a basis for understanding that mathematics anxiety is a common phenomenon among students as they reach high school. Several experts in the field of education also argue that mathematics anxiety tends to worsen and accumulate as students get older (Dowker et al., 2016; Wigfield & Meece, 1988).

Table 1
The Research Results Conducted by Pujiadi in Central Java (2021)

No	Level of Math Anxiety	The Number of Students (People)	Percentage (%)
1	High Anxiety	62	2,77
2	Moderate Anxiety	711	31,74
3	Low Anxiety	1191	53,17
4	No Anxiety	276	12,32
	Total	**2240**	**100**

Source: Pujiadi (2021) © Copyright 2022 BBPMP Provinsi Jawa Tengah.

If this issue continues to persist among students, it is not surprising that it will impact their mathematical problem-solving abilities. This assumption is certainly not without basis. One of the theories that suggests anxiety can affect a person's performance is the Yerkes-Dodson Law. This law states that high physiological stress can enhance a person's performance. However, this performance boost only occurs up to a certain point. If the physiological stress becomes too high, it will lead to a decline in performance (Broadbent, 1965; Corbett, 2015; Mellifont et al., 2016; Yerkes & Dodson, 1908). In other words, if we relate this law to the situation of students in the classroom, we can infer that when students experience extreme pressure (anxiety), it will lead to a decrease in their overall mathematical abilities. It has also been stated that mathematics anxiety affects the ability to perform mental arithmetic (Si et al., 2016).

The mathematics anxiety experienced by students is believed to be caused by several factors, including emotional intelligence and inhibitory control. Daniel Goleman's theory of emotional intelligence suggests that individuals with good emotional intelligence are better able to avoid actions that could have negative consequences, both for themselves and for others, such as aggressive behavior and negative emotions (Endriani et al., 2017; Goleman, 1995; Nasution et al., 2023; Suhendro & Agustina, 2022). This theory of emotional intelligence forms the basis for the assumption that mathematics anxiety may be influenced (predicted) by an individual's emotional intelligence.

Some experts also argue that as an individual develops, executive functions (inhibitory control) can reduce behaviors associated with increased self-anxiety. Good inhibitory control is said to enable children to engage in more frequent, satisfying, and successful social interactions, as well as protect them from negative social and emotional outcomes (White et al., 2011). Therefore, these two variables are projected to have an impact on whether mathematics anxiety arises in students.

The relationship between the variables of emotional intelligence, inhibitory control, mathematics anxiety, and mathematics problem-solving skills becomes important to examine and reconsider. These variables should indeed be a point of focus for mathematics teachers. As we know, a good teacher cares about the psychological well-being of their students (Hamid, 2017; Hardianto et al., 2023; Sugiatno, 2009; Tilaar, 2010).

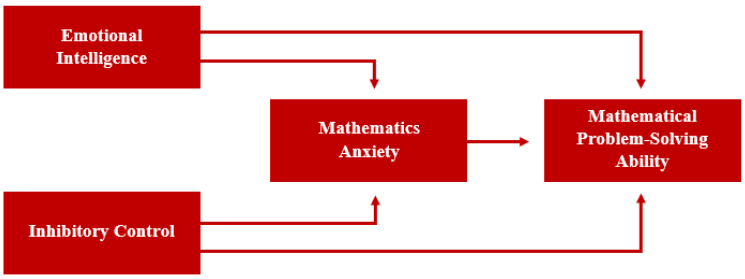

Figure 2. Relationship between variables
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Based on the explanations provided, this study proposes seven hypotheses to be tested. The first hypothesis examines whether mathematics anxiety (Y1) significantly affects students' mathematical problem-solving ability (Y2). The second hypothesis tests whether emotional intelligence (X1) significantly affects students' mathematics anxiety (Y1). The third hypothesis investigates whether emotional intelligence (X1) significantly affects students' mathematical problem-solving ability (Y2). The fourth hypothesis examines whether inhibitory control (X2) significantly affects students' mathematics anxiety (Y1). The fifth hypothesis tests whether inhibitory control (X2) significantly affects students' mathematical problem-solving ability (Y2). The sixth hypothesis investigates whether emotional intelligence (X1) significantly affects students' mathematical problem-solving ability (Y2) through the mediation of mathematics anxiety (Y1). Lastly, the seventh hypothesis examines whether inhibitory control (X2) significantly affects students' mathematical problem-solving ability (Y2) through the mediation of mathematics anxiety (Y1).

