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The Influence of Self-efficacy on Self-Anxiety Based on Students' Mathematics Learning

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ABSTRACT

Anxiety towards a particular subject is experienced by most students in various schools, especially in mathematics. This research aims to determine the influence of self-efficacy and self-anxiety on mathematics in one of the schools in Cirebon City. The sample was selected using a purposive sampling technique, with a sample size of 40 students, each representing a higher grade. This study employs a quantitative approach. The data analysis techniques used are regression analysis and ANOVA test. The results of the research conclude that self-efficacy does not have a significant influence on self-anxiety in mathematics. Based on the R-Square analysis, a coefficient of determination of 0.238 is obtained, indicating that self-efficacy accounts for 28.5% of the influence on self-anxiety, while other variables influence the remaining 71.5%. Meanwhile, the ANOVA analysis shows a value of ÿ1 of 0.232. This means that each unit increase in the coefficient of self-efficacy will influence 0.232 on self-anxiety. Additionally, ÿ is equals 45.146, which means that if self-efficacy (d) is equal to 0, self-anxiety will be equal to 15.382. Therefore, it can be concluded that self-efficacy does not have a significant influence on self-anxiety in students, particularly in the subject of mathematics.

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1. INTRODUCTION

Humans are emotional beings, and every individual experiences anxiety in their lives. Specifically, 40% of individuals experience anxiety about things that have never happened, 30% feel anxious about things that have already happened, and 30% experience anxiety about fundamental aspects such as the future, health, and so on [1]. One source of this anxiety is related to mathematics education, which can be observed through learning outcomes. Learning is a cognitive and disciplinary process and requires affective

components [2]. Mathematics education actively provides scientific and technological knowledge as it trains innovative thinking patterns to solve everyday problems.

Additionally, mathematics education helps develop students' reasoning abilities [3]. However, individuals' emotional experiences during mathematics learning are crucial to consider. Students' mathematics learning experiences are determined using the learning model chosen by the teacher [4].

During the learning process, students often experience anxiety, especially when it comes to mathematics. Anxiety is an emotion that involves feelings of worry, tension, and physical modifications such as increased blood pressure [5]. It can be described as a simple human emotional response characterized by restlessness and fear, usually occurring when individuals perceive threats [6]. High levels of anxiety can lead to detrimental consequences, including disruptions in social, emotional, and functional development, as well as an increased risk of suicide [7]. Anxiety can also arise from low levels of self-efficacy in social situations, which affects individuals' beliefs in their ability to achieve goals when interacting with others [8].

Furthermore, persistent anxiety can cause problems and disturbances in learning, clinical outcomes, low academic achievement, school dropout, and even a decrease in the student population due to suicide. Emotional states can significantly impact student interactions and overall well-being [9]. Low experience levels can lead to low self-confidence and greater sadness, increasing the likelihood of failure [10]. In the context of learning, teachers often fail to identify students with higher levels of anxiety, misinterpret their abilities, and differentiate their performance from those who are not anxious [2].

Self-efficacy is an individual's belief in their ability to perform tasks and achieve desired outcomes successfully. It influences students' motivation, effort, perseverance, and academic achievement [11]. High self-efficacy is characterized by confidence in one's abilities, setting ambitious goals, and persistence in facing obstacles. Low self-efficacy is characterized by doubt, avoidance of challenging tasks, and decreased motivation and performance [12], [13]. Factors influencing self-efficacy in learning include past experiences, social support, mastery experiences, and vicarious learning [14]. Educators can foster self-efficacy by providing opportunities for success, constructive feedback, modelling successful behaviour, and creating a supportive learning environment. Inadequate learning experiences can lead to a lack of self-efficacy, which results in negative impacts such as anxiety [15].

Self-efficacy is an individual's belief in their ability to exert effort to improve their environment and achieve desired outcomes, closely related to behavioural outcomes and significantly influencing behaviour [16]. The same applies to mathematics learning. Self-efficacy is a potential strength individuals can utilize to empower themselves [17]. Self-efficacy can assist individuals in setting goals more effectively, reducing anxiety, and instilling self-confidence by helping them evaluate their abilities and capacities [18]. This is based on the theory of individual agency, where individuals take action to influence their environment based on their beliefs and capabilities to perform affective actions [7]. Furthermore, self-efficacy convinces individuals of their ability to engage in secondary appraisal activities [19].

