

Mathematical Disposition and Mathematical Self-efficacy: How Do They Affect Mathematics Learning Outcomes Based On Gender?

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Abstract

Mathematics must be taught in education because it is inseparable from the development of science and technology and in everyday life. In terms of psychology, mathematics learning outcomes are influenced by mathematical disposition and mathematical self-efficacy. Gender is also an important factor in improving students' mathematics learning outcomes. This study aims to determine the effect of mathematical disposition and mathematical self-efficacy simultaneously on students' mathematics learning outcomes in terms of gender. This research is included in quantitative descriptive research with a correlational approach. The independent variables in this study are mathematical disposition and mathematical self-efficacy, while the dependent variable is students' mathematics learning outcomes. The population of this research is X and XI grade high school students in Yogyakarta. The sample of this study amounted to 189 respondents, with 110 males and 79 females. The results of this study are: 1) mathematical disposition has a significant influence on mathematics learning outcomes in male female students; 2) mathematical disposition has a significant influence on mathematics learning outcomes in female students; 3) mathematical self-efficacy has a significant influence on mathematics learning outcomes in male students; 4) mathematical self-efficacy has a significant influence on mathematics learning outcomes in female students; 5) mathematical disposition and self-efficacy simultaneously have a significant influence on mathematics learning outcomes in male students; 6) mathematical disposition and self-efficacy simultaneously have a significant influence on mathematics learning outcomes in female students; 7) mathematical disposition has a significant effect on mathematics learning outcomes when mathematical self-efficacy is taken into account in male students; 8) mathematical self-efficacy has no significant effect on mathematics learning outcomes when mathematical disposition is taken into account in male students; 9) mathematical disposition has no significant effect on mathematics learning outcomes when mathematical self-efficacy is taken into account for female students; 10) mathematical self-efficacy has no significant effect on mathematics learning outcomes when mathematical disposition is taken into account for female students.

Introduction

The development of science and technology and daily life is inseparable from mathematics so that mathematics is mandatory in the world of education. It is important for math to be mastered from an early age to parents considering that math learning is an important part of education (Siahaan et al., 2019). Starting from the elementary school level to the lecture level. The abilities that students are expected to have are the ability to logic, analyze, think critically, creatively, and the ability to discuss in mathematics learning (Bernard, 2015; Islamiah et al., 2018; Chotimah et al., 2019). Not limited to the ability to increase knowledge, but including knowledge in shaping the character of good students (Chotimah et al., 2019).

Students certainly have different characters, as well as a diverse sense of enthusiasm for knowledge. Some characteristics can be a factor in improving their math learning outcomes, especially when the learning methods used are appropriate. One of the characters that can be formed is the student's attitude of curiosity, perseverance, confidence, and interest in learning mathematics or referred to as mathematical disposition (Hendriana & Soemarmo, 2017).

In terms of psychology, students' mathematical disposition is an important factor in students' mathematics learning outcomes. Research by Lestari et al. (2016) revealed that mathematical disposition has a real contribution to their mathematics learning outcomes, especially for integral material by 19%. The same thing also applies to students at the junior high school level. suggested that 21.9% of junior high school students' mathematics learning outcomes were influenced by their mathematical disposition. At the elementary level, mathematical disposition also has an impact on the understanding of mathematical concepts although it is not so significant (Febriyani et al., 2022). Thus, in general, from elementary to high school level, mathematical disposition is an important element that binds mathematics learning.

Self-efficacy is also a student's social character that has an impact on math learning outcomes. According to Ningsih dan Hayati (2020), on average, students who have high math learning outcomes have good self-efficacy. Likewise, on the contrary, students with poor self-efficacy will quickly give up during the math learning process so that the results are not satisfactory. With a contribution of 65.3% from self-efficacy and 34.7% from external factors, self-efficacy has a significant real influence in determining student learning outcomes. However, this contribution is expected to be different according to gender. Gender in math learning is important in improving students' math learning outcomes. According to Hafidz (2019) there is an influence of gender on the mathematics achievement of junior high school students. According to Hidayat dan Dwiningrum (2016) in contrast to elementary school students, gender characteristics do not have a significant effect on student math learning outcomes. At the high school level, gender actually affects student math learning outcomes. Suryaprani et al. (2016) conducted research in several high schools in Denpasar and found that gender has a direct influence on their math learning achievement.

