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## Mathematics Anxiety and Self-Efficacy of Pre-Service Special Education Teachers: Impact and Challenges

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### Abstract

*Mathematics anxiety and self-efficacy in teaching mathematics are essential elements that play a crucial role in properly instructing children with disabilities in the field of mathematics, particularly for pre-service special education instructors. The present study examined the relationship between mathematics anxiety and self-efficacy in teaching mathematics to children with disabilities among pre-service special education instructors. Significantly, the present study examined the influence of gender, practical training, academic year, and course load on levels of mathematics anxiety and self-efficacy in the context of teaching mathematics. The study involved a cohort of 157 pre-service special education teachers. The findings of the study indicated that individuals in the pre-service special education teacher programme expressed a moderate degree of anxiety about mathematics and a high level of confidence in their ability to effectively teach mathematics to children with disabilities. In addition, there was a modest negative correlation seen between mathematics anxiety and self-efficacy for instructing students with impairments in mathematics, but this correlation did not reach statistical significance. There was no observed correlation between gender and math anxiety, as well as self-efficacy in teaching mathematics. The results of this study indicate that it is important for teacher education programmes to focus on addressing mathematics anxiety and improving self-efficacy in pre-service special education instructors. This will help to facilitate successful mathematics instruction for children with disabilities.*

**keywords:** Pre-service teachers; special education; mathematics anxiety; self-efficacy; students with disabilities; teacher education.

### Introduction

The comprehensive examination of mathematics anxiety and teacher self-efficacy is of utmost importance when considering pre-service special education instructors. These variables possess the capacity to significantly influence the level of education provided to children with disabilities. The importance of teacher self-efficacy in facilitating the adoption of effective teaching practises is consistently underscored by a multitude of research investigations. According to Xu and Brown (2021), educators with elevated levels of self-efficacy demonstrate greater initiative in the use of impactful pedagogical approaches, establishment of a conducive atmosphere for learning, and responsiveness to the unique requirements of each student.

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Nevertheless, a significant obstacle emerges when pre-service instructors encounter elevated levels of mathematics anxiety. The presence of anxiety can provide a substantial obstacle to the cultivation of self-efficacy in the context of mathematics instruction (Xu & Brown, 2021). The potential consequences on educational achievements can be harmful for pupils, particularly those with impairments. Additionally, it should be noted that the inadequate level of readiness and training in instructing mathematics to children with disabilities might intensify feelings of mathematics anxiety and contribute to diminished self-confidence among pre-service special education instructors (Deringol, 2018). Furthermore, a study by Hernández de la Hera et al. (2023) examined the relationship between attitudes towards mathematics, emotional traits (such as anxiety and self-efficacy), and academic accomplishment. Two cohorts of students from a Spanish university and a secondary school were analysed. The researchers used a backpropagation artificial neural network. The study found that anxiety negatively affected maths and statistics attitudes, but self-efficacy positively affected them. This study highlights the importance of emotional education in mathematics and shows how advanced neural network analytic tools may predict these traits. This research sheds light on the complex link between emotions and academic success in mathematics.

Several studies emphasize the role of teachers' attitudes and beliefs in shaping their perceptions of mathematics. For example, the study conducted by Alghazo, McIntyre, and Alghazo (2013) and Al Mutawah (2016) emphasises that the perception of mathematics as a challenging discipline can frequently be linked to the unfavourable attitudes exhibited by instructors towards the subject. The presence of unfavourable attitudes can exert a significant influence on the calibre of instruction and academic performance in the field of mathematics (Schaeffer Rozek, Maloney, Berkowitz, Levine & Beilock, 2021; Beswick, 2015).

The research done by Schaeffer et al. (2021) highlights the importance of math anxiety among primary school instructors. The extensive inquiry conducted by the researchers unveiled a noteworthy correlation between the presence of math anxiety in educators and the academic achievements of their students in mathematics. Even after accounting for variables such as previous academic performance and demographic characteristics, it was seen that pupils who were taught by teachers with greater levels of math anxiety had lower levels of improvement in math achievement.

Additionally, Hembree's (1990) study revealed a significant inverse relationship between mathematics anxiety and mathematics teaching self-efficacy among pre-service teachers. The observed link indicates that an increase in levels of mathematics anxiety is associated with a decrease in self-efficacy for teaching mathematics. This relationship has the potential to influence teaching practises and ultimately effect student learning results.

In a more recent investigation, Gresham (2007) conducted a research to examine the impact of a mathematics intervention programme on pre-service special education teachers. The research findings indicated that the implementation of specific treatments aimed at mitigating mathematics anxiety resulted in notable enhancements in individuals' self-perceived competence and confidence in instructing mathematics. This discovery highlights the capacity of interventions to successfully tackle these crucial concerns.

In addition, a study done by Ekstam, Korhonen, Linnanmaki, and Aunio (2017) examined the effects of targeted training in mathematics pedagogy for educators specialising in special education. It was shown that educators who underwent specialised training in instructing mathematics to students with disabilities had elevated levels of self-efficacy and demonstrated a greater inclination

to utilise evidence-based instructional strategies within their educational settings. Consequently, this resulted in enhanced academic achievements for the students involved.