Self-efficacy becomes positive when accompanied by positive influence and good performance [20]. Self-efficacy is positively related to perseverance in handling challenging materials, self-perceptions of achievement, and actual performance indicators, including grades [21]. Assessing self-efficacy in children is crucial as it influences their beliefs and abilities to engage in tasks and interactions necessary for maintaining relationships [22].

Mastery experiences refer to personal experiences of completing tasks or achieving goals. These experiences are the strongest source of self-efficacy beliefs, providing tangible evidence of one's abilities. Social modelling involves observing others who have completed tasks or achieved goals. This is influential for students with limited personal experiences in a particular field. Social persuasion refers to verbal feedback and encouragement received by students from others. Positive feedback can enhance self-efficacy beliefs, while negative feedback can diminish them. Emotional and physiological states refer to the internal feelings and bodily sensations experienced by individuals in specific situations.

Sociometry was initially developed by Jacob L. Moreno [23], involving behavioural patterns such as choosing friendships, ranking, and creating maps [9]. Sociometry can reveal social dynamics and individual popularity within a group and identify difficulties in social relationships between individuals and the group. Sociometry is characterized by analyzing connections within families, school environments, campuses, communities, and other contexts [24]. Sociometry was employed in this research to gather information related to ranking preferred and disliked subjects, experiencing anxiety or not during learning, and indications of self-efficacy towards student self-anxiety. This sociometry was conducted through interviews, and the results were analyzed based on the order in which the students responded. The influence of self-efficacy on self-anxiety in the context of mathematics learning deserves attention. High self-efficacy in mathematics can serve as a protective factor against self-anxiety [25]. Students with strong self-efficacy in mathematics are more likely to approach math tasks confidently, effectively manage their anxiety, and persevere in problem-solving. Low self-efficacy can lead to increased math anxiety [26]. Categorization is determined based on the mean and standard deviation of scores. Nurturing self-efficacy in mathematics is crucial for reducing math anxiety and promoting positive learning experiences. Low self-efficacy can lead to anxiety and avoidance behaviours.

The unsatisfactory condition of students' self-efficacy towards anxiety in learning is a global challenge. Many countries face this issue, where students feel uncertain and anxious about academic demands, hindering their academic achievement and overall mental well-being. At the national level, governments and educational institutions must implement a holistic approach considering students' social, emotional, and psychological aspects. Psychological support and counselling within schools are crucial in assisting students in managing self-anxiety and enhancing self-efficacy. Teachers play a significant role in creating an inclusive and supportive local classroom environment, providing constructive feedback to foster students' self-efficacy. This study aims to ascertain the influence of self-efficacy on students' self-anxiety in mathematics education.

2. METHOD

This research design employs a quantitative approach utilizing questionnaires and sociometry as research instruments. The study participants were collected for all research instruments used in the validation process. The research sample consisted of 40 students from one elementary school in Cirebon City. The sampling technique used was random sampling with a population of 100 students. The age range of the participants in the sample was between 10 and 14 years old, and they were all enrolled in higher grades of elementary school. The random sampling of 40 participants was conducted using a randomized selection process. This involved assigning a unique identifier to each individual in the target population and using a random number generator or a randomization table to select the desired number of participants. This method ensured that everyone in the population had an equal chance of being selected, eliminating bias and increasing the sample's representativeness. By employing random sampling, the researchers aimed to obtain a diverse and unbiased sample that would accurately reflect the characteristics of the larger population.

Self-efficacy was assessed through a questionnaire that assessed different aspects of magnitude, strength, and generality [14]. The questionnaire reflected different aspects of self-efficacy and had an inverse relationship with levels of anxiety, adopted from Trisnawati et al. [27]. Percentage scores were obtained for overall self-efficacy and each specific aspect, with higher scores indicating higher levels of self-efficacy. Categorization was determined based on the mean and standard deviation of the scores.

Self-anxiety was evaluated through a questionnaire that assessed various aspects of emotions, behaviours, somatic sensations, and cognition [28]. The questionnaire reflected different aspects of self-anxiety. Percentage scores were obtained for overall self-anxiety and each specific aspect, with higher scores indicating levels of self-anxiety influenced by higher efficacy. Categorization was determined based on the mean and standard deviation scores.