The finding in this research is to identify the effect of mathematical disposition and mathematical self-efficacy together on mathematics learning outcomes based on gender. Therefore, the purpose of this research is to determine the effect of mathematical disposition and mathematical self-efficacy simultaneously on mathematics learning outcomes based on gender.

Methods

This type of research is correlational with a descriptive quantitative approach. This research aims to find out how students' mathematics learning outcomes are affected by mathematical disposition (X_1) and mathematical self-efficacy (X_2) based on gender. The response variable is students' mathematics learning outcomes ("Y" or in the regression equation " \hat{Y} "), the predictor variables are mathematical disposition (X_1) and mathematical self-efficacy (X_2), while the control variable is gender. The independent factors include mathematical disposition and mathematical self-efficacy. The research design to be conducted is depicted in Figure 1 below:



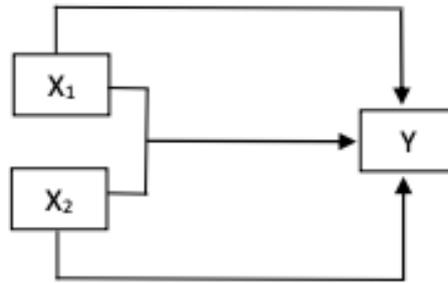


Figure 1. Research Design

All high school students in Yogyakarta in grades X and XI became the population of this study. The sampling used a random sampling approach. There were 189 students who became the sample of this study, 110 male students and 79 female students. The approach used in data collection is to use documents and questionnaires. Mathematics self-efficacy scale and mathematical inclination scale were the non-test instruments used.

The mathematical self-efficacy scale was tested for content validity using Expert Judgement and measured by the Aiken index formula and reliability estimation using the Cronbach Alpha formula, while the mathematical disposition scale was taken from Maherta (2023). The results of this research revealed that the Cronbach Alpha score was 0.717 and the Aiken index score was 0.99. There were 28 and 17 statement items for the mathematical disposition and mathematical self-efficacy scales, respectively. The documents of the mathematics teacher concerned provide information about student learning outcomes in mathematics. The following is the research grids for the mathematical self-efficacy and disposition scales.

Table 1. Mathematical Disposition Scale and Mathematical Self-efficacy Scale

Predictor Variables	Aspects	Indicators	Statements		Total
			(+)	(-)	
Mathematical Disposition (X ₁)	Self-confidence	Confidence in solving maths problems.	1	-	
		Ability to communicate opinions in learning mathematics.	15, 21	2, 9	
	Curiosities	Interest in learning maths.	3, 10	22	
		Have curiosity in learning mathematics.	16, 23	4	
	Perseverance	Take learning seriously.	28	11, 17	
		Persevere and persevere in solving maths problems.	18	5	28
	Flexibility	Trying different strategies to solve maths problems.	6, 12	24	
		Seeking various learning resources to improve maths skills.	19, 25	-	
	Reflective	Reflecting on the thinking process in solving mathematical problems.	7, 13	26	
		Reflecting on own abilities in learning mathematics.	20, 27	8, 14	
Mathematical Self-efficacy (X ₂)	Power Level	Confidence to complete a certain	1, 10	4, 12	
	Level Task	Confidence to self-motivate, and act accordingly	5, 13	2, 11	
		Self-belief to strive hard, persevere, and be diligent	9	7, 15	17
	Field Area	Confidence to persevere against distractions, and problems	3	6, 14	
		Self-confidence to solve a problem under various conditions	8, 16	17	

Descriptive statistics are carried out to determine the overall characteristics of the sample under study. Prerequisite tests are carried out before conducting linear regression tests. The tests carried out include data normality, multicollinearity between independent variables, and data heteroscedasticity. The data was analyzed using the help of SPSS 25.00 software. The formula used to calculate the t_{hitung} value according to Sugiyono (2020) is as follows.

$$t = \frac{\bar{X} - \mu_0}{\frac{s}{\sqrt{n}}} \quad (1)$$

with:

- t : t score
- \bar{X} : average score
- μ_0 : hypothesis score
- s : standard deviation
- n : number of respondents

Before conducting t-tests and F-tests, it is important to ensure that some traditional assumption test conditions are met. The F-test can be conducted under the assumption that the sample groups being analyzed are of equal size, although not homogeneous. This is in line with the findings of Kleinbaum dan Kupper (1978), who showed that in both the t-test and F-test, the F-test retains its sensitivity even when the sample groups are not homogeneous, as long as the sample sizes are equal. According to Minium (1978), if the sample groups have a large and equal number of participants, the heterogeneity of variance among them has no impact on the F test findings.