In summary, the teaching of children with disabilities, particularly in the context of pre-service special education instructors, is significantly influenced by mathematics anxiety and teacher self-efficacy. The presence of anxiety has the potential to impede self-efficacy. However, the implementation of focused interventions, specialised training, and a positive transformation in teachers' attitudes towards mathematics may collectively contribute to the advancement of teaching practises and the attainment of improved student results. The aforementioned findings highlight the significance of treating mathematical anxiety and fostering self-efficacy in pre-service special education teachers, with the ultimate goal of benefiting children with disabilities.

### **Mathematics Anxiety and self-efficacy**

Mathematics anxiety is a widely studied phenomena that can have an especially negative impact on pupils who have impairments. These pupils frequently encounter supplementary obstacles when acquiring mathematical knowledge, and the presence of mathematics anxiety might intensify this difficulty. According to a study conducted by Devine, Fawcett, Szucs, and Dowker (2012), it has been found that mathematics anxiety has the potential to impede the working memory capacity of children who have learning impairments. Consequently, this can further exacerbate the difficulties they face in comprehending and assimilating mathematical concepts and information.

Additionally, it is important to consider that pupils who have impairments may possess distinct learning requirements and may benefit from receiving tailored training in the subject of mathematics. Mathematical anxiety has the potential to impede teachers' capacity to flexibly adjust their instructional strategies in order to cater to the diverse demands of their students. According to a study conducted by Dowker and Sheridan (2022), there is evidence to suggest that instructors who experience greater levels of mathematics anxiety are inclined to offer less levels of personalised help to their pupils. This can be a significant challenge, especially for students with impairments who may necessitate customised assistance.

### **Teacher Self-Efficacy and Inclusive Education**

The role of teacher self-efficacy is of paramount importance in effectively implementing inclusive education practises, particularly when it comes to teaching mathematics to students with disabilities. The primary objective of inclusive education is to ensure that all students, irrespective of their individual skills or impairments, have access to fair and impartial educational opportunities. According to Pajares (1996), educators who possess a strong sense of self-efficacy in the domain of mathematics instruction are more inclined to effectively employ inclusive teaching strategies. Educators has enhanced capabilities to discern their pedagogical approaches, offer supplementary assistance, and modify their instructional techniques in order to cater to the heterogeneous requirements of their pupils (Tschannen-Moran & Hoy, 2001).

### **Addressing Mathematics Anxiety and Enhancing Self-Efficacy**

Numerous interventions and techniques have been suggested as potential solutions for addressing mathematics anxiety and improving teacher self-efficacy in the instruction of mathematics to students with disabilities. Research conducted by Graham and Reed (2020) has indicated that professional development initiatives that prioritise the enhancement of teachers' self-efficacy and offer targeted training in inclusive mathematics education have demonstrated

encouraging results. These programmes have the potential to assist educators in cultivating the necessary confidence and aptitude to effectively address the obstacles presented by mathematics anxiety and the varying educational requirements of their pupils.

According to Ingersoll and Strong (2011), the use of mentoring and peer support networks has demonstrated efficacy in diminishing mathematics anxiety and bolstering self-efficacy in both pre-service and in-service teachers. By facilitating the collaboration between seasoned mentors and novice teachers, a significant opportunity arises to offer invaluable assistance and emotional support, ultimately leading to a reduction in anxiety levels and an enhancement of teaching methodologies.

### **The Role of Policy and Teacher Preparation Programs**

In order to effectively handle mathematics anxiety and foster self-efficacy in teaching mathematics, particularly within the realm of special education, it is imperative to implement well-designed policies and teacher development programmes. It is imperative for policymakers to provide precedence to the incorporation of mathematics education within teacher training programmes, with particular emphasis on the implementation of effective instructional approaches for teaching mathematics to children with disabilities (Ball & Forzani, 2009). Furthermore, it is important that teachers have access to continuing professional development opportunities throughout their careers in order to facilitate the continual enhancement of their instructional methodologies (Darling-Hammond, 2017).

In summary, the education of students with disabilities is greatly influenced by two key factors: mathematics anxiety and instructor self-efficacy. Existing data indicates that the presence of mathematics anxiety might intensify the difficulties experienced by pupils, whereas the level of self-efficacy among teachers plays a pivotal role in delivering teaching and assistance that is successful. It is important to acknowledge the significance of addressing mathematics anxiety and building self-efficacy among instructors in order to promote inclusive education practises and enhance the academic performance of students with disabilities in the field of mathematics. In order to foster teacher empowerment and promote equitable learning opportunities for all students, it is imperative that policymakers, teacher preparation programmes, and professional development efforts give priority to these components.

### **The Current Study**

As previously mentioned, the above-discussed literature review revealed that there is a gap in our understanding of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the United Arab Emirates (UAE). While some research has examined these factors in general pre-service teachers, there is limited research focusing on pre-service special education teachers in the UAE. Therefore, the current study aims to fill this gap by examining the levels of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the UAE. Additionally, the current study will explore the potential impact of gender, practical training, year in college, and number of courses on these factors.

The research questions were developed based on this gap and aim to address it by providing insights into the levels of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the UAE and exploring potential factors that may impact these levels. To achieve this, the current study aimed to answer the following research questions:

Q1: What are the levels of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE?