In addressing self-anxiety and self-efficacy in mathematics education, sociometry tests with the lecture method can clarify the levels of anxiety and self-efficacy in everyone. Sociometry is a technique used to gather information about relationships and patterns of interaction among individuals in a group. This approach is based on the argument that a group consists of interconnected parts [29].

Table 1. Indicator of Self-Efficacy

Aspect	Indicator
Magnitude	• Maintain a positive outlook • Show enthusiasm toward tasks • Perceive tasks as opportunities for growth, not as burdens • Develop plans for task completion • Overcome learning challenges
Strength	• Demonstrate competence in task completion • Display commitment to task completion • Persist in problem-solving despite difficulties • Exhibit resilience during exams • Have confidence in one's abilities

Aspect	Indicator
Generality	• Learn from past experiences • Adapt to different situations and conditions in a positive manner • Utilize effective stress management strategies

Table 2. Indicator of Self-Anxiety

Aspect	Indicator
Cognitive	• Empty mind. • Feeling powerless. • Difficulty concentrating. • Exaggerating threats
Somatic	• Empty mind. • Feeling powerless. • Difficulty concentrating. • Exaggerating threats
Emotional	• Worried. • Anxious. • Tense. • Unhappy.
Behavioural	• Excessive vigilance. • Wanting to cry. • Restlessness. • Nervousness. • Avoiding situations. • Wanting to escape. • High dependency.

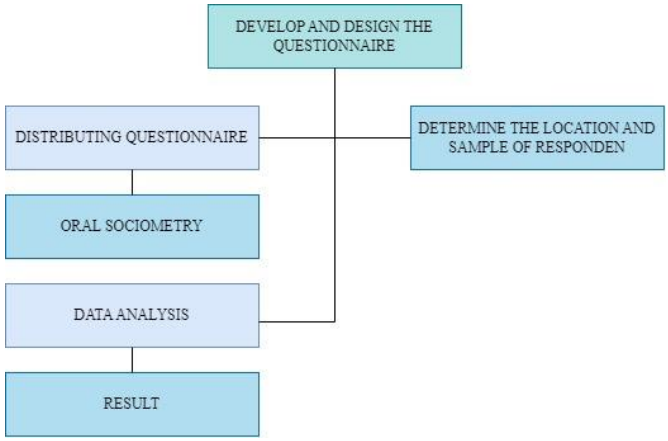

Figure 1. Flowchart of Questionnaire

The research instruments consisted of self-efficacy and self-anxiety questionnaires, as well as oral sociometry to assess the extent of students' self-efficacy and self-anxiety. Data was collected using purposive sampling, a sampling technique for selecting samples based on specific considerations. After collecting data through the questionnaires, the data were analyzed using the Statistical Package for Social Sciences (SPSS). Oral sociometry, descriptive statistics of the study, data analysis, and descriptive statistical procedures were obtained, and measurements such as frequency distribution, mean, and standard deviation were calculated to summarize the data. The next step involved data processing using regression analysis. Regression analysis is a statistical technique used to examine the relationship between one or more independent variables (predictor variables) and a

dependent variable (response variable) in a regression model [30]. This analysis was conducted to determine the strength of the relationship between students' self-efficacy and self-anxiety in mathematics.

3. RESULTS AND DISCUSSION

Data collection was conducted following the procedures outlined in the flowchart. Figure 1 presents the flowchart depicting the questionnaire distribution process, followed by data testing based on the chosen method. Data analysis was performed in detail as follows.

Table 3. Descriptive Statistic

	Self Efficacy	Self Anxiety
N	40	40
Range	31	29
Minimum	56	47
Maximum	87	76
Mean	71.88	61.85
Std. Deviation	7.994	6.526
Variance	63.907	42.592

Based on Table 3 above, it can be deduced that the average scores of students' self-efficacy and self-anxiety are not different. The maximum and minimum scores are not very different, although self-efficacy remains slightly higher. Furthermore, the percentages of variables and the number of students can be calculated and presented through a bar graph.

