

The Relationship Between Math Anxiety and Self-Efficacy on the Basic Mathematical Ability of Prospective Elementary School Teachers

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ARTICLE INFO

Article history

Received 20 November 2025

Revised 4 December 2025

Accepted 15 December 2025

ABSTRACT

This study aims to analyze the relationship between math anxiety and self-efficacy on the basic mathematical abilities of prospective elementary school teachers. The study used a correlational quantitative approach with 282 students from five state universities in Indonesia. The instruments consisted of a math anxiety scale, a self-efficacy scale, and a basic mathematical ability test, all of which had been tested for validity and reliability. Descriptive analysis results show that self-efficacy is in the high category ($M = 70.44$; $SD = 11.21$), math anxiety is in the moderate category ($M = 29.35$; $SD = 6.33$), and basic mathematical ability is in the good category ($M = 19.04$; $SD = 3.69$). Pearson's correlation analysis revealed that self-efficacy was negatively and significantly related to math anxiety ($r = -0.436$, $p < 0.001$) and positively related to basic mathematical ability ($r = 0.304$, $p < 0.001$). Meanwhile, math anxiety had a weak negative relationship with basic mathematical ability ($r = -0.175$, $p = 0.003$). Multiple linear regression results show that self-efficacy has a significant effect on basic mathematical ability ($\beta = 0.281$, $p < 0.001$), while math anxiety has no significant effect ($\beta = -0.053$, $p = 0.402$), with a model contribution of 9.5% ($R^2 = 0.095$). Math anxiety is negatively correlated with basic mathematical ability but becomes non-significant when self-efficacy is included in the regression model, indicating an indirect effect. These findings emphasize the importance of strengthening self-efficacy in teacher education to improve prospective elementary school teachers' mathematical competence.

Keywords

Basic Math Skills
Math Anxiety
Prospective Elementary
School Teachers
Self-Efficacy

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**Introduction**

Mathematics is a science that plays an important role in the development of science, technology, and logical thinking. Mathematics comes from the Greek term “Mathema,” which means that mathematics equips a person with critical thinking, analytical, and problem-solving skills [1]. Mathematics plays an important role in developing cognitive skills and building concepts in life [2]. However, mathematics is considered boring and abstract, resulting in a negative perception of mathematical concepts [3]. Mathematics is often considered a difficult subject [4]. Therefore, mathematics plays an important role, but negative perceptions remain.

Basic education influences a teacher's mastery of mathematics. Elementary school teachers are prepared not only to teach arithmetic concepts, but also to instill a relational understanding of concepts [5]. Professional elementary school teachers can facilitate diversity in logic, learning processes, and collaboration among various components in education [6]. Basic mathematical skills or numeracy skills are essential for prospective elementary school teachers as an indicator of the quality of basic education [7]. According to NCTM (2000), the mandatory mathematical competency standards are (1) mathematical problem solving, (2) mathematical reasoning, (3) mathematical communication, (4) mathematical connections, and (5) mathematical representation. In this study, basic mathematical ability refers to numeracy skills that include understanding numbers, arithmetic operations, and applying mathematical concepts in everyday life [8–10]. Thus, mastery of basic mathematical skills is fundamental in developing professional elementary school teachers and improving the quality of learning.

Indonesia ranks 10th lowest in basic math skills out of 79 countries worldwide [11]. Not only that, according to PISA and AKMI, Indonesia has a low level of student mathematical literacy [12],[13]. This means that the perception of difficulty in mathematics is not only an issue, but also relates to challenges in the quality of mathematics education in Indonesia [14], [15]. Low national performance in international and national assessments such as PISA and AKMI does not solely reflect students' learning outcomes but may also indicate challenges in teacher preparation. Prospective elementary school teachers are responsible for shaping students' early mathematical understanding and attitudes. Insufficient basic mathematical competence, combined with math anxiety at the teacher education level, may contribute to the

persistence of low mathematical achievement across generations. Indonesia's low mathematics ranking has resulted in poor teacher quality and low-quality mathematics learning in schools [16]. Not only that, but prospective elementary school teachers have a negative perspective on mathematical ability, which affects the learning process for students [17]. Prospective elementary school teachers are a unique component, because their perspective on mathematical concepts can influence students, which has implications for the cycle of math anxiety [18–20]. This has resulted in prospective elementary school teachers experiencing difficulties in mastering basic mathematics material [21]. These difficulties have an impact on the ability of prospective elementary school teachers to teach [22]. Therefore, the basic mathematical abilities of prospective elementary school teachers are a crucial factor, as they will have a direct impact on the effectiveness of mathematics learning in elementary schools.

Creating effective learning is closely related to affective and psychological factors [23]. This means that not only cognitive abilities, but also the emotional state and self-confidence of prospective elementary school teachers play a role in the learning process. The emotional aspects and self-confidence of prospective elementary school teachers determine their success in instilling concepts in mathematics learning [24]. This aspect stems from feelings of being unable to do math problems, being humiliated, and being taught under pressure, which leads to math anxiety [25]. Math anxiety is not just a dislike, but a condition of anxiety that manifests itself in nervousness, tension, and panic when faced with numbers and math problems [26]. This problem will result in anxiety among teachers, which will have an impact on students' anxiety levels [27]. This also results in cognitive impairment in children, causing feelings of anxiety when solving complex math problems [28]. Thus, the math anxiety experienced by prospective elementary school teachers not only affect themselves, but also has implications for their ability to create learning processes.