RESEARCH METHOD

Research Model

The research model used in this study is an ex post facto research design with a causal (cause-effect) quantitative approach. This type of research is conducted to investigate events that have already occurred and then followed by tracking data to explore the various factors that determine the cause of the events being studied (Kerlinger, 2006; Rahmadi, 2011; Sandu Siyoto & Sodik, 2015).

The causal quantitative approach is a research approach used to examine the relationship between one variable and another, where the variables are considered in a cause-and-effect context. Research using this approach will test existing hypotheses and then investigate the influence of the independent variable on the dependent variable (Rif'at, 2018; Sugiyono, 2016).

Four variables that will be examined in this study. The first variable is emotional intelligence (X1), the second is inhibitory control (X2), followed by the variable of math anxiety (Y1), and finally, the variable of mathematical problem-solving ability (Y2). The subjects of this study consist of 28 students from the 10th grade at SMA Kemala Bhayangkari.

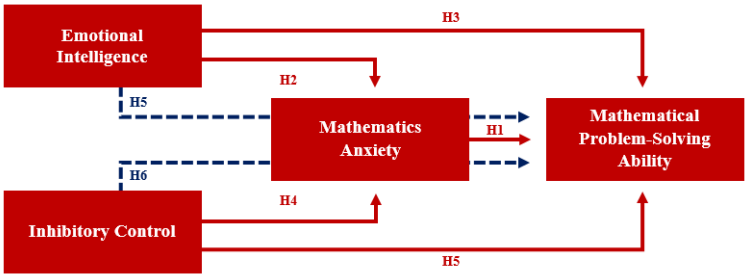

Figure 3. Research hypothesis pathway model
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Research Instrument

Data collection for the emotional intelligence (X1) and math anxiety (Y1) variables will be conducted using closed-ended questionnaires. The emotional intelligence questionnaire consists of 17 items, while the math anxiety questionnaire contains 24 items. For measuring mathematical problem-solving ability, a multiple-choice test consisting of 8 questions will be used. Additionally, the instrument used to measure students' inhibitory control is the Stroop color-word test.

Data Analysis Techniques

The data from the four previous instruments will be analyzed and processed using descriptive statistics and path analysis with the bootstrapping method. Descriptive statistics will provide an overview of the data by calculating the mean, median, mode, and other measures. For path analysis using the bootstrapping method, Elfron and Tibshirani in Suparman (2012) explain that bootstrapping comes from the expression "pull oneself up by one's bootstrap," which translates to "trying to lift oneself with minimal resources."

In the context of this study, minimal resources refer to the limited research data, which may deviate from certain assumptions such as normality, heteroscedasticity, or even data that does not make any assumptions about its distribution. Therefore, the bootstrap technique aims to provide the best possible estimation using minimal data aided by computer software, in this case, SmartPLS 3.

Limitations of the Study

This study is limited to the material of geometric sequences and also uses non-parametric bootstrap statistics. Therefore, the conclusions of the study cannot be generalized broadly. The conclusions will only apply to the sample (subjects) used in this research. This is due to the limited data and the fact that the data does not follow certain assumptions typically required in parametric statistical calculations.

RESULT AND DISCUSSION

Result

The results obtained from the descriptive statistical calculations of the four variables emotional intelligence (X1), inhibitory control (X2), math anxiety (Y1), and mathematical problem-solving ability (Y2) are presented in the following table and figures.

Table 2
The result of descriptive the statistics

Variable	Min	Max	Mean	Mode	Median	Variace	Std. Dev
Y2	1,000	6,000	4,500	6,000	5,000	2,108	1,452
Y1	32,000	70,000	55,214	53,000	57,000	121,749	11,034
X2	-10,000	17,000	-0,464	-3,000	-3,000	63,536	7,971
X1	31,000	46,000	39,821	42,000	41,000	13,075	3,616