Table 4. Percentage of Self-efficacy

No.	Aspect	Percentage	Category
1	Magnitude	80%	Strong
2	Strength	78%	Weak
3	Generality	75%	Weak
	Average	77,6%	Weak

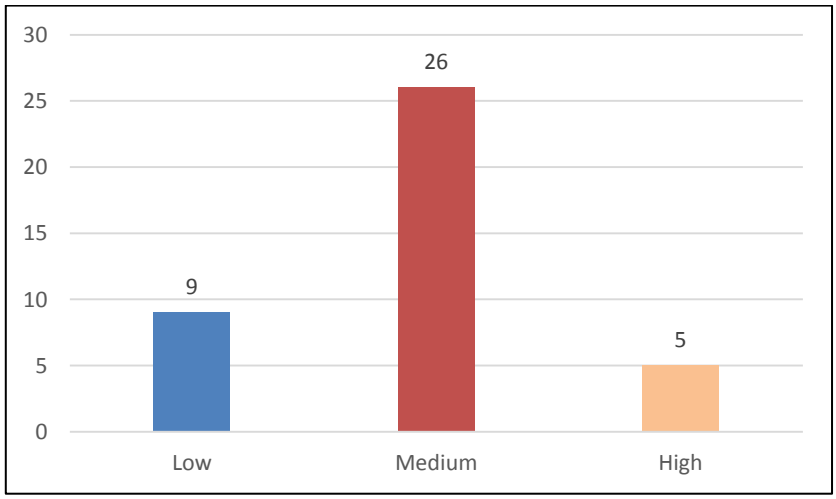

Figure 2. Bar Graph of *Self-efficacy*

Based on Table 4 above, the total percentage of magnitude is 80% with a high criterion. Almost all respondents involved in the data analysis process indicate that students always strive to achieve maximum scores to gain personal satisfaction by completing tasks on time and having confidence in their abilities or understanding when solving given problems. In addition to believing in their capabilities, Khoirunnisa and Gumiandari [30] explain that self-efficacy also directs students to have a positive attitude, take action, and think positively about challenges or difficulties encountered in the teaching and learning process. Self-efficacy can train and enhance students' curiosity towards new subjects or lessons they want to pursue, which concludes with self-evaluation. Self-efficacy has a significant impact on student behaviour and outcomes [31].

Based on Table 3 above, the maximum and minimum scores are also not much different, although self-efficacy remains slightly higher. Furthermore, the percentages of variables and the number of students can be calculated and presented through a bar graph. Through the conducted oral sociometry, students' self-efficacy emerges due to experiences, social modelling, and social persuasion. Previous research has found [32] several factors contributing to ELs' self-efficacy and persistence, including interest, motivation, social persuasion, social modelling, psychological responses, and strategy instruction. This is in line with research [33] that Individuals rely on four sources of information when estimating their self-efficacy: Mastery experiences, vicarious experiences, social persuasion, and physiological states.

Mariatun et al. [1] suggest that positive emotions and feelings of confidence can enhance self-efficacy, while negative emotions and anxiety can diminish it. Umaroh et al. [32] explain that self-efficacy becomes one of the solutions to reduce the self-anxiety experienced by students. From these two opinions, it can be concluded that there is a reciprocal relationship and influence between self-efficacy and self-anxiety, where the actual composition is inversely related. If students have high self-efficacy, then their self-anxiety is low, and vice versa.

Table 5. Percentage of Self Anxiety

No.	Aspect	Percentage	Category
1	Cognitive	66%	Severe
2	Somatic	72%	Severe
3	Emotional	70%	Severe
4	Behaviour	64%	Severe
	Mean	68%	Severe

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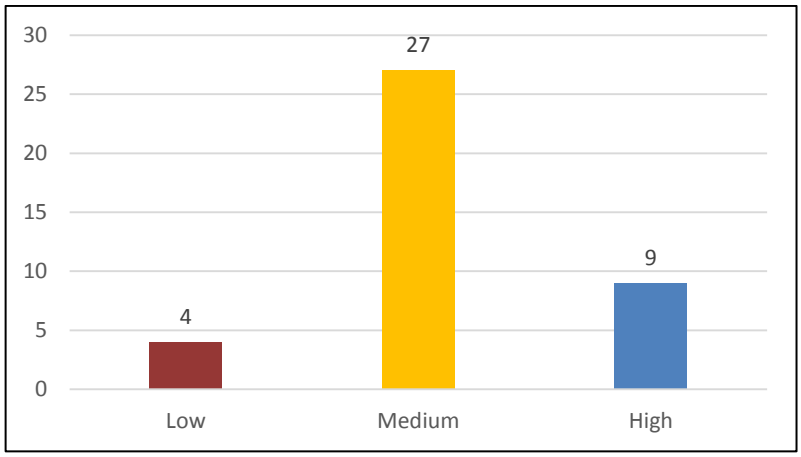