This study used a sample size of 103 students, which indicates that this sample can be considered as a population that is almost representative of a normal population. According to Minium dan Clarke (1982), as the sample size increases, the sampling distribution of the means tends to normalize, even for populations that are not normally distributed. If the sample size is above 30 and 40, the resulting t value will be quite accurate even if the population is not normally distributed. Therefore, both the t-test and F-test can be performed as they are both resilient. According to Swediati (2001), some experts argue that the t-test and F-test are considered 'robust', indicating that these statistical tests can still be used and produce accurate findings even if the underlying assumptions are violated, without compromising the research. In this scenario, the t-test and F-test can be performed directly, without the need to conduct conventional assumption tests first. However, to ensure the reliability of the data, this study still conducts the necessary classical assumption tests.

Result

1.1. Descriptive Statistics

The research findings show that the data has the properties outlined in Table 1. As stated below. The maximum math learning outcome for male learners was limited to 80, but female learners had higher outcomes, reaching 100. In addition, female students achieved a mathematical self-efficacy score 4 points greater than males, reaching a total of 63. In terms of mathematical disposition, female learners tended to be lower, with a score of 103, while male students scored 106. Nevertheless, the majority of female students have a greater mathematical disposition rating than male students. This is based on the average score of mathematical disposition of female students which reached 74.14, while male students only 71.14.

Table 2. Descriptive Statistics

Gender	Keterangan	Jumlah	Perolehan skor minimum	Perolehan skor maksimum	Skor maksimum yang diperoleh	Skor rata-rata	Standar deviasi
Male	Math learning outcomes	110	0,000	80,000	100	35,240	17,970
	Mathematical Disposition	110	52,000	106,000	112	71,150	9,210
	Mathematical Self-efficacy	110	25,000	59,000	68	42,090	6,920
Female	Math learning outcomes	79	6,670	100,000	100	40,510	23,080
	Mathematical Disposition	79	57,000	103,000	112	74,140	9,110
	Mathematical Self-efficacy	79	30,000	63,000	68	42,280	6,550

1.2. Normality Test

The data normality test, conducted with 189 degrees of freedom (df), resulted in significant Kolmogorov-Smirnov and Shapiro-Wilk values of 0.00 and <0.05, respectively. Therefore, the data does not follow a normal distribution.

Table 3. Normality Test Result

Variable	Kolmogorov-Smirnov	Shapiro-Wilk
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	df	Significance	df	Significance
Math learning outcomes	189	0,000	189	0,000

1.3. Multicollinearity Test

Based on the SPSS output in Table 4, it is known that the tolerance value obtained is 0.351, which is above the 0.1 threshold. Furthermore, the VIF (Variance Inflation Factor) score is 2.849, which is below the threshold of 10.00. Therefore, there is no visible relationship between the independent variables.

Table 4. Multicollinearity Test Results

Variables	Collinearity statistics	
	Tolerance value	VIF Value
Mathematical disposition	0,350	2,850
Mathematical self-efficacy	0,350	2,850

1.4. Heteroscedasticity Test

The arithmetic learning outcome data, which was used to investigate heteroscedasticity, was initially converted into residual form. The residuals were then converted into absolute values to assess heteroscedasticity using the Glejser technique. The heteroscedasticity test in Table 5. yielded significance values of 0.395 for mathematical disposition and 0.249 for mathematics self-efficacy, both of which were above 0.05. Therefore, it is concluded that there is no heteroscedasticity. Simply put, there is no difference in variation among residuals from different observations.