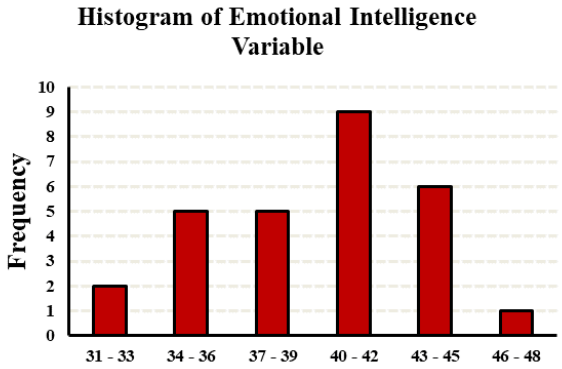

Figure 4. Histogram of emotional intelligence variable
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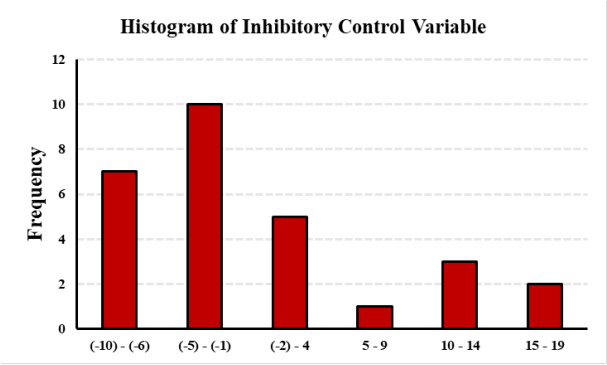

Figure 5. Histogram of inhibitory control variable
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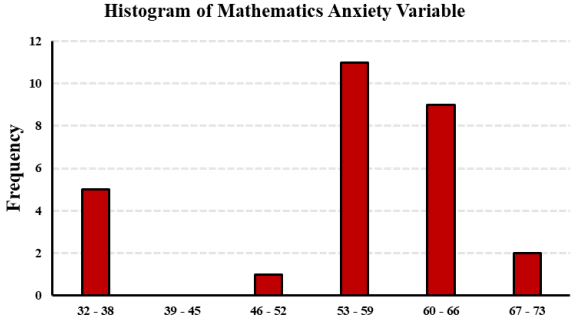

Figure 6. Histogram of mathematics Anxiety Variable
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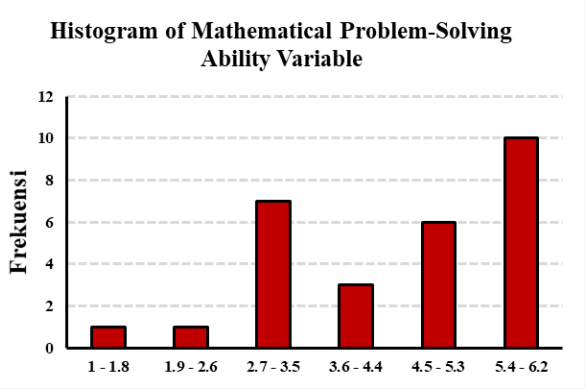

Figure 6. Histogram of mathematical problem-solving ability variable
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Based on the results obtained from the four variables, a path analysis was then conducted using the SmartPLS 3 program with the bootstrap method, setting the addition of 1,000 new random samples. The results of the path analysis can be seen in the following figure and table.

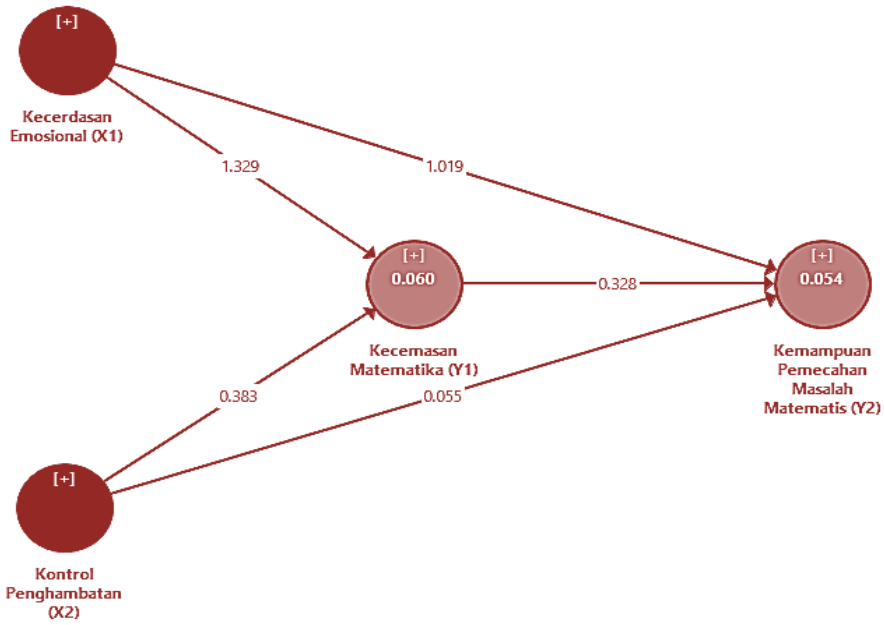

Figure 4. The result of path analysis
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Table 3
The result of path analysis