Q2: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to gender?

Q3: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to practical training?

Q4: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to year in college?

Q5: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to the number of courses?

Q6: Are there any significant statistical effect ( $\alpha = 0.05$ ) of average in mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE?

Q7: Is there a relationship between mathematics anxiety and pre-service special education teachers' self-efficacy for teaching mathematics in UAE?

These research questions were developed to investigate the levels of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the UAE and to identify any differences based on gender, practical training, year in college, and the number of courses. By answering these research questions, the study aimed to provide insights into the factors that contribute to mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the UAE, and to identify areas for future research and intervention.

## **Method and Results**

### **Scales**

The current study utilized a quantitative survey approach to gather data on mathematics anxiety and self-efficacy attitudes related to mathematics teaching among pre-service teachers enrolled in a teachers' education programme at a public university in the United Arab Emirates. The researchers utilized two distinct questionnaires to collect data on these constructs: The Abbreviated Math Anxiety Scale (AMAS) and the Self-Efficacy Beliefs toward Mathematics Teaching Scale (SEBMTS).

The AMAS, developed by Hopko et al. (2003), is a shortened version of the Mathematics Anxiety Rating Scale (MARS) that measures mathematics anxiety levels in participants. Devine et al. (2012) reported that the AMAS has high internal consistency ( $\alpha = .90$ ) and a reliable test-retest score over two weeks ( $r = .85$ ). The scale comprises nine items that participants rate on a 5-point Likert scale, with higher scores indicating higher levels of mathematics anxiety.

The SEBMTS, created by Dede (2008), measures participants' self-efficacy beliefs towards teaching mathematics and consists of 14 items that participants rate on a 5-point Likert-type scale. According to Peker (2016), Dede (2008) reported a reliability coefficient of 0.80 for the scale, as determined by Cronbach's alpha. The SEBMTS evaluates three different aspects of self-efficacy: efficacy in teaching, motivation and taking on responsibility, and effective teaching.

Table 1 displays a comprehensive overview of the demographic characteristics of the participants, including information on their gender, college year, practicum, and mathematics methods courses.

**Table 1:** Demographic Characteristics of participants.

Percent	Frequency	Category	Variable
19.3	29	Male	Gender
80.7	121	Female	
7.3	11	1 <sup>st</sup>	Year of college
26.0	39	2 <sup>nd</sup>	
49.3	74	3 <sup>rd</sup>	
17.3	26	4 <sup>th</sup>	
84.7	127	Yes	Practicum
15.3	23	No	
16.7	25	0	mathematics or mathematics methods courses
63.3	95	1	
20.0	30	2	

Q1: What are the levels of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE?

To investigate this question, we calculated the mean levels, standard deviations, and ranks of mathematics anxiety and self-efficacy for teaching mathematics in pre-service teachers who specialize in special education in the UAE.

### Anxiety

Table 2 displays that the pre-service special education teachers in the UAE had a moderate level of mathematics anxiety towards teaching mathematics, with a mean score of (3.17) and a standard deviation of (1.10). These items also received moderate scores, with the highest mean score of (3.43) and a standard deviation of (1.45) being assigned to item (8) "Being given a 'pop' quiz in math class." In contrast, item (1) "Having to use the tables in the back of a math book" was ranked lowest, with a mean score of (2.37) and a standard deviation of (1.23).

**Table 2:** Means, Standard Deviations, Ranks and the mean levels of mathematics anxiety for teaching mathematics in pre-service special education teachers in UAE ranked in descending order.

Mean level	SD	Mean	Item	No.	Rank
Medium	1.45	3.43	Being given a "pop" quiz in math class.	8	1
Medium	1.45	3.39	Taking an examination in a math course.	4	2
Medium	1.38	3.35	Being given a homework assignment of many difficult problems that is due the next class meeting.	5	3
Medium	1.40	3.35	Listening to a lecture in math class.	6	4
Medium	1.41	3.25	Starting a new chapter in a math book.	9	5
Medium	1.43	3.14	Watching a teacher work an algebraic equation on the blackboard.	3	6
Medium	1.31	3.13	Listening to another student explain a math formula.	7	7
Medium	1.40	3.12	Thinking about an upcoming math test 1 day before.	2	8
Medium	1.23	2.37	Having to use the tables in the back of a math book.	1	9
Medium	1.10	3.17	Anxiety		



### Self-efficacy

Table 3 indicates that the pre-service special education teachers in the UAE had a moderate level of self-efficacy towards teaching mathematics, with a mean score of 2.41 and a standard deviation of 0.84. The individual items on the self-efficacy scale also received moderate scores. The highest mean score of 2.59 and a standard deviation of 1.34 was assigned to item 15, which is "Collect, plot and interpret data (on any type of graph)." In contrast, the lowest mean score of 2.17 and a standard deviation of 1.18 was assigned to item 22, which is "Describe characteristics of Numbers (i.e. whole numbers, rational/irrational numbers)."

**Table 3:** Means, Standard Deviations, Ranks and the mean levels of mathematics self-efficacy for teaching mathematics in pre-service special education teachers in UAE ranked in descending order.