Table 5. Heteroscedasticity Test Results

Variables	Residual	
	t-score	Significance
Mathematical disposition	0,853	0,390
Mathematical self-efficacy	1,160	0,250

1.5. Test the Effect of Mathematical Disposition on Student Mathematics Learning Outcomes

Table 6., Table 7., and Table 8. below display the results obtained from performing simple linear regression using SPSS. Table 6 shows that female students' mathematical inclination contributed 0.21 or 21% to their mathematics learning outcomes. In contrast, male students only contributed 0.18 or equivalent to 18%. Male learners showed more precision in their scores compared to female learners, as shown by the difference in standard error values of 4.34.

Table 6. Summary of Mathematical Disposition on Mathematics Learning Outcomes

Gender	R ² Score	Standard Error's Estimates
Male	0,180	16,290
Female	0,210	20,630

Based on the statistical analysis shown in Table 7, it can be seen that both men and women showed a significance score of 0.00, which is below the significance level of 0.05.

Table 7. Anova of Mathematical Disposition on Mathematics Learning Outcomes

Gender	F Score	Significance
Male	24,450	0,000
Female	20,590	0,000



Similarly, in Table 8, from male to female participants, the significance score is 0.00, which is lower than the significance level of 0.05. The regression model equations found for male and female learners respectively are $\hat{Y}_1 = -24,324 + 0,837X_1$ and $\hat{Y}_2 = -45,740 + 1,163X_1$.

Table 8. Coefficient of Mathematical Disposition on Mathematics Learning Outcomes

Gender	Independent's Variable	B Score	Standard error	t Score	Significance
Male	Constant	-24,324	12,146	-2,003	0,048
	Mathematical disposition	0,837	0,169	4,940	0,000
Female	Constant	-45,740	19,147	-2,389	0,019
	Mathematical disposition	1,163	0,256	4,540	0,000

Therefore, it was concluded that the mathematical inclinations of male and female learners have an important impact on their mathematics education achievement.

1.6. *Test the Effect of Mathematical Self-Efficacy on Student Mathematics Learning Outcomes*

Table 9., Table 10. and Table 11. display the results obtained from performing simple linear regression using SPSS. Table 9. displays the contribution score of female students' mathematical self-efficacy, which is 0.20 or 20% of their mathematics learning outcomes. In contrast, male students showed a 9% higher mathematical disposition than their overall disposition, with a value of 0.11 or 11%. Regarding the value of the estimated standard error, the accuracy of male students was superior to that of female students, with a standard error difference of 3.69.

Table 9. Summary of Mathematical Self-efficacy on Mathematics Learning Outcomes

Gender	R ² Score	Standard Error's Estimates
Male	0,110	17,050
Female	0,200	20,740

Based on the statistical analysis shown in Table 10, both men and women showed a significance score of 0.00, less than the 0.05 threshold.

Table 10. Anova of Mathematical Self-efficacy on Mathematics Learning Outcomes

Gender	F Score	Significance
Male	12,960	0,000
Female	19,600	0,000

In Table 11, both male and female students have a significance value of 0.00, which is less than 0.05. The regression model equations for male and female students are respectively $\hat{Y}_1 = -0,519 + 0,850X_2$ and $\hat{Y}_2 = -26,654 + 1,589X_2$.

Table 11. Coefficient of Mathematical Self-efficacy on Mathematics Learning Outcomes

Gender	Independent's Variable	B Score	Standard error	t Score	Significance
Male	Constant	-0,519	10,067	-0,052	0,959
	Mathematical Self-efficacy	0,850	0,236	3,600	0,000
Female	Constant	-26,654	15,347	-1,737	0,086
	Mathematical Self-efficacy	1,589	0,359	4,430	0,000



Therefore, it was concluded that the mathematical inclinations of male and female learners have an important impact on their performance in mathematics.

1.7. Test the Effect of Mathematical Disposition and Mathematical Self-efficacy Simultaneously on Student Mathematics Learning Outcomes

Table 12, table 13, and table 14 below display the results obtained from performing simple linear regression using SPSS. Table 12. shows that the combined contribution score of female students' mathematical aptitude and mathematical self-efficacy is 0.22, which is equivalent to 22%, to their mathematics learning outcomes. In contrast, the percentage for male students was 0.19 or 19%. Male learners showed a better level of rigor in terms of their scores compared to female students. This is shown by the difference in the standard error value of 4.34.