No	Path	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
1	(Y1) → (Y2)	0,072	0,061	0,220	0,328	**0,743**
2	(X1) → (Y1)	-0,251	-0,237	0,189	1,329	**0,184**
3	(X1) → (Y2)	0,241	0,228	0,236	1,019	**0,308**
4	(X2) → (Y1)	-0,078	-0,083	0,203	0,383	**0,701**

5	(X2) → (Y2)	0,012	0,003	0,214	0,055	**0,956**
6	(X1) → (Y1) → (Y2)	-0,018	-0,030	0,073	0,248	**0,804**
7	(X2) → (Y1) → (Y2)	-0,006	-0,013	0,052	0,108	**0,914**

Discussion

We can observe that the p-values for each path are greater than 0.05. Therefore, the null hypotheses are accepted, and we conclude that there is no significant effect on each of the hypothesized paths. The R-squared value for the model of the effect of emotional intelligence (X1) and inhibitory control (X2) on math anxiety (Y1) is 0.060. This means that the combined effect of X1 and X2 on Y1 is 6%. Thus, we can conclude that 94% of math anxiety is influenced by other variables outside of these two.

Next, in the model examining the effect of emotional intelligence (X1), inhibitory control (X2), and math anxiety (Y1) on mathematical problem-solving skills (Y2), the R-squared value is 0.054. This means that the combined effect of these three variables on Y2 is 5.4%. Therefore, for this model, mathematical problem-solving skills are influenced by factors other than X1, X2, and Y1 to the extent of 94.6%.

The data for the mathematical problem-solving skills variable (Y2) shows a minimum value of 1.000 and a maximum value of 6.000, indicating a wide range of scores. The average value of the data is 4.500, which means that, in general, the values tend to cluster around this number. However, with a variance of 2.108, this indicates that there is a significant spread or variability in the data.

The high variance indicates that the distance between each data point and the mean is quite large. This is supported by a standard deviation of 1.452, meaning that, on average, the data points deviate from the mean by about 1.452 units. Additionally, the mode of the data is 6.000, suggesting that this value appears most frequently or has the highest frequency. Meanwhile, the median is 5.000, indicating that 50% of the data falls below this value and 50% falls above it. Based on this statistical analysis, it can be concluded that the data for this variable is likely not normally distributed.

The data for the mathematics anxiety variable (Y1), based on the previously presented descriptive statistics, shows a wide range of values from 32.000 to 70.000, indicating substantial variability within the data. However, the mean value (55.214) suggests that the data tends to cluster around this number. The difference between the mode (53.000), median (57.000), and mean (55.214) is not significant, indicating that the data distribution is relatively symmetric without significant skewness. Nonetheless, the high variance (121.749) and large standard deviation (11.034) indicate that the data has a broad spread around the mean.

The high variability in the data, as reflected by the large variance and standard deviation values, has several important implications. First, it indicates that the data exhibits significant heterogeneity or diversity, meaning the data values differ substantially from each other and do not cluster around the mean. As a result of this high variability, the reliability or consistency of the analysis results becomes less assured. With

wide fluctuations in the data, the conclusions drawn tend to be less stable and may vary depending on the sample used. Additionally, the data becomes highly sensitive to outliers, as these extreme values can have a large impact on descriptive statistics such as mean, variance, and standard deviation.

The inhibitory control variable (X2) shows a minimum value of -10,000 and a maximum value of 17,000, indicating a relatively wide range. The mean value of -0.464 suggests that, in general, the data is centered around negative values. Both the mode and median, which are both at -3,000, indicate a tendency or concentration of values around that point. The data exhibits considerable variability, as reflected in the variance value of 63,536 and the standard deviation of 7,971.

This indicates that the data has significant dispersion or diversity, is not centralized, and does not cluster around its mean. The very low minimum value of -10,000, while the maximum value reaches 17,000, suggests that the data distribution is skewed, leaning towards the left, i.e., the negative side. This is further supported by the mean value of -0.464, while the mode and median, which are lower at -3,000, indicate a concentration of values on the negative side.

The significant difference between the mean, mode, and median values indicates that the data distribution is not symmetric but has a longer tail towards the right (positive) side. Additionally, the wide range of data, from -10,000 to 17,000, does not align with the characteristics of a normal distribution, which typically has a more limited range. The leftward (negative) skew in the graph also suggests skewness or asymmetry in the data distribution, which is a typical feature of non-normal data.