Math anxiety not only causes fear and anxiety, but also weakens self-confidence in mathematics [29]. Self-efficacy, also known as self-confidence, refers to the belief in one's ability to organize and execute tasks according to one's capacity to achieve success [30]. Prospective elementary school teachers must possess self-efficacy in the form of resilience, persistence, and emotional control during the learning process [31]. Prospective elementary school teachers who have high self-efficacy will have an optimistic, persistent, and creative attitude in the process of determining problem-solving strategies, thereby minimizing the emergence of math anxiety [32]. Therefore, math anxiety tends to be inversely proportional to self-efficacy, and both influence the basic mathematical abilities of elementary school teachers.

Self-efficacy and math anxiety are interrelated in the process of learning mathematics [33]. Prospective elementary school teachers with high math anxiety usually have low

mathematical self-efficacy [34]. On the contrary, building self-efficacy can be a powerful weapon to fight and reduce math anxiety [35]. Based on observations of students at Yogyakarta State University, it was found that around 55% of students experienced anxiety during mathematics lessons, as evidenced by restless behavior, avoidance of contact with lecturers, and frequent requests to leave the classroom. These findings are also supported by findings by [36], which states that the majority of PGSD students at UNESA Campus, amounting to 69.4%, have moderate math anxiety, and 18.5% show high anxiety. It was also found in the study [37] that anxiety in mathematics and self-efficacy tendencies among students are formed from their original majors when they were in high school, as seen in the findings that 65%-67% of students fall into the moderate category in terms of anxiety towards mathematics, which affects their basic mathematical abilities. Based on these findings, further research can be conducted on the relationship between math anxiety and self-efficacy, as both influence the basic abilities of students as prospective elementary school teachers.

Although math anxiety and self-efficacy have been studied separately, research on the simultaneous relationship between the two and basic mathematical ability is still needed. However, more exploration is needed in Indonesia regarding the treatment of prospective elementary school teachers. Prospective elementary school teachers are a unique population because they are both learners and future teachers. Anxiety has the potential to be transferred to students in the future (phenomenon of the cycle of anxiety). Understanding the dynamics between anxiety (math anxiety), self-efficacy, and basic math skills in these prospective teachers needs to be considered. Pre-service elementary school teachers represent a unique population because they function both as learners and future educators. Their beliefs, emotions, and confidence toward mathematics are likely to influence their future instructional practices and students' emotional responses to mathematics. If math anxiety and low self-efficacy are not addressed at this stage, an anxiety transmission cycle may occur in elementary classrooms. Therefore, this study will be conducted to determine the measurement of the levels of math anxiety, self-efficacy, and basic math skills of prospective elementary school teachers.

Previous studies have examined math anxiety and self-efficacy separately; however, findings regarding their simultaneous contribution to basic mathematical ability remain inconsistent, particularly among pre-service teachers. Many studies focus on school students and do not consider shared variance between affective variables, or overlook the teacher education context. This study addresses these gaps by examining the interrelationships among math anxiety, self-efficacy, and basic mathematical ability within Indonesian teacher education.

Material and Methods

The research was conducted using a quantitative approach with a correlational design. Correlational research aims to identify the relationship and contribution between math anxiety and self-efficacy on the basic mathematical abilities of prospective elementary school teachers. The population of this study consisted of fifth-semester students majoring in Elementary School Teacher Education at state universities in Indonesia, namely Universitas Negeri Yogyakarta (UNY), Universitas Negeri Padang (UNP), Universitas Pendidikan Ganesha (UNDIKSHA), Universitas Negeri Surabaya (UNESA), and Universitas Negeri Medan (UNIMED). In addition, all participants were enrolled in the same semester of fifth-semester students at each university and had completed similar foundational mathematics courses, further supporting the homogeneity of initial competence. The sample selection used the Purposive Sampling Technique, with the sample size in this study determined based on Isaac and Michael's sample determination table, with a 5% error rate, namely 282 students, representing the population proportionally [38]. Table 1. Distribution of Participants Based on University.

Table 1. Distribution of Participants Based on the University

University	Number of Students
Universitas Negeri Yogyakarta (UNY)	39
Universitas Negeri Padang (UNP)	59
Universitas Negeri Medan (Unimed)	114
Universitas Pendidikan Ganesha (Undiksha)	31
Universitas Negeri Surabaya (Unesa)	39
Total Students	282

This was used to obtain a representative picture that took into account the diversity of human resources and targeted prospective elementary school teachers with basic skills, so that the selection of participants was adjusted to the relevant population.