Table 12. Summary of Mathematical Disposition and Mathematical Self-efficacy on Mathematics Learning Outcomes

Gender	R ² Score	Standard Error's Estimates
Male	0,190	16,360
Female	0,220	20,640

Based on the statistical analysis shown in Table 13, both male and female learners obtained a significant value of 0.00, less than 0.05. Evidently, the combination of mathematics disposition and mathematics self-efficacy has a significant impact on mathematics learning outcomes for learners of both genders.

Table 13. Anova Mathematical Disposition and Mathematical Self-efficacy on Mathematics Learning Outcomes

Gender	F Score	Significance
Male	12,120	0,000
Female	10,800	0,000

The statistical analysis in Table 14 shows that male students' mathematical aptitude is statistically significant, with a significance value of 0.00, which is lower than the set threshold of 0.05. However, his mathematical self-efficacy had a statistically significant value of 0.92, which is higher than the threshold of 0.05. When self-efficacy was included in the regression model, the effect of mathematical aptitude on mathematics learning outcomes remained significant for male students. However, the inclusion of mathematical aptitude in the regression model made self-efficacy ineffective in influencing their mathematics learning outcomes.

In contrast, the statistical importance of mathematical aptitude and self-efficacy among female students was indicated by significant values of 0.18 and 0.32, respectively. The p-value exceeds 0.05, which indicates that the inclusion of self-efficacy in the regression model makes mathematical inclination insignificant in its effect on arithmetic learning outcomes. Conversely, when the regression model included mathematical aptitude, self-efficacy had no impact on female students' learning outcomes. The regression model equations found for male and female learners respectively are $\hat{Y}_1 = -24,298 + 0,858X_1 - 0,035X_2$ and $\hat{Y}_2 = -42,639 + 0,704X_1 + 0,732X_2$.

Table 14. Coefficient of Mathematical Disposition and Mathematical Self-efficacy on Mathematics Learning Outcomes

Gender	Independent's Variable	B Score	Standard error	t Score	Significance
Male	Constant	-24,298	12,205	-1,991	0,049
	Mathematical Disposition	0,858	0,269	3,190	0,000
	Mathematical Self-efficacy	-0,035	0,358	-0,100	0,920



	Constant	-42,639	19,397	-2,198	0,031
Female	Mathematical Disposition	0,704	0,527	1,340	0,180
	Mathematical Self-efficacy	0,732	0,733	1,000	0,320



Discussion

1.1. *The effect of mathematical disposition on mathematics learning outcomes*

Findings from the research showed that male learners' mathematical disposition had a significant impact on their success when learning mathematics. Male learners' mathematical dispositions accounted for 18% of the variance in their math learning outcomes. Mathematical disposition had a significant impact on the high and low math learning outcomes, accounting for about a quarter of the variance. The regression model, $\hat{Y}_1 = -24,324 + 0,837X_1$, indicates that each one-unit increase in mathematical disposition leads to a 0.837 increase in mathematics learning outcomes (\hat{Y}_1).

These results are in line with the findings of Nurhaja dan Suhar (2015), who stated that students' performance in learning mathematics is influenced by their mathematical disposition. Fitriani and Nopriana (in Mahmud et al., 2023) supported the idea that having strong mathematical disposition ability enables students to approach mathematical problems with confidence and perseverance. This, in turn, equips students to effectively overcome challenges, fulfill their responsibilities, and foster positive learning habits in mathematics. In Sumarmo's research in Mahmud et al. (2023) asserts that having a strong mathematical inclination fosters a character characterized by unwavering determination, perseverance, responsibility, and commitment to achieve the highest level of success.

Female learners' mathematics learning outcomes are influenced by their mathematical disposition, as well as male learners. Female learners showed a 3% greater influence of mathematical disposition on their mathematics learning outcomes compared to male students, which contributed 21%. The remaining 79% was due to factors outside this study. The regression model obtained is represented by the equation $\hat{Y}_2 = -45,740 + 1,163X_1$, which indicates that a one-unit increase in mathematical disposition (X_1) will result in a 1.163 increase in mathematics learning outcomes (\hat{Y}_2).