Figure 3. Bar Graph of Self-Anxiety

Based on Table 5 above, the average self-anxiety is 68% with a severe anxiety category. The respondents are high school students who are preparing themselves for more serious educational levels and often experience anxiety due to increasing difficulties and diversity in learning. The self-anxiety and self-efficacy of the students are nearly parallel, with a similar proportion indicating high self-efficacy and severe anxiety. Through the conducted oral sociometry, students express anxiety in specific situations, such as being asked to step forward, engaging in disliked learning activities, unexpected questioning, and solving difficult problems. However, they also feel confident in their efforts to achieve maximum scores. Students with self-anxiety may experience negative thoughts and beliefs about their abilities, the world around them, and their prospects. Rahmawati [33] states that these negative thoughts can persist and create worry, fear, and uncertainty. In this aspect, 66% of students admit to feeling anxious, making it difficult to concentrate on studying.

Based on the conducted sociometry, female students reported experiencing anxiety more frequently than male students. This is consistent with the findings of Imro'ah et al. [34] and Putra and Yulanda [35], who state that in their research, female students have higher levels of self-anxiety compared to males, as males generally tend to pay less attention to anxiety during lessons.

Table 6 presents the results for the normality of data using the One-sample Kolmogorov-Smirnov test. For self-efficacy, with a significance level of 0.510, the data does not significantly deviate from a normal distribution. This indicates that the participants' self-efficacy scores can be considered normally distributed. For self-anxiety, with a significance level of 0.204, the data also does not significantly deviate from a normal distribution. This suggests that the self-anxiety scores of the participants can be considered approximately normally distributed. Based on these results, it can be concluded that the self-efficacy and self-anxiety data are normally distributed as the significance level is greater than 0.05.

Tabel 6. Normality Test

One-Sample Kolmogorov-Smirnov Test

		Self Efficacy	Self Anxiety
N		40	40
Normal Parameters[a,b]	Mean	71.88	61.85
	Std. Deviation	7.994	6.526
Most Extreme Differences	Absolute	.130	.169
	Positive	.092	.169
	Negative	-.130	-.088
Kolmogorov-Smirnov Z		.821	1.068
Asymp. Sig. (2-tailed)		.510	.204

a. Test distribution is Normal.

b. Calculated from data.

Next is the second prerequisite test, namely the homogeneity test:

Table 7. Homogeneity Test

Test of Homogeneity of Variances

	Data		
Levene Statistic	df1	df2	Sig.
2.538	1	78	.115

Based on the data in Table 7, the self-efficacy and anxiety variables have a significance level of 0.115. The data does not significantly violate the assumption of homogeneity of variances. This indicates that the variance of self-efficacy scores across different groups or conditions is approximately equal, demonstrating homogeneity. Based on these results, it can be concluded that the self-efficacy and self-anxiety data meet the assumption of homogeneity as the significance level is greater than 0.05. This is important for conducting appropriate statistical analyses that rely on the assumption of homogeneity of variances.

Table 8. R-Square Test

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.285[a]	.081	.057	6.338

a. Predictors: (Constant), Self_Efficacy

According to the table 8, the coefficient of determination R-Square = 0.81 (8.1). This indicates that only 8.1% of the variance in the anxiety variable can be explained by the self-efficacy variable, while the remaining 91.9% is influenced by other variables not included in the analysis.

Table 9. ANOVA Test

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	134.623	1	134.623	3.351	.075[b]
	Residual	1526.477	38	40.170		
	Total	1661.100	39			

a. Dependent Variable: Self_Anxiety

b. Predictors: (Constant), Self_Efficacy

Table 9 displays the analysis of variance results, showing the obtained significance value of 0.075. Setting the significance level at 5% (0.05), we can conclude that 0.075 > 0.05. This indicates that self-efficacy does not significantly contribute to anxiety. Data from previous research showed there is a significant negative relationship between research anxiety and self-efficacy. There is no relationship between demographic characteristics and self-efficacy [34].

