

RESEARCH REPORTS

UNDERSTANDING MATH ANXIETY THROUGH SELF-EFFICACY AND CULTURE: A MIXED-METHODS STUDY

Eihab Khasawneh, DDS, PhD, RN¹; Ala'a Oteir, PhD¹; Cameron Gosling, PhD²; Brett Williams, PhD^{*3}

Author Affiliations: 1. Department of Applied Medical Sciences, Jordan University of Science and Technology, Irbid, Jordan; 2. Department of Paramedicine, Monash University, Melbourne, VIC, Australia; 4. Department of Emergency Medical Care, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Recommended Citation: Khasawneh, E., Oteir, A., Gosling, C., & Williams, B. (2026). Understanding math anxiety through self-efficacy and culture: A mixed-methods study. *International Journal of Paramedicine*. (16). 20-36. <https://doi.org/10.56068/PLIL9598>

Keywords: anxiety, education, mixed methods, self-efficacy, students, emergency medical services, EMS, paramedicine

Disclosures: The authors have no conflict of interest.

Funding: None.

Acknowledgements: The authors would like to thank the students for participating in the study.

Received: February 17, 2026

Revised: June 1, 2026

Accepted: June 3, 2026

Published: October 22, 2026

***Corresponding Author:**
bawilliams@iau.edu.sa

ABSTRACT

Background: Health care providers' and students' performances may be impacted by math anxiety and self-efficacy levels. Many factors contribute to math anxiety and self-efficacy, such as bad grades in math at school and a lack of encouragement from parents or teachers. This study aimed to explore the difference in math anxiety and math self-efficacy for paramedic students at two universities in different cultures.

Methods: A sequential explanatory mixed-method study was conducted where data were collected using anonymous self-report questionnaires from students studying paramedicine at Monash University, Australia ($n = 344$) and Jordan University of Science and Technology, Jordan ($n = 161$), followed by face-to-face interviews.

Results: In multivariable regression, higher math self-efficacy was independently associated with lower math anxiety ($B = 0.14, p < .001$), and school country remained a significant predictor ($B = 1.48, p = .024$); interviews suggested motivation, self-confidence, and practice as perceived strategies to strengthen self-efficacy and reduce math anxiety.

Conclusion: This study, conducted in Australia and Jordan paramedic schools, addressed the relationship between self-efficacy and math anxiety among paramedic students. Math self-efficacy and math anxiety levels differed between the two schools according to sex, age groups, and study year level. Future research should focus on studying the effect of self-efficacy on math anxiety for practicing paramedics at national and international levels and focus on teaching and training strategies and interventions. The findings suggest that paramedicine programs should identify students with low math confidence early and use repeated, clinically contextualized medication-calculation practice, supportive feedback, and confidence-building activities to reduce avoidable anxiety before clinical placement.

INTRODUCTION

Math anxiety occurs when a person perceives a threat to their self-esteem in any situation that involves mathematics. It is a complex construct consisting of cognitive, behavioral, and affective responses to this perceived threat (Olango, 2016). Math anxiety is more than not liking math. Many people are genuinely fearful of math, and engaging in math-related tasks makes them feel nervous (Maloney & Retanal 2020). People then avoid math and math-related careers, potentially limiting future op-

portunities (Olango, 2016). Math anxiety is widespread. A study by Beilock and Maloney (2015) in the US revealed that approximately 80% of college students enrolled in a certificate or associate degree, and 25% of students enrolled in a bachelor's degree, experience a moderate to high degree of math anxiety. Math anxiety has previously been linked to previous negative math experiences, such as being punished for not understanding or solving a math concept or problem and/or receiving a poor math grade, as well as not being encouraged by parents and teachers or having a positive role model (Smith & Penazzi, 2020). Math anxiety has been associated with academic failure and emotional tension (Barroso et al., 2021; Gürefe & Bakalım, 2018) and can lead to a loss of self-confidence, awareness, and poor learning (Arslanoglu & Ercan, 2017).

One component of self-confidence is self-efficacy. Self-efficacy is how a person judges their own capability in organizing and implementing a course of action that is required to achieve the desired performance (Bandura & Lightsey, 1999). Therefore, math self-efficacy is the confidence a person has in their own ability to solve a math problem or complete a math task (Zakariya, 2022). While better math skills have been shown to have a positive correlation with math self-concept and math self-efficacy, poorer math skill has been shown to have a negative correlation with math anxiety (Kaskens et al., 2020). An example of math self-efficacy is when a person achieves better results academically by using cognitive strategies to improve their belief in being able to complete tasks and develop alternative solutions (Gürefe & Bakalım, 2018). Studies have demonstrated that students who perceive they have high self-efficacy are more persistent and put more effort into achieving a difficult task (Arslanoglu & Ercan, 2017). In addition, studies have shown that students who have high math self-efficacy also have low math anxiety and value math more than students with low math self-efficacy (Hackett & Betz, 1989). Lepma and Darrah (2024) found that higher math anxiety existed in university students in non-STEM majors (compared to science, technology, engineering, and mathematics (STEM) majors) and that self-compassion and self-efficacy were predictive of math anxiety, while mindfulness was only significantly correlated to math anxiety and not predictive. They conclude that math anxiety is likely to be a key factor when a person avoids a STEM major or STEM profession.

Health care providers' and students' performances are also impacted by math anxiety and self-efficacy levels. For example, one study in paramedicine showed that learning and understanding science-based material (e.g., pharmacology) caused enough anxiety to influence the possibility of performing a medication error (Caffey et al., 2016). Johnson et al. (2020) note that a long-standing tension in nursing education is being able to develop the required math skills in nursing students to ensure the safe provision of prescribed medication doses. In a scoping study by Williams and Davis (2016), math anxiety, self-efficacy, teaching methods, and numerical ability were the four key factors identified that caused drug dosage calculation errors. Another study by Blanch et al. (2008) showed that female medical students reported lower self-efficacy and self-confidence, and higher anxiety, concerning math competence, even though they performed just as well as male medical students. In the paramedic discipline, LeBlanc et al. (2005) found that paramedics in high-stress conditions achieved lower accuracy scores when calculating drug dosage compared with the low-stress condition 43% vs. 58%. In another study, however, Eastwood et al. (2015) found that paramedic drug calculation accuracy was poor regardless of whether they were in a high-stress or low-stress situation. In

paramedicine, these concerns are especially relevant because medication calculations may need to be performed quickly, under pressure, and in environments where interruptions, fatigue, limited support, and patient acuity can increase the risk of error. Previous paramedic research has shown that drug calculation accuracy can be affected under stressful conditions, while other work has demonstrated that calculation accuracy may remain problematic even outside high-stress scenarios (Eastwood et al., 2015; LeBlanc et al., 2005). For students, anxiety may therefore be linked not only to abstract mathematics, but also to practical tasks such as weight-based medication calculations, infusion rates, unit conversions, and volume-based dose calculations (Caffey et al., 2016; Johnson et al., 2020; Williams & Davis, 2016).

Math anxiety and self-efficacy are also highly influenced by cultural surroundings and not influenced so much by curricula goals or how curricula are implemented (Evans, 2014). All the previously mentioned studies were conducted within one cultural context, highlighting a gap in the literature and a limitation in terms of being able to generalize results across contexts. Investigation of math anxiety and its contributing factors in one context gives only part of the picture, leaving comparisons difficult and limiting conceptual understanding of cultural differences (Fan et al., 2019). Therefore, we conducted this cross-cultural study, which sought to analyze the differences in math anxiety and self-efficacy profiles between paramedicine students in Australia versus those in Jordan. Understanding these differences is important for paramedicine educators because it can help identify where students require more targeted support before they are expected to perform math-dependent clinical skills in simulation or clinical placement.

METHODOLOGY

DESIGN AND PARTICIPANTS

This is a sequential explanatory mixed-method study. Data was collected using anonymous self-report questionnaires from students studying a Bachelor of Paramedicine at Monash University, Australia ($n = 344$) and Jordan University of Science and Technology, Jordan ($n = 161$). The paper-based questionnaire was completed by students during the last 15 minutes of one of their classes. Participation was voluntary, and submission of the completed questionnaire implied consent. In the second part of the study, the students were invited to participate in a face-to-face structured interview. Integration occurred at two points: i) during the interviews, where interview questions were guided by quantitative findings, and ii) during interpretation, where quantitative and qualitative results were integrated across the two cultural contexts. Reporting of this study was guided in accordance with the GRAMMS (Good Reporting of a Mixed Methods Study) to maintain transparency in the reporting and integration of quantitative and qualitative results (O'Cathain et al., 2008).

INSTRUMENTATION