The mean score of female students' mathematical disposition was 74.14, which tended to be higher than the mean score of male students, which was 71.15. In addition, female students showed better math learning outcomes compared to male students, with a striking score difference of 5.27. The findings of this study are in line with the research of Ashuri et al. (2022), which indicated differences in learning outcomes and mathematical dispositions between males and females. This was supported by a clear difference in their mathematics learning achievement and mathematical disposition.

The findings of this research indicate that female students show superior mathematical dispositions and achieve better learning outcomes than male learners. According to mathematical disposition plays an important role in influencing students' mathematics learning outcomes. Ashuri et al. (2022) also share the same viewpoint, stating that students who aspire to achieve good learning outcomes should have a positive mathematical disposition. The document also includes indicators of mathematical disposition, which include curiosity to learn mathematics, interest to learn mathematics, learners' dedication in learning mathematics, as well as their perseverance in solving problems in mathematics subjects. As a result, learners with stronger mathematical dispositions tended to have better learning outcomes in the subject. From male to female learners, both are equally affected by mathematical disposition regardless of their gender.

1.2. *The effect of mathematical self-efficacy on mathematics learning outcomes*

This study shows that mathematical self-efficacy has a great impact on mathematics academic achievement for students of both genders. Fitriani dan Pujiastuti (2021) proposed that a strong sense of self-efficacy is essential for achieving optimal mathematics learning outcomes. This is due to the fact that students with high self-efficacy have a strong tendency to persevere and remain steadfast in pursuing answers to mathematical difficulties (Sari et al., 2021). This characteristic is in line with one of the markers of self-efficacy, namely being confident in one's ability to exert effort and persevere. In addition, individuals with high self-efficacy have a tendency to be optimistic, persistent motivation to overcome challenging circumstances, and a sense of responsibility in fulfilling obligations (Yunianti et al., 2016). This view is in line with measurable indicators, specifically the belief in one's ability to resolve difficulties under any circumstances.

The study found that self-efficacy in male students had a significant effect of 11% on their mathematics learning outcomes. Females have a greater level of self-efficacy than males, with a difference of 20%. This figure shows that the effect of female students' self-efficacy on their learning outcomes is greater than that of male students. The regression model for male students resulted in the equation $\hat{Y}_1 = -0,519 + 0,850X_2$, which indicates that a one unit increase in math self-efficacy (X_2) will result in an increase in math learning outcomes (\hat{Y}_1) of 0,850. In contrast, the regression model for female students can be expressed as $\hat{Y}_2 = -26,654 + 1,589X_2$, which indicates that each one-unit increase in mathematics self-efficacy results in a 1.589 increase in mathematics learning outcomes for female students. Based on their self-efficacy (X_2), female students showed better development of math learning outcomes (\hat{Y}_1) than male students.

It can be seen that the average score of female students' mathematics self-efficacy is higher at 42.28. Meanwhile, male students who have an average score of 42.09, with 0.19 lower than the score of female students. According to the results of research by Disai et al. (2017), female self-efficacy in mathematics is greater than male self-efficacy. According to Minja dan Mujib (2022), female students show more self-efficacy due to their increased perseverance when faced with mathematical challenges.

1.3. *The effect of mathematical disposition and mathematical self-efficacy simultaneously on mathematics learning outcomes*

The results of the analysis in Table 13. show that mathematical inclination and mathematical self-efficacy have a simultaneous impact on male and female students' learning outcomes in mathematics (Sig. 0.00 < 0.05). This finding is in line with the research of Mahmud et al. (2023) and Putra et al. (2022), which indicated that mathematics self-efficacy and mathematical inclination have a large impact on students' mathematics learning outcomes.

Based on their contribution, in Table 14, male students' mathematical disposition influenced their mathematics learning outcomes even when considering mathematical self-efficacy (Sig. 0,00 < 0,05). However, when considering mathematical disposition, it is seen that mathematical self-efficacy has no significant impact on their mathematics learning outcomes (Sig. 0,92 > 0,05). The regression model obtained through SPSS software is $\hat{Y}_1 = -24,298 + 0,858X_1 - 0,035X_2$, which implies that when mathematical disposition increases by one unit, learning outcomes will increase by 0.858. However, every one unit increase in mathematical self-efficacy will decrease their learning score by 0.035.

Female students' mathematical inclination did not have a statistically significant effect on their mathematics learning outcomes, including the role of self-efficacy (p-value = 0.18, which is greater than the 0.05 significance level). Similarly, the opposite was also true: when mathematical inclination was included in the model, mathematical self-efficacy did not have a substantial impact on mathematics learning outcomes (0.32 > 0.05). In addition, the regression model obtained is represented by the equation $\hat{Y}_2 = -42,639 + 0,704X_1 + 0,732X_2$, which indicates that for every one unit increase in mathematical aptitude, there will be an increase of 0.704 in mathematics learning outcomes. Similarly, if mathematical self-efficacy grows by one unit, the corresponding increase in math learning outcomes is 0.732. The observed increases in mathematical aptitude and mathematical self-efficacy are quite large, with values of 0.704 and 0.732, respectively. Nevertheless, the resulting significance values exceed 0.05 (specifically, 0.18 and 0.32). The source of this phenomenon is the significant standard errors, with math aptitude and math self-efficacy having standard errors of 0.527 and 0.733, respectively. These values are twice as large as the standard errors of mathematical disposition and mathematical self-efficacy of male students, which are 0.269 and 0.358, respectively.



Undoubtedly, this will affect the statistical significance of the t-test. Standard error is a factor that affects the estimated t value. According to Sugiyono (2020), formula (1) states that t_{count} is calculated by subtracting the hypothesized value from the mean value. In addition, the result is divided by the standard deviation of the sample, taking into account the square root of the number of sample members. Therefore, according to this calculation, the t value obtained will decrease, indicating a decrease in the amount of effect. As the impact decreases, the significance value increases resulting in significance values above 0.05 (specifically, 0.18 and 0.32). Consequently, it can be concluded that female students' mathematical aptitude and mathematical self-efficacy do not have a large impact on their mathematics learning outcomes.

Conclusion

The presentation of the research results above resulted in conclusions, namely: 1) mathematical disposition affects mathematics learning outcomes of male students; 2) mathematical disposition affects mathematics learning outcomes of female students; 3) mathematical self-efficacy affects mathematics learning outcomes of male students; 4) mathematical self-efficacy affects mathematics learning outcomes of female students; 5) mathematical disposition and self-efficacy simultaneously have a significant influence on mathematics learning outcomes in male students; 6) mathematical disposition and self-efficacy jointly affect mathematics learning outcomes in female students; 7) mathematical disposition affects mathematics learning outcomes when mathematical self-efficacy is taken into account in male students; 8) mathematical self-efficacy does not affect mathematics learning outcomes when mathematical disposition is taken into account in male students; 9) mathematical disposition does not affect mathematics learning outcomes when mathematical self-efficacy is taken into account in female students; 10) mathematical self-efficacy does not affect mathematics learning outcomes when mathematical disposition is taken into account in female students.

Declarations

Author contribution statement

The first author conducted the initial qualitative data collection, including in-depth interviews and thematic analysis to uncover key patterns and themes. She was also instrumental in formulating relevant research questions and structuring the qualitative findings as a foundation for the development of the quantitative instrument. The second author was involved in designing the quantitative instrument based on the earlier qualitative findings. She was also responsible for quantitative data collection, statistical analysis to test the research hypotheses, and integration of qualitative and quantitative findings in the discussion. The third author served as the primary supervisor, providing in-depth methodological and conceptual guidance. She oversaw the research steps and provided critical feedback to improve the article, ensured the quality and relevance of qualitative and quantitative data, and provided deep academic insights in the interpretation of the research results.

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Data availability statement

The data we have collected and used in our analysis is stored in the following google drive link: <https://docs.google.com/spreadsheets/d/14V5DKMw9iNs3e1A9phjzg0Gs2udvfaiZ/edit?usp=sharing&oid=116429474573179893417&rtpof=true&sd=true>

Declaration of interests statement

We as authors have no competing financial interests or personal relationships that could influence the work reported in this paper.

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