Mean level	SD	Mean	Item	No.	Rank
Medium	1.34	2.59	Collect, plot and interpret data (on any type of graph)	15	1
Medium	1.31	2.52	Interpret variables in an algebraic equation	21	2
Medium	1.42	2.51	Interpret probability of outcomes	22	3
Medium	1.24	2.51	Convert a fraction to a decimal and vice versa.	11	4
Medium	1.26	2.51	Manipulate coordinate planes.	14	5
Medium	1.16	2.49	Perform strategies for composing and decomposing numbers by manipulating place value in addition and subtraction.	9	6
Medium	1.26	2.47	Measure the length of objects.	19	7
Medium	1.20	2.45	Convert between units in a different system (i.e. kilograms $\rightarrow$ pounds, inches $\rightarrow$ centimeters).	18	8
Medium	1.29	2.45	Compare equivalence of fractions and decimals	12	9
Medium	1.26	2.45	Interpret inverse relationships between operations (i.e. +, - and *, $\div$ )	13	10
Medium	1.26	2.41	Discover and create mathematical patterns	20	11
Medium	1.17	2.41	To what extent can you use a variety of assessment strategies in mathematics?	5	12
Medium	1.27	2.38	Measure area and perimeter	16	13
Medium	1.20	2.37	Convert between units in the same system (i.e. grams $\rightarrow$ kilograms, inches $\rightarrow$ yards).	17	14
Medium	1.09	2.36	To what extent can you get your students to believe they can do well in mathematics?	4	15
Medium	1.29	2.36	How well can you implement alternative teaching strategies for mathematics in your classroom?	7	16
Medium	1.06	2.35	To what extent can you help your students' value learning mathematics?	2	17
Medium	1.18	2.35	Perform strategies for composing and decomposing numbers by manipulating place value in multiplication and division.	10	18
Low	1.17	2.32	To what extent can you provide an alternative explanation or example in mathematics when students are confused?	6	19
Low	1.10	2.30	To what extent can you craft relevant questions for your students related to mathematics?	3	20
Low	1.12	2.23	To what extent can you motivate students who show low interest in mathematics?	1	21
Low	1.18	2.17	Describe characteristics of Numbers (i.e. whole numbers, rational/irrational numbers).	8	22
Medium	0.841	2.41	Self-efficacy		

Q2: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to gender?

Table 4 indicates that there is no notable variation, at a significance level of  $\alpha \leq 0.05$ , in the averages of mathematics anxiety and self-assurance in teaching mathematics in pre-service special education teachers in the UAE in relation to gender.

**Table 4:** Means, standard deviation and t-test for the differences in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to gender.

Variable	Practical training	N	mean	SD	t-value	df	Sig.
anxiety	Male	29	3.15	0.97	-0.117	148	0.907
	Female	121	3.18	1.14			
self-efficacy	Male	29	2.38	0.94	-0.192	148	0.848
	Female	121	2.41	0.82			

Q3: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to practical training?

Table 3 indicates that the pre-service special education teachers in the UAE had a moderate level of self-efficacy towards teaching mathematics, with a mean score of 2.41 and a standard deviation of 0.84. The individual items on the self-efficacy scale also received moderate scores. The highest mean score of 2.59 and a standard deviation of 1.34 was assigned to item 15, which is "Collect, plot and interpret data (on any type of graph)." In contrast, the lowest mean score of 2.17 and a standard deviation of 1.18 was assigned to item 22, which is "Describe characteristics of Numbers (i.e. whole numbers, rational/irrational numbers)."

**Table 5:** Means, standard deviation and t-test for the differences in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to practical training.

Variable	Practical training	N	mean	SD	t-value	df	Sig.
Anxiety	Yes	127	3.20	1.15	0.857	148	0.397
	No	23	3.02	0.84			
Self-efficacy	Yes	127	2.37	0.85	-1.231	148	0.220
	No	23	2.60	0.80			

Q4: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to year in college?

To address this research question, we computed the means and standard deviations for mathematics anxiety and self-efficacy in teaching mathematics in pre-service special education teachers in the UAE, categorized by their academic year level. Table 6 shows that significant variations were observed in the means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the UAE based on their academic year level. To determine the significance of these differences, a One-Way ANOVA test was conducted and the results are presented in Table 7. The findings suggest that:



At a significance level of  $\alpha \leq 0.05$ , there are no significant differences in the means of mathematics anxiety for teaching mathematics in pre-service special education teachers in the UAE based on academic year level, with  $F=0.72$ .

At a significance level of  $\alpha \leq 0.05$ , there is a significant difference in the means of mathematics self-efficacy for teaching mathematics in pre-service special education teachers in the UAE based on academic year level, with  $F=2.86$  and a p-value of 0.000.

**Table 6:** Means, standard deviations for the mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE were calculated according to year in college variable.