The final variable is emotional intelligence. Based on the previously obtained statistical values, this data exhibits interesting distribution characteristics. The data range is quite broad, with a minimum value of 31,000 and a maximum value of 46,000, indicating significant variation within the dataset. However, the mean value of 39,821 and the median of 41,000, which are quite close, suggest that the data is generally centered around the middle value. This is further supported by the mode 42,000, which is also not far off, indicating a relatively symmetric data distribution.

On the other hand, the variance of 13,075 and standard deviation of 3,616 reveal that the data's spread from the mean is quite large. On average, the data deviates by about 3.616 units from the central value. In terms of central tendency, the data shows a tendency to cluster around the middle value. The closeness between the mean, median, and mode suggests symmetry in the distribution, which is one of the characteristics of a normal distribution.

When we look at relevant research findings regarding the relationship between emotional intelligence, inhibition control, math anxiety, and mathematical problem-solving ability, such as those found in the studies by Ratna and Yahya (Ratna & Yahya, 2022) and Yani (2022), we can see that math anxiety has a significant impact on students' mathematical problem-solving ability, with influences of 15.5% and 31%, respectively. Additionally, Ghea's (2023) research shows that emotional intelligence also has a significant influence on mathematical problem-solving ability, contributing 23.3%.

Similar studies on the influence of inhibition control on problem-solving ability, such as the one conducted by Galarza (2020), found that inhibition control had an impact of 14% on problem-solving ability. In addition, Alim's (2023) research at SMAN 5 Makassar showed that emotional intelligence had an influence of 40% on academic anxiety. Lastly, White's (2011) study found a significant correlation between inhibition control and anxiety. However, the results of these studies differ from the findings in this research, as hypothesis testing of the paths in this study did not show significant values.

When a coefficient or parameter in statistical analysis is stated as "not statistically significant" based on the T-statistics test or p-value, it has important implications. Simply put, this means that the effect or relationship indicated by the coefficient is not statistically strong or consistent enough to be considered significant. In this context, "not significant" means that we do not have sufficient statistical evidence to conclude that there is a meaningful relationship or effect. The further implication is that the researcher cannot state that the independent variable being tested has a significant influence on the dependent variable in the analyzed model.

The analysis results show that the hypothesized relationships are not sufficiently supported by empirical evidence. This indicates the need for further investigation, such as gathering more data or improving the research design, to achieve statistically significant results. The findings diverge from existing theories and relevant research. This difference may be attributed to the conditions of the students themselves. In general, the relationship between emotions and student performance is not simple. The influence of emotions is likely mediated by different mechanisms, making it difficult to predict its overall impact on student performance (Pekrun, 1992).

The question often arises whether a scientific approach in psychology is truly necessary or if we can reach the same conclusions based solely on common sense. While we all have beliefs about the behavior, thoughts, and feelings of others (often referred to as folk psychology), many of these beliefs may not be entirely accurate. For example, many people believe that emotions such as anger can be alleviated by explicitly releasing them, such as by hitting something or shouting. However, scientific research shows that such approaches tend to make a person feel angrier rather than reduce the anger (Bushman, 2002; Price et al., 2015). Therefore, differing research findings like these are likely due to the complexity of student psychology itself.

CONCLUSION

The analysis results indicate that none of the seven hypotheses tested in the research model were significant. In other words, all initial hypotheses were rejected: (1) mathematical anxiety significantly affects students' mathematical problem-solving ability; (2) emotional intelligence significantly affects students' mathematical anxiety; (3) emotional intelligence significantly affects students' mathematical problem-solving ability; (4) inhibition control significantly affects students' mathematical anxiety; (5) inhibition control significantly affects students' mathematical problem-solving ability; (6) emotional intelligence significantly affects students' mathematical problem-solving

ability mediated by mathematical anxiety; and (7) inhibition control significantly affects students' mathematical problem-solving ability mediated by mathematical anxiety. The influence of variable X1 (emotional intelligence) and X2 (inhibition control) on Y1 (mathematical anxiety) was 6%. Meanwhile, the influence of X1, X2, and Y1 on Y2 (mathematical problem-solving ability) was 5.4%. This means that no significant effect was found in the tested regression model. Based on these findings, the researchers suggest conducting further studies with a larger sample size, improved instruments, and more accurate statistical methods. This aims to better understand the relationships among the four variables, emotional intelligence, inhibitory control, math anxiety, and math problem-solving skills.

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