Table 10. Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	45.146	9.180		4.918	.000
	Self_Efficacy	.232	.127	.285	1.831	.075

a. Dependent Variable: Self_Anxiety

Based on the coefficient calculation shown in Table 10, the value of ÿ1 is 0.232. The assumption is that for every one-unit increase in self-efficacy, there will be a 0.232 effect on self-anxiety. Additionally, ÿ is equal to 45.146. This means that if self-efficacy (d) equals 0, self-anxiety will equal 15.382.

Self-efficacy can have a significant impact on mathematics anxiety. When individuals have high self-efficacy in mathematics, they believe in their competence and have confidence in their ability to understand and perform mathematical tasks effectively. Positive beliefs help reduce anxiety and foster a more positive attitude toward mathematics [35].

The results of this study indicate that students with high self-efficacy in mathematics tend to approach mathematical tasks with a positive mindset. Students are more likely to see challenges as opportunities to enhance motivation through various efforts to understand and solve mathematical problems. This increased motivation helps reduce anxiety as students feel more prepared and capable. Several researchers mentioned above are consistent with the research findings, which indicate that self-efficacy does not significantly contribute to self-anxiety. However, this is contradicted by the research conducted by Safiyah and Widyastuti [36], Türkmenoğlu and Yurtal [37], Mamolo [6],

Mao [38], Ducay and Alave [39], Rozgonjuk [24], Sevgi and Arslan [40], and Batiibwe et al. [41], who found that self-efficacy has a significant influence on reducing student self-anxiety.

Self-efficacy fosters a sense of control over students' abilities and outcomes [36]. Students who believe they have control over mathematical outcomes tend to experience less anxiety. Students feel empowered to engage with the subject matter actively, seek help from peers when needed, and employ effective problem-solving strategies.

Mathematics anxiety experienced by students often arises from fear of making mistakes or facing difficulties in solving mathematical problems. However, students with high self-efficacy in mathematics are more resilient when working on mathematical tasks. They view failure as temporary and continue to make improvements through learning. This resilience helps reduce anxiety and encourages students to continue learning mathematics. Delshad et al. [42] stated that anxiety decreases with high levels of self-efficacy.

Mathematics anxiety can lead students to have negative perceptions of themselves and mathematics. Conversely, students with high self-efficacy in mathematics tend to have more positive self-perceptions. These negative attitudes significantly impact students, causing anxiety when facing mathematics lessons. This is supported by the research conducted by Razak [43], which found that higher self-efficacy is associated with higher work anxiety.

Self-efficacy has a reciprocal relationship with the learning experience in mathematics. Students with high self-efficacy have good mathematical abilities, and their belief in their abilities strengthens. On the other hand, students with low self-efficacy work harder and experience increased learning anxiety. By developing and maintaining a strong sense of self-efficacy in mathematics, students can alleviate anxiety in learning and have confidence. Meng et al. [44] found that there is an influence of self-anxiety and social self-efficacy on anxiety.

Based on a literature review, several factors contributed to increased self-efficacy in learning, including learning experiences and feedback support. Positive learning experiences greatly contribute to learning success [45]. When individuals have completed a mathematical challenge, they will believe and have confidence in their ability to solve mathematics in the following material topics. Encouragement and supportive feedback from teachers and parents also contribute to an increase in self-efficacy [46]. When individuals receive recognition and praise for their mathematical achievements, it strengthens their belief in their abilities and fosters a positive attitude toward mathematics. By considering these factors, educators and parents can cultivate a learning environment that nurtures self-efficacy.

4. CONCLUSION

The research findings indicate that self-efficacy does not significantly influence mathematics anxiety in students. High levels of self-efficacy can reduce anxiety levels. Experience, social modelling, and social persuasion are factors that contribute to the development of self-efficacy in students. On the other hand, one of the consequences of anxiety, particularly in mathematics lessons, is that students have difficulty concentrating

on learning. This highlights the need to increase self-efficacy in learning, especially at the elementary school level. It is expected that in the school context, educators can play a specific role in reducing student anxiety, particularly in mathematics subjects.

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