Variable	Year in college	N	Mean	SD
anxiety	1 <sup>st</sup>	11	2.86	1.12
	2 <sup>nd</sup>	39	3.11	1.13
	3 <sup>rd</sup>	74	3.29	1.17
	4 <sup>th</sup>	26	3.05	0.86
	Total	150	3.17	1.10
self-efficacy	1 <sup>st</sup>	11	2.97	0.91
	2 <sup>nd</sup>	39	2.53	0.99
	3 <sup>rd</sup>	74	2.25	0.74
	4 <sup>th</sup>	26	2.42	0.76
	Total	150	2.41	0.84

**Table 7:** One Way ANOVA for the differences in the means of the mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE were calculated according to year in college variable

Variable	Variation of Source	Sum of Squares	DF	Mean Square	F	Sig.
anxiety	Between groups	2.66	3.00	0.89	0.72	0.54
	Within groups	179.14	146.00	1.23		
	Total	181.79	149.00			
self-efficacy	Between groups	5.85	3.00	1.95	2.86	0.039*
	Within groups	99.63	146.00	0.68		
	Total	105.48	149.00			

**Table 8:** (LSD) test for the differences between the means of the mathematics self-efficacy for teaching mathematics in pre-service special education teachers in UAE according to year in college variable.

Year in college	Mean	Mean differences				Sig.
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	
1 <sup>st</sup>	2.97	-	-	0.716	-	0.008*
2 <sup>nd</sup>	2.53	-	-	-	-	
3 <sup>rd</sup>	2.25	-0.716	-	-	-	0.008*
4 <sup>th</sup>	2.42	-	-	-	-	

Q5: Are there any significant statistical differences ( $\alpha = 0.05$ ) in means of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE attributed to number of courses?

To address this inquiry, we conducted analyses to determine the means and standard deviations of mathematics anxiety and self-efficacy pertaining to the instruction of mathematics among pre-service special education teachers in the United Arab Emirates. These calculations were performed while considering the categorization of participants based on the number of courses they had completed. According to the data shown in Table 9, there were notable variations in the average scores of mathematics anxiety and self-efficacy for teaching mathematics among pre-service special education teachers in the UAE, depending on the number of courses they had completed. In order to assess the statistical significance of the observed differences, a One-Way Analysis of Variance (ANOVA) test was performed. The findings of this analysis are displayed in Table 10. The examination produced the subsequent results. There were no statistically significant variations seen in the average levels of mathematics anxiety among pre-service special education teachers in the UAE when considering the amount of mathematics courses they have completed. This finding is supported by an F-value of 1.89. Moreover, a notable disparity was seen in the averages of mathematics self-efficacy among pre-service special education teachers in the UAE, depending on the number of courses they had completed. This difference was statistically significant, as indicated by an F-value of 3.49 at a significance level of 0.000.

**Table 9:** Means, standard deviations for the mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE were calculated according to no. of courses variable.

Variable	No. of courses	N	Mean	SD
Anxiety	0	25	2.81	1.10
	1	95	3.28	1.15
	2	30	3.12	0.91
	Total	150	3.17	1.10
Self-efficacy	0	25	2.77	0.94
	1	95	2.29	0.80
	2	30	2.49	0.82
	Total	150	2.41	0.84

**Table 10:** One Way ANOVA for the differences in the means of the mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE were calculated according to no. of courses variable

Variable	Variation of Source	Sum of Squares	DF	Mean Square	F	Sig.
anxiety	Between groups	5	2.00	2.28	1.89	0.155
	Within groups	177	147.00	1.21		
	Total	182	149.00			
self-efficacy	Between groups	5	2.00	2.39	3.49	0.033*
	Within groups	101	147.00	0.69		
	Total	105	149.00			

To find out the source of differences, LSD post test was conducted. Table 11 shows statistically significant differences between (0 & 1) course in response to self-efficacy.

**Table 11:** (LSD) test for the differences between the means of the mathematics self-efficacy for teaching mathematics in pre-service special education teachers in UAE according to no. of courses variable.

No. of courses	Mean	Mean differences			Sig.
		0	1	2	
0	2.77	-	0.479	-	0.011*
1	2.29	-0.479	-	-	0.011*
2	2.49	-	-	-	-

Q6- Are there any significant statistical effect ( $\alpha=0.05$ ) of average in mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE?

A simple regression analysis was undertaken to examine the association between GPA and mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the United Arab Emirates (UAE). The findings, as depicted in Table 12, indicate that there is no statistically significant influence, at a significance level of  $\alpha \leq 0.05$ , of the grade point average (GPA) on the mean scores of mathematics anxiety and self-efficacy for teaching mathematics among the participants.

**Table 12:** Simple Regression Analysis test results of the direct effect of average in mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in UAE

Sig.	t-value	Standardized Beta	Sig.	F-value	R <sup>2</sup>	R	Variables
0.988	0.014	0.001	0.988	0.00	0.00	0.001	anxiety
0.314	-1.01	-0.083	0.314	1.02	0.007	0.083	self-efficacy

Q7: Is there a relationship between mathematics anxiety and pre-service special education teachers' self-efficacy for teaching mathematics in UAE?

To investigate the correlation between mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the UAE, Pearson's correlation coefficient was computed. The results are presented in Table 13, showing a weak negative correlation coefficient of -0.102, indicating that as mathematics anxiety increases, self-efficacy for teaching mathematics decreases slightly. However, this correlation is not statistically significant at the (0.05) level.