Data collection techniques in this study were conducted using questionnaires to determine the level of math anxiety and self-efficacy, as well as tests to explore basic mathematical abilities in prospective elementary school teachers. Three categories of instruments were used in this study. The Mathematics Anxiety instrument in this study was adapted from The Mathematics Anxiety Scale (MAS) [39]. There are 10 items consisting of 5 positive items and 5 negative items using a Likert scale (1 = rarely, 4 = almost always). The reliability of the Mathematics Anxiety Scale instrument has a Cronbach's Alpha value of 0.92, so it is considered reliable for use. The following is Table 2 showing the results of the adaptation of the Mathematics Anxiety Scale (MAS) [39]. In addition, content validity was established through expert judgment and pilot testing to ensure clarity, relevance, and suitability of each item for the targeted respondents.

Table 2. Adaptation of the Mathematics Anxiety Scale (MAS)

No	Item	Adaptation Item
1	It wouldn't bother me at all to take more math courses.	<i>Saya tidak keberatan jika harus mengambil lebih banyak mata kuliah matematika.</i>
2	I have usually been at ease during math tests	<i>Saya biasanya merasa tenang saat ujian matematika.</i>
3	I have usually been at ease in math courses.	<i>Saya biasanya merasa nyaman mengikuti perkuliahan matematika.</i>
4	I usually don't worry about my ability to solve math problems.	<i>Saya biasanya tidak khawatir tentang kemampuan saya menyelesaikan soal matematika.</i>
5	I rarely get uptight while taking math tests.	<i>Saya hampir tidak pernah merasa tegang saat ujian matematika.</i>
6	I get really uptight during math tests.	<i>Saya sering merasa tegang saat ujian matematika.</i>
7	I get a sinking feeling when I think of trying hard math problems	<i>Saya merasa cemas ketika memikirkan soal matematika yang sulit.</i>
8	My mind goes blank, and I am unable to think clearly when working with mathematics.	<i>Pikiran saya kosong dan sulit berpikir jernih saat mengerjakan matematika.</i>
9	Mathematics makes me feel uncomfortable and nervous	<i>Matematika membuat saya merasa tidak nyaman dan gugup.</i>
10	Mathematics makes me feel uneasy and confused.	<i>Matematika membuat saya merasa bingung dan gelisah.</i>

Adaptation of the Mathematics Self-Efficacy Instrument, adapted from the Mathematics Confidence Scale (MCS) according to Dowling [40] consists of 18 problems divided into 3 components in mathematics and 3 cognitive levels. The reliability of the adapted instrument in this study has a Cronbach's Alpha value of 0.91 [40], so that it is declared reliable for use. The following Table 3 shows the results of the adaptation of mathematics self-efficacy [40].

Table 3. Adaptation of Mathematics Self-Efficacy

No	Item	Adaptation Item
1	In a certain triangle, the shortest side is 6 inches. The longest side is twice as long as the shortest side, and the third side is 3.4 inches shorter than the longest side. What is the sum of the three sides in inches?	<i>Sebuah segitiga memiliki sisi terpendek 15 cm. Sisi terpanjang dua kali panjang sisi terpendek, dan sisi ketiga 8,5 cm lebih pendek dari sisi terpanjang. Berapa jumlah ketiga sisi segitiga tersebut?</i>
2	If $y = 9 + x/5$, find x when $y = 10$.	<i>Jika $y = 9 + x/5$, tentukan nilai x jika $y = 10$.</i>
3	There are three numbers. The second is twice the first, and the first is one-third of the other number. Their sum is 48. Find the largest number.	<i>Ada tiga bilangan. Bilangan kedua dua kali bilangan pertama, dan bilangan pertama adalah sepertiga dari bilangan ketiga. Jumlah ketiganya adalah 48. Tentukan bilangan terbesar.</i>
4	If $P = M + N$, then which of the following will be true? a. $N = P - M$ b. $P - N = M$ c. $N + M = P$	<i>Jika $P = M + N$, maka manakah pernyataan berikut yang benar? a. $N = P - M$ b. $P - N = M$ c. $N + M = P$</i>
5	Bridget buys a packet containing 9-cent and 13-cent stamps for \$2.65. If there are 25 stamps in the	<i>Andi membeli satu paket perangko seharga Rp 26.500 yang berisi perangko senilai Rp 900 dan Rp 1.300.</i>