**Table 13:** Correlation coefficient between mathematics anxiety and pre-service special education teachers' self-efficacy for teaching mathematics in UAE

Self-efficacy	Anxiety	
	"R" Correlation Variable	-0.102
	Significance	0.215
	Number	150

## Discussion

Prior research has examined the extent of mathematics anxiety and self-efficacy in pre-service teachers across different nations, mostly focusing on general education rather than special

education. The results of our study suggest that pre-service special education teachers in the UAE exhibit moderate levels of mathematics anxiety and self-efficacy in relation to their ability to teach mathematics. The findings presented in this study align with other research that has documented moderate levels of mathematics anxiety and self-efficacy among pre-service teachers (Sowinski et al., 2018; Morán-Soto, & González-Peña, 2022, Hendral & Hidayati, 2023).

The mathematics anxiety measure yielded the greatest mean score in relation to the situation of "Being administered an unannounced quiz in a mathematics class," whilst the lowest mean score was associated with the situation of "Being required to utilise the tables located at the end of a mathematics textbook." The results of this study align with other research, indicating that timed quizzes and assessments are a prevalent factor contributing to mathematics anxiety among pre-service teachers (Hembree, 1990; Massouti, 2021). In relation to self-efficacy, the data indicates that the task with the greatest mean score pertained to the ability to collect, plot, and analyse data using various types of graphs. Conversely, the task with the lowest mean score was associated with the capacity to describe the features of numbers, such as whole numbers and rational/irrational numbers. The findings of this study indicate that pre-service teachers in the UAE exhibit higher levels of self-assurance while engaging in activities that require the analysis and interpretation of data. Conversely, their confidence levels are comparatively lower when it comes to tasks associated with fundamental mathematical principles. Significantly, prior research has shown analogous results (Morán-Soto & González-Peña, 2022; Herawan, Surya & Suyitno, 2020).

The results of our investigation indicate that there is no statistically significant correlation between mathematics anxiety and self-efficacy for teaching mathematics among pre-service special education teachers in the UAE. This discovery is consistent with the findings of several studies that have demonstrated minimal or non-significant correlations, as illustrated by the investigation carried out by Rozgonjuk et al. (2020) including pre-service instructors. However, the findings of our study contradict the results reached by Alkhateeb and Hammoudi (2006) as well as Gorero and Balila (2016), whose research suggested a different relationship between mathematics anxiety and self-efficacy. It is critical to acknowledge that self-efficacy has been identified as a robust predictor of instructors' instructional practises and student results in previous research (Bandura, 1997; Klassen & Chiu, 2010). Consequently, gaining a comprehensive grasp of the components that impact self-efficacy is imperative for enhancing the field of mathematics education. Moreover, prior studies have documented an inverse relationship between mathematics anxiety and self-efficacy (Pajares & Miller, 1994). As levels of mathematics anxiety escalate, there is a corresponding drop in self-efficacy for instructing mathematics, potentially resulting in adverse consequences for the instruction and acquisition of mathematical concepts among kids in special education.

The rationale for choosing mathematics anxiety and self-efficacy as primary variables in this study is based on their inherent importance in the field of mathematics education, particularly in relation to pre-service special education teachers in the United Arab Emirates. The presence of mathematics anxiety is a widespread concern that has the potential to impede the efficacy of educational instruction and acquisition of knowledge. Consequently, it is essential to comprehend the extent to which this particular demographic is affected by this phenomenon. The research investigation centres on the phenomenon of mathematics anxiety, with a specific emphasis on the factors associated with timed quizzes and examinations. This research direction is congruent with the issue description, as it elucidates the precise catalysts of anxiety

experienced by pre-service special education instructors. Similarly, the examination of self-efficacy is warranted due to its recognition as a powerful indicator of instructional methodologies and student achievements. This study provides insights into the strengths and shortcomings of prospective special education instructors by analysing their self-efficacy in the areas of data analysis and fundamental mathematical concepts. The findings of this study are directly relevant to the issue of guaranteeing successful mathematics instruction in inclusive settings. Moreover, the lack of a substantial association between mathematics anxiety and self-efficacy highlights the intricate characteristics of these variables within the educational context, emphasising the necessity for a sophisticated approach to the training and support of teachers. This is consistent with the overarching issue statement of enhancing mathematics instruction, particularly in the context of special education, where customised techniques are crucial to address the varied requirements of children.

### **Cultural aspects**

The reported levels of mathematics anxiety and self-efficacy for teaching mathematics among pre-service special education teachers in the UAE may be influenced by the cultural background of the region. In the UAE, the use of mathematics in daily life is not prevalent, leading students to see mathematics as a challenging discipline (Alzyoudi et al., 2019; Devine et al., 2012). The cultural perspective of mathematics may have contributed to the pre-service teachers' moderate levels of mathematics anxiety and self-efficacy in teaching mathematics. Moreover, it is worth noting that the education system in the UAE places significant importance on the practise of rote memorization and conventional teaching techniques. However, it is important to acknowledge that these methods may not be in line with the constructivist principles of mathematics education, which prioritise student-centered learning and the development of problem-solving abilities (Alzyoudi et al., 2019). The mismatch seen in this study may have played a role in the decreased levels of self-efficacy among pre-service teachers in relation to fundamental mathematical concepts. Further investigation is required to examine the impact of cultural elements on the levels of mathematics anxiety and self-efficacy for teaching mathematics among pre-service teachers in the UAE and other nations that share comparable educational environments.