	packet, how many are 13-cent stamps?	<i>Jika jumlah perangko dalam paket 25 lembar, berapa lembar perangko bernilai Rp 1.300?</i>
6	In an auditorium, the chairs are usually arranged so that there are rows and y seats in a row. For a popular speaker, an extra row is added, and an extra seat is added to every row. Thus, there are $x + 1$ rows and $y + 1$ seats in each row, and there will be $(x + 1)$ and $(y + 1)$ seats in the auditorium. Multiply $(x + 1)(y + 1)$	<i>Di aula sekolah, kursi biasanya disusun sebanyak x baris dan y kursi per baris. Untuk acara spesial, satu baris tambahan dan satu kursi tambahan per baris ditambahkan. Tentukan jumlah kursi total setelah penambahan dengan rumus $(x + 1)(y + 1)$</i>
7	Fred's bill for some household supplies was \$13.64. If he paid for the items with a \$20 bill, how much change should he receive?	<i>Andi berbelanja kebutuhan rumah tangga dengan jumlah tagihan Rp. 136.400. Andi membayar dengan uang Rp. 200.000. Berapa kembalian yang Andi terima?</i>
8	The hands of a clock form an obtuse angle at ____ o'clock	<i>Jarum jam membentuk sudut tumpul pada pukul ____</i>
9	A Ferris wheel measures 80 feet in circumference. The distance on the circle between two of the seats is 10 feet. Find the measure in degrees of the central angle SOT whose rays support the two seats.	<i>Sebuah bianglala memiliki keliling 24 m. Jarak di lingkaran antara dua kursi adalah 3 m. Tentukan besar sudut pusat (dalam derajat) yang dibentuk oleh kedua kursi tersebut.</i>
10	Five spelling tests are to be given to Mary's class. Each test has a value of 25 points. Mary's average for the first four tests is 15. What is the highest possible average she can have on all five tests?	<i>Mary mengikuti lima ulangan, setiap ulangan bernilai 25 poin. Rata-rata empat ulangan pertama adalah 15. Berapakah rata-rata tertinggi yang dapat dicapai pada lima ulangan?</i>
11	The opposite angles of a parallelogram are...	<i>Sudut berhadapan pada jajar genjang adalah</i>
12	$3\frac{4}{5} - 1\frac{1}{2} =$	$3\frac{4}{5} - 1\frac{1}{2} =$
13	Five points are on a line. T is next to G. K is next to H. C is next to T. H is next to G. Determine the positions of the points along the line.	<i>Lima titik berada pada satu garis:</i> • T di sebelah G • K di sebelah H • C di sebelah T • H di sebelah G <i>Tentukan urutan titik-titik tersebut sepanjang garis.</i>
14	Set up the problem to find the number asked for in the expression "six less than twice $4\frac{5}{6}$ "?	<i>Tentukan langkah-langkah untuk menyelesaikan masalah yang ditanyakan pada persamaan berikut:</i> <i>"Enam kurang dari dua kali $4\frac{5}{6}$"</i>
15	On a certain map, $\frac{7}{8}$ inch represents 200 miles. How far apart are two towns whose distance apart on the map is $3\frac{1}{2}$ inches?	<i>Pada suatu peta, $\frac{7}{8}$ cm mewakili 200 km. Jarak antara dua kota pada peta adalah $3\frac{1}{2}$ cm. Berapa jarak sebenarnya antara kedua kota tersebut?</i>
16	About how many times larger than 614.360 is 30.668.00?	<i>Berapa kali lebih besar 614.360 dibandingkan 30.668?</i>
17	Staples for a certain brand of staple gun are available in the following widths: $\frac{3}{4}$, $\frac{3}{2}$, $\frac{1}{3}$, $\frac{7}{8}$, and $\frac{4}{3}$ inches. Which width is closest to 1 inch?	<i>Staples untuk merek tertentu tersedia dalam lebar: $\frac{3}{4}$, $\frac{3}{2}$, $\frac{1}{3}$, $\frac{7}{8}$, and $\frac{4}{3}$ cm. Berdasarkan lebar tersebut yang paling mendekati 1 cm adalah ...</i>
18	Some people suggest that the following formula be used to determine the average weight for boys between the ages of 1 and 7: $W = 17 + 5A$, where W is the weight in pounds and A is the boy's age in years. According to this formula, for each year older a boy gets, his weight becomes more or less, and by how much?	<i>Rumus berat rata-rata anak laki-laki usia 1–7 tahun:</i> $W = 17 + 5A$ W = berat dalam kg A = usia dalam tahun. <i>Setiap tahun bertambah, apakah berat anak bertambah atau berkurang?</i> <i>Berapa kg bertambah tiap tahun menurut rumus ini?</i>

Basic Mathematics Test Instruments were developed based on the NCTM [41]. NCTM states that there are five standard contents, namely numbers and operations, algebra,

geometry, measurement, data analysis, and probability. The instrument was developed into 30 questions, consisting of 25 multiple-choice questions and 5 essay questions. Each multiple-choice item was given a score of 1 for a correct answer and 0 for an incorrect answer, so the maximum score for multiple-choice questions was 25. The essay questions were assessed on a scale of 1-5, with a minimum score of 25, and then scaled to 0-1 to align with the multiple-choice component. This instrument underwent content validity testing (Expert Judgment) by lecturers from UNESA, UIN Padang, and UNY using a 1-5 Likert scale covering 3 aspects of assessment, namely the instrument aspect (7 items), content aspect (6 items), and language aspect (3 items). Content validity was calculated using the Item-Level Content Validity Index (I-CVI) formula, which is the number of validators who gave a score of 4 or higher divided by the number of validators [42]. Table 4 below shows the results of content validation based on I-CVI.

Table 4. Results of Content Validation Based On I-CVI

No	Aspect	V1	V2	V3	I-CVI	Decision
1	Instrument	4	5	4	1.00	Valid
2	Instrument	4	4	5	1.00	Valid
3	Instrument	4	5	5	1.00	Valid
4	Instrument	5	4	5	1.00	Valid
5	Instrument	5	3	4	0.67	Minor Revision
6	Instrument	4	5	4	1.00	Valid
7	Instrument	5	4	3	0.67	Minor Revision
8	Content	4	5	4	1.00	Valid
9	Content	4	3	3	0.33	Major Revision
10	Content	4	4	4	1.00	Valid
11	Content	4	4	3	0.67	Valid
12	Content	5	3	4	0.67	Minor Revision
13	Content	5	5	5	1.00	Minor Revision
14	Content	5	5	4	1.00	Valid
15	Language	4	5	3	0.67	Minor Revision
16	Language	4	3	5	0.67	Minor Revision
17	Language	4	4	5	1.00	Valid
18	Language	4	5	5	1.00	Valid

The assessment results show that of the 18 items in the instrument, 12 items (66.7%) had an I-CVI value of 1.00 and were therefore declared valid. Six items (33.3%) obtained an I-CVI score of 0.67, so minor revisions were recommended to improve the language, clarity of sentences, and word choice. One item obtained an I-CVI score of 0.33, which, according to the criteria [43]. This falls under the category of major revision because the validators did not give the same assessment, so the item needs to be majorly revised or redone in accordance with the mathematical construct. Overall, these findings show that most of the items in the instrument have met content suitability, although some items need refinement to improve the clarity and relevance of the concepts.

Before hypothesis testing, prerequisite analyses were conducted to ensure the suitability of parametric statistical procedures. Normality was assessed using the Shapiro-Wilk test, multicollinearity was examined through Variance Inflation Factor (VIF) and tolerance values, and homoscedasticity was evaluated using residual analysis. After these assumptions were met, Pearson correlation analysis was employed to examine the relationships among math anxiety, self-efficacy, and basic mathematical ability. Subsequently, multiple linear regression analysis was performed to determine the combined contribution of math anxiety and self-efficacy in predicting basic mathematical ability.

The next instrument underwent EFA testing, which showed that the items were grouped according to construct with adequate goodness of fit results, and underwent reliability testing to obtain Cronbach's Alpha. The instrument is declared valid and reliable for use in research if this analysis has been carried out. The EFA results were obtained from testing 281 respondents at several Indonesian universities. The EFA calculation used a factor loading of 0.30, because if there were 282 respondents, a factor loading of 0.3 would be used [44]. Based on the results obtained, basic competency questions numbered 3, 4, 6, 18, and 25 were eliminated because they had criteria below the factor loading. Therefore, the remaining 25 questions are numbered 1, 2, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, and 30. Table 5 shows the reliability test obtained for the basic mathematics ability items.

Table 5. Frequentist Scale Reliability Statistics

Estimate	McDonald's ω	Cronbach's α
Point estimate	0.818	0.808
95% CI lower bound	0.787	0.775
95% CI upper bound	0.849	0.838

Based on the reliability results obtained, the values $\alpha = 0.808$ and $\omega = 0.818$ were obtained. This indicates that the developed instrument shows high reliability, or more than 0.70 [45]. Therefore, the instruments used are consistent and reliable in measuring constructs in basic elementary school mathematics concepts.

Results

The research results were obtained from the analysis of instruments that had undergone construct validity testing using Exploratory Factor Analysis (EFA) and instrument reliability testing. The results were then followed by descriptive analysis to describe the research data. The analysis results were then subjected to Pearson's correlation test to see the relationship between variables, and then subjected to multiple regression testing to determine the simultaneous effect on the research. Table 6 shows the descriptive analysis results obtained.

Table 6. Descriptive Statistics

	Self-Efficacy	Math Anxiety	Basic Math Skills
Valid	282	282	282
Missing	0	0	0
Mean	70.440	29.351	19.040
Std. Deviation	11.210	6.328	3.696
Minimum	33.000	10.000	5.800
Maximum	90.000	48.000	24.000

Based on the results of descriptive analysis, it shows that self-efficacy is classified as high, with an average value of 70.44 and a standard deviation of 11.21, which means that most respondents have good self-confidence in completing mathematical tasks. The mean value for the math anxiety variable was 29.35 with a standard deviation of 6.33, indicating that the anxiety level was in the moderate category. The variable of basic mathematical ability has an average of 19.04 with a standard deviation of 3.69, which indicates that the respondents' basic mathematical ability is in the good category. Therefore, based on the standard deviation results of the three variables, which are relatively small, the data distribution in this study can be said to be homogeneous.