Cultural beliefs have also been found to play a role in mathematics anxiety and achievement, with Geist (2019) conducting a meta-analysis that found a significant relationship between culture and mathematics anxiety and achievement. This highlights the need to consider cultural factors when addressing mathematics anxiety and promoting inclusivity in the classroom. Teacher education programs should also address the cultural and societal beliefs on mathematics and its perceived difficulty. Pre-service teachers should be encouraged to adopt a growth mindset and view mathematics as a subject that can be learned and taught effectively with the right strategies and support (Dweck, 2006). It is important for teacher education programmes to provide chances for pre-service teachers to actively participate in conversations and engage in activities that effectively challenge their existing ideas and foster a more optimistic perspective towards the subject of mathematics. In general, it is imperative to augment the self-efficacy of pre-service special education instructors in the domain of mathematics instruction, since this is pivotal in raising student results and fostering a favourable disposition towards the subject. Teacher education programmes that are effective in providing pre-service teachers with inclusive teaching practises and enhancing their self-efficacy are crucial in the pursuit of these objectives.

## **The impact of demographic factors on mathematics anxiety and self-efficacy**

Our study found no significant gender difference in math anxiety, which is consistent with previous research conducted on elementary school children (Devine, Fawcett, Szűcs, & Dowker, 2012; Helal & Abo Hamza, 2013; Wang, Rimfeld, Shakeshaft, Schofield & Malanchini, 2020; Dowker et al., 2012; Young et al., 2012; Jansen et al., 2013; Ramirez et al., 2013; Erturan & Jansen, 2015; Schleepen & Van Mier, 2016; Kucian et al., 2018). The results shown in this study are contradictory to the conclusions put out by Hembree (1990), who conducted an extensive meta-analysis investigating the presence of gender disparities in math anxiety across a range of educational settings, spanning from sixth grade to college. Devine et al. (2012), Goetz et al. (2013), and Bieg et al. (2015) have reported findings that demonstrate similar gender differences among students in junior and senior high school. The observed variations in outcomes can be ascribed to the occurrence of math anxiety, which tends to increase over the high school years (Hembree, 1990). This tendency is also likely to play a role in the expansion of the gender gap. Ma and Xu (2004) performed a study which revealed that comparable levels of math anxiety were detected among male and female students in both junior and senior high school. Differences in sample characteristics, variations in the math anxiety tests or scales used, or the particular type of math anxiety assessed can also lead to divergent results (Goetz et al., 2013; Erturan & Jansen, 2015; Jansen et al., 2016).

In summary, the findings of our study indicate that there is no substantial influence of gender and practical training on mathematics anxiety and self-efficacy in the context of pre-service special education teachers in the United Arab Emirates. Nevertheless, it is imperative that teacher training programmes persist in their efforts to investigate efficacious approaches in mitigating mathematics anxiety and bolstering self-efficacy among pre-service teachers, irrespective of their gender and practical training status (Devine, Fawcett, Szűcs, & Dowker, 2012; Helal & Abo Hamza, 2013; Wang, Rimfeld, Shakeshaft, Schofield, & Malanchini, 2020). However, other studies conducted by Pelch (2018) and Wang, Li, and X. Wang (2023) have found that female students tend to have elevated levels of anxiety within STEM classroom settings, as observed in the aforementioned study.

Moreover, Stoet, Bailey, Moore, and Geary (2016) have found that nations characterised by greater gender equality tend to exhibit more pronounced national disparities in mathematics anxiety between genders, as well as comparatively diminished parental appreciation for girls' mathematical abilities. Nevertheless, the study indicated above yielded results that are incongruent with the research done by Abo Hamza et al. (2011) and Helal et al. (2013), which posited that counties do not exert a significant impact on the levels of math anxiety.

Prior studies have also examined the correlation between mathematics anxiety and self-efficacy, as well as the influence of gender and practical training on pre-service teachers. Karaman and Karaman (2019) discovered that female pre-service teachers had elevated levels of mathematics anxiety in comparison to their male counterparts. Nevertheless, our research yielded no statistically significant disparities in the average levels of mathematics anxiety and self-efficacy for teaching mathematics among pre-service special education teachers in the United Arab Emirates (UAE) when considering gender as a contributing factor. The observed variation may be attributed to dissimilarities in culture and society between the United Arab Emirates and the context in which the prior investigation was conducted.

In relation to practical training, our research has revealed that there are no statistically significant variations in the average levels of mathematics anxiety and self-efficacy for teaching



mathematics among pre-service special education teachers in the UAE that can be ascribed to practical training. This observation aligns with the outcomes of a research conducted by Liu et al. (2020), whereby it was determined that practical training did not have a statistically significant impact on the reduction of mathematics anxiety and the enhancement of self-efficacy among pre-service teachers in China. Prior studies have indicated that the use of practical training can provide favourable outcomes in terms of enhancing self-efficacy beliefs and diminishing anxiety levels among pre-service teachers (Peker, 2016; Hembree, 1990). The acquisition of practical experience during training has the potential to enhance the self-assurance and alleviate anxiety levels among pre-service special education instructors in the UAE.

The findings of our study suggest that there is no statistically significant variation in levels of mathematics anxiety among pre-service teachers in relation to their academic year level or the number of mathematics courses they have completed. This aligns with previous research that has similarly reported no significant differences in mathematics anxiety levels among pre-service teachers based on their academic level (Massouti, 2021; Gierl et al., 2018). Nevertheless, there exists a notable disparity in self-efficacy levels contingent upon the academic year level. Nevertheless, our discovery of a notable disparity in self-efficacy levels contingent upon the academic year level contrasts with certain other investigations that have shown the absence of substantial distinctions (Morán-Soto & González-Peña, 2022; Sowinski et al., 2018). The potential cause for this variation may be attributed to disparities in the contextual factors and sample demographics seen in the various research. Further investigation of cultural variations in connection to this conclusion may be warranted in future studies. In addition, it has been established in prior research that pre-service teachers who have completed a greater number of mathematics courses tend to have elevated levels of self-efficacy (Swars et al., 2007). This phenomenon may be attributed to the potential enhancement of individuals' mathematical abilities, knowledge, and confidence through the enrollment in additional courses, hence fostering heightened self-efficacy beliefs in the domain of mathematics instruction.

## **Conclusions**

In summary, the study's results offer significant insights into the levels of mathematics anxiety and self-efficacy pertaining to the instruction of mathematics among pre-service special education teachers in the UAE. The observed disparities in the means of mathematics anxiety and self-efficacy for teaching mathematics, ascribed to various variables, underscore the significance of offering practical training and comprehensive mathematical coursework to pre-service teachers. These measures aim to bolster their self-efficacy beliefs and mitigate their levels of anxiety. Further investigation is warranted to examine the underlying factors that contribute to the constructs of mathematics anxiety and self-efficacy for teaching mathematics, as well as their implications for the instruction and acquisition of mathematical skills among students in special education.

## **Future Studies and Recommendations**

Further, to address the moderate levels of mathematics anxiety and self-efficacy for teaching mathematics in pre-service special education teachers in the UAE, it is recommended to develop training programs. These programs should aim to provide effective strategies and build confidence in mathematics instruction to enhance the pre-service teachers' self-efficacy.

Further, it is important to increase collaboration in special education teachers and other math teachers can be an effective approach, especially for those with low self-efficacy in mathematics. Peer support can help build confidence and facilitate the exchange of effective strategies for teaching mathematics. Importantly, reflective practice is an essential component that should be encouraged in pre-service special education teachers to help them become aware of their strengths and areas for improvement in teaching mathematics. Thus, it should be considered an important element of any teacher training program in the UAE.

It is recommended that these programmes offer pre-service educators with the means to enhance their proficiency in both subject matter expertise and instructional strategies pertaining to the instruction of mathematics to children with disabilities (Deringol, 2018; Al Mutawah, 2016). The inclusion of practical and experiential learning opportunities, specifically through practicum experiences in inclusive classrooms, has been identified as a valuable approach for fostering the confidence and alleviating anxiety among pre-service teachers in the instruction of mathematics to students with disabilities or special needs (Unlu, Ertekin, & Dilmac, 2017; Schaeffer et al., 2021). According to Tschannen-Moran and Woolfolk Hoy (2007), these programmes are of significant importance in the cultivation of teachers' self-efficacy beliefs and equipping them with the essential methods and resources to effectively tackle mathematics anxiety among their pupils. According to the study conducted by Massouti (2021), it was determined that teacher education programmes that want to be effective should prioritise the provision of inclusive teaching methods to pre-service teachers. These tactics are essential in enabling instructors to effectively cater to the different learning requirements of their students. One successful approach for teaching mathematics to students with disabilities is the use of differentiated instruction, which involves altering teaching methods to accommodate individual student requirements (Konukman & Kargin, 2020). Additionally, the integration of technology and the utilisation of peer tutoring have also been identified as helpful techniques in this context (Konukman & Kargin, 2020). In order to evaluate the usefulness of teacher training programmes in enhancing mathematics anxiety and self-efficacy for teaching mathematics among pre-service special education teachers, it is advisable for future study to analyse the influence of various training methodologies. This may entail the implementation of a longitudinal research aimed at monitoring the fluctuations of those variables throughout a span of time, while also assessing and contrasting the efficacy of diverse training programmes.

Further research is required to explore the correlation between self-efficacy and academic achievements among students. In light of the significant role that self-efficacy plays in forecasting instructors' instructional practises and student results, it is imperative for forthcoming studies to explore the correlation between self-efficacy for teaching mathematics among pre-service special education teachers in the United Arab Emirates (UAE) and the resultant impact on students' mathematical achievements. This study aims to investigate the potential influence of pre-service teachers' self-efficacy on the academic achievements of children in special education, as well as to explore the underlying mechanisms that contribute to this association.

In general, the aforementioned recommendations and prospective avenues underscore the imperative for more scholarly inquiry focused on augmenting the efficacy of teacher training initiatives and mitigating mathematics anxiety among pre-service special education teachers in the United Arab Emirates. The identification of successful techniques for enhancing self-efficacy and alleviating anxiety in mathematics instruction holds the potential to enhance the overall quality of mathematics education for special education children in the UAE.

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