Table 7. Pearson's Correlations

No.	Variable	Self-Efficacy	Math Anxiety	Basic Math Skills
1	Self-Efficacy	Pearson's r p-value	— —	
2	Math Anxiety	Pearson's r p-value	-0.436 < .001	— —
3	Basic Math Skills	Pearson's r p-value	0.304 < .001	-0.175 0.003

Based on Table 7 above, Pearson's correlation test was conducted to show self-efficacy with math anxiety. Pearson's correlation test results show that self-efficacy has a strong and significant negative relationship with math anxiety ($r = -0.436$, $p < 0.001$), so that the higher the students' self-efficacy level, the lower the math anxiety experienced. In addition, self-efficacy also has a positive and significant relationship with basic mathematical ability ($r = 0.304$, $p < 0.001$), which shows that students with higher self-confidence tend to have better mathematical abilities. Not only that, but math anxiety shows a significant but relatively weak negative relationship with basic math skills ($r = -0.175$, $p = 0.003$).

The findings of this study indicate that math anxiety has the potential to reduce students' basic mathematical abilities; however, its influence is not as strong as that of self-efficacy. The analysis reveals the presence of shared variance between math anxiety and self-efficacy, meaning that both variables overlap in explaining students' performance. When tested simultaneously, this overlapping variance causes the predictive strength of one variable to

weaken relative to the other. The results further demonstrate that self-efficacy exerts a more dominant and consistent influence on students' basic mathematics abilities compared to math anxiety [46]. The significant relationship has been proven through Pearson's correlation analysis. Research data must also undergo statistical assumption testing before performing linear regression Table 8 shows the assumption tests that have been conducted.

Table 8. Assumption Test

Assumptions	Indicators	Results	Criteria	Conclusions
Normality	Shapiro-Wilk	W = 0.929 p < .001	p > .05 = Normal	The data is not normally distributed, but the number of respondents is 282, so the CLT is satisfied, and regression can still be performed.
Multicollinearity	VIF	1.234	VIF < 10	There is no multicollinearity.
	Tolerance	0.810	Tolerance > 0.10	Independent variables do not excessively influence each other.
	Condition Index	22.081	< 30	There are indications of slight multicollinearity, but it is still tolerable.

The Shapiro–Wilk normality test shows a W value of 0.929 with $p < .001$, indicating that the residuals are not normally distributed. However, the large sample size ($n = 282$) allows the regression estimates to remain valid according to the Central Limit Theorem, which states that the distribution of regression parameter estimates tends to be normal for large sample sizes [47]. Linear regression remains robust to violations of residual normality when the sample size is large, because coefficient estimates remain stable following the Central Limit Theorem [48]. The multicollinearity test shows a VIF value of 1.234 and a Tolerance value of 0.810. These values are within safe limits (VIF < 10 and Tolerance > 0.10), so there is no serious multicollinearity between predictor variables [44]. The collinearity diagnostics results show a Condition Index value of 22.081, which is still below the threshold of 30 [49]. These findings indicate mild multicollinearity, but it is still tolerable and does not interfere with regression estimation.

Fig. 1 illustrates the results of the homoscedasticity test based on the dispersion pattern observed in the Residuals versus Predicted plot. The scatterplot demonstrates that the residuals are randomly distributed around the zero line and do not form any systematic or recognizable pattern, such as a funnel or curved shape. This random spread indicates that the variance of the residuals remains stable across all levels of the predicted values. Therefore, the assumption of homoscedasticity is satisfied, confirming that the regression model meets one of the essential classical assumptions for valid statistical inference [50].

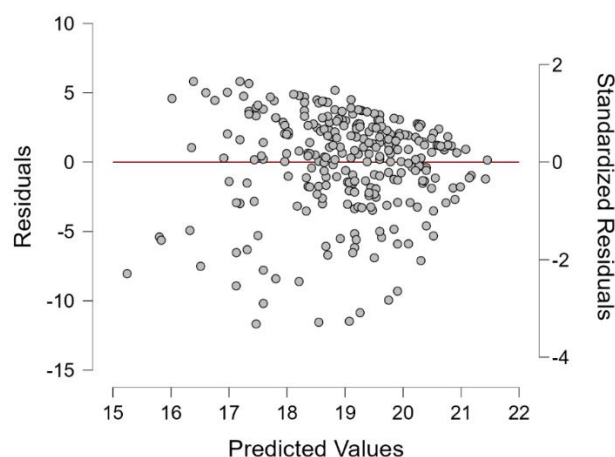


Fig. 1. The homoscedasticity test

Thus, overall, the regression model was found to meet the statistical assumptions required for further analysis. The analysis continued by using multiple linear regression to test the contribution of self-efficacy and math anxiety in predicting the basic mathematical ability of PGSD students. Tables 9 and 10 below show the results of multiple linear regression.

Table 9 presents the summary of the multiple linear regression model predicting students' basic mathematical skills. The null model (H_0) shows no explanatory power ($R^2 = 0.000$), indicating that without predictors, the model does not explain any variance in the dependent variable. In contrast, Model H_1 yields an R value of 0.308, reflecting a moderate relationship between the predictors and basic mathematical skills. The R^2 value of 0.095 indicates that 9.5% of the variance in students' basic mathematical skills is explained by the independent variables included in the model. The adjusted R^2 (0.088) suggests a slight correction for the number of predictors, confirming a modest but meaningful explanatory contribution. Furthermore, the RMSE decreases from 3.696 (H_0) to 3.529 (H_1), indicating improved prediction accuracy when the independent variables are included.

Table 9. Model Summary – Basic Mathematical Skills

Model	R	R^2	Adjusted R^2	RMSE
H_0	0.000	0.000	0.000	3.696
H_1	0.308	0.095	0.088	3.529

Table 10 presents the ANOVA results for the multiple regression model (H_1). The regression sum of squares (363.306) represents the variance explained by the predictors, while the residual sum of squares (3475.394) reflects the unexplained variance. The F-value of 14.583 with a significance level of $p < .001$ indicates that the overall regression model is statistically significant. This means that, collectively, the independent variables significantly predict students' basic mathematical skills. Therefore, the model provides a better fit than the

intercept-only model and demonstrates that the predictors jointly contribute to explaining variations in mathematical performance.

Table 10. ANOVA

Model		Sum of Squares	df	Mean Square	F	p
pH ₁	Regression	363.306	2	181.653	14.583	<.001
	Residual	3475.394	279	12.457		
	Total	3838.699	281			

Note. The intercept model is omitted, as no meaningful information can be shown.

The results of multiple linear regression analysis show that the regression model on the variables of self-efficacy and math anxiety has a significant relationship. The multiple correlation value (R) of 0.308 indicates a moderate relationship between the variables of self-efficacy and math anxiety with basic mathematical ability. The R^2 value of 0.095 shows that 9.5% of the variation in basic mathematical ability can be explained by the combination of these two variables, while the remaining 90.5% is influenced by other factors. The adjusted R^2 value of 0.088 confirms that the proportion of variation explained remains stable after adjusting for the number of predictors. This study does not provide evidence of a causal relationship between self-efficacy and math anxiety due to its correlational design. While the regression analysis indicates a significant association between these variables, it cannot determine whether self-efficacy reduces math anxiety or whether math anxiety undermines self-efficacy. Nevertheless, theoretical frameworks suggest a reciprocal relationship, in which higher self-efficacy may help individuals manage anxiety, while persistent anxiety may negatively affect confidence in mathematical tasks.

The RMSE value of 3.529 indicates the average prediction error of the model against the basic math ability score. In addition, the F test produced an F value of 14.583 with $p < .001$, indicating that the regression model is simultaneously significant, so that self-efficacy and math anxiety together contribute to basic math ability. Thus, after the regression model met the feasibility criteria, a coefficient analysis was performed to identify the variables that played a significant role in explaining the variation in basic math skills. Table 11 below shows the coefficient analysis that was performed.

Table 11. Coefficients

						95% CI		Collinearity Statistics	
Model		Unstandardized	Standard Error	Standardized	t	p	Lower	Upper	Tolerance
H ₀	(Intercept)	19.040	0.220		86.509	<.001	18.607	19.474	
H ₁	(Intercept)	13.431	2.185		6.148	<.001	9.131	17.732	
	Self-Efficacy	0.093	0.021	0.281	4.436	<.001	0.051	0.134	0.810
	Math Anxiety	-0.031	0.037	-0.053	-0.840	0.402	-0.104	0.042	0.810

The results of the analysis show that self-efficacy has a positive and significant effect on basic mathematical ability ($B = 0.093$, $SE = 0.021$, $\beta = 0.281$, $t = 4.436$, $p < .001$). The positive

coefficient value indicates that an increase in self-efficacy is associated with an increase in basic mathematical ability, with a 95% confidence interval ranging from 0.051 to 0.134, indicating a stable estimate. In addition, math anxiety did not have a significant effect on basic mathematical ability ($B = -0.031$, $SE = 0.037$, $\beta = -0.053$, $t = -0.840$, $p = .402$). Although the negative coefficient direction indicates a downward trend in mathematical ability, a p-value greater than 0.05 indicates that the effect is not statistically significant in the simultaneous model. All variables show a Tolerance value of 0.810 and a VIF of 1.234, which are within safe limits ($VIF < 5$), so there is no indication of multicollinearity that could interfere with the stability of the coefficient estimates. Based on the results of the regression coefficient analysis, the multiple linear regression model obtained can be written as follows.

$$Y = 13.431 + 0.093 (\text{Self Efficacy}) - 0.031 (\text{Math Anxiety}) \quad (1)$$

Based on this equation, the constant coefficient of 13.431 indicates that the baseline value for basic mathematical ability is at the lowest level or at the starting point in forming the regression. Self-efficacy shows a positive and significant effect on basic mathematical ability ($B = 0.093$, $p < .001$), so that every increase in self-efficacy also affects improving basic mathematical ability by 0.093. However, math anxiety has a negative coefficient ($B = -0.031$, $p = .402$), indicating that its direct effect on basic mathematical ability is not statistically significant when self-efficacy is included in the regression model.

The results of a study conducted on 282 university students in Indonesia show that self-efficacy has a significant relationship with basic mathematical ability, but the variable of math anxiety does not affect basic mathematical ability. These findings are consistent with previous studies [51–52] emphasizes that self-efficacy is the component that has the most influence on basic mathematical ability compared to other affective variables. This shapes self-confidence in thinking, behaving, and understanding basic mathematical concepts. Not only that, findings by [53] revealed that self-efficacy has a direct influence on basic mathematical ability and even affects mathematics achievement in university students. The influence of self-efficacy on basic mathematical ability shapes success, verbal ability, and emotional regulation [54]. This means that students with high self-efficacy tend to have good calculation skills, are consistent in their answers, and show resilience in facing mathematical difficulties. Therefore, self-efficacy in basic mathematical abilities has a positive and significant relationship.

The results show that math anxiety has a negative relationship with basic math skills, but does not have a significant effect. This means that students who have math anxiety usually have lower basic math skills, and math anxiety does not emerge as a statistically significant independent predictor of basic math skills when self-efficacy is considered. This is in line with the findings [55] shows that self-efficacy, when combined with the variable of math anxiety,

will cause the level of math anxiety to decrease or even disappear, because self-efficacy has a greater influence in determining basic mathematical ability. Math anxiety will have a strong influence when dealing with complex mathematical problems that require high-level thinking, whereas basic mathematical ability is classified as basic mathematical problems [56]. The level of difficulty of the questions also contributed to the minimal effect of math anxiety on basic math skills [57]. Not only that, Prospective elementary school teachers with high self-efficacy still perform well in basic mathematics, even though they experience math anxiety [58]. This is because students are able to regulate their emotions, manage their learning strategies, and remain focused on the basic skills required.

Several factors may explain why math anxiety becomes non-significant in the regression model despite its negative correlation with basic mathematical ability. First, a suppressor or shared variance effect may occur, as math anxiety and self-efficacy are conceptually and empirically related [59–60]. When entered simultaneously, self-efficacy may account for the variance in mathematical ability that overlaps with anxiety, leaving math anxiety with a reduced unique contribution [61]. Second, measurement limitations should be considered, as math anxiety instruments may capture general emotional responses rather than task-specific anxiety, potentially attenuating their predictive power [62–63]. Third, although the sample size is adequate for regression analysis, the remaining unique effect of math anxiety may be relatively small, making it more difficult to detect once overlapping predictors are controlled [60]. These considerations suggest that math anxiety may influence basic mathematical ability indirectly through self-efficacy rather than functioning as an independent predictor.

Overall, the findings of this study prove that increasing students' self-efficacy needs to be the focus of mathematics learning interventions. Intervention programs based on gradual success experiences, problem-based learning, and emotional support from prospective elementary school teachers have been proven to increase self-efficacy while reducing mathematics anxiety [64]. Meanwhile, math anxiety remains an important component in influencing basic mathematical ability, because basic mathematical ability can be minimized if prospective elementary school teachers have high levels of self-efficacy and adaptive learning strategies. These findings should be interpreted within the context of Indonesian elementary teacher education. Pre-service teachers in PGSD/PGMI programs are not only developing mathematical competence but also constructing their professional teacher identity, which is closely associated with confidence, authority, and perceived responsibility for students' success [65–66]. Cultural norms that emphasize avoiding failure and maintaining social harmony may heighten emotional sensitivity toward mathematics, making self-efficacy a particularly salient factor in this context [67–68]. In addition, teacher-training pedagogy in

Indonesia has traditionally emphasized procedural mastery and high-stakes assessment, which may reinforce anxiety when confidence is low [69]. Therefore, the strong role of self-efficacy observed in this study may reflect both individual psychological factors and broader cultural-pedagogical influences. These contextual characteristics should be considered when generalizing the findings to teacher education systems in other cultural settings.

Conclusion

This study concludes that self-efficacy is a factor that significantly influences the basic mathematical abilities of prospective elementary school teachers at five state universities in Indonesia. Students with higher levels of self-efficacy demonstrate better basic mathematical abilities. However, math anxiety does not have a significant influence on basic mathematical abilities. This means that mathematics anxiety is not a major determinant of basic mathematical abilities when students have high levels of self-efficacy. These results prove that students' self-confidence in doing math assignments can play a role in reducing the negative impact of math anxiety. In addition, low levels of math anxiety can be associated with basic abilities and the academic experiences of prospective elementary school teachers who have been equipped with mathematical pedagogical learning in previous semesters.

These findings emphasize the need to strengthen self-efficacy in the mathematics learning process in higher education, especially for prospective elementary school teachers. Efforts to develop successful experiences, active learning strategies, and emotional support from lecturers need to be the focus in order to improve students' basic mathematical abilities and minimize the impact of anxiety that may arise. Thus, this study provides empirical and practical contributions to the development of mathematics curriculum and learning strategies in teacher education in Indonesia.

Acknowledgment

The authors express their sincere appreciation to Universitas Negeri Yogyakarta, Dr. Fery Muhamad Firdaus, S.Pd., M.Pd., Dr. Anwar Senen, M.Pd., Prof. Yoppy Wahyu Purnomo, S.Pd., M.Pd., and Pebria Dheni Purnasari, M.Pd. for their collective support, guidance, and contributions, all of which were instrumental in the successful completion of this article.

Conflict of Interest

The authors declare that there is no conflict of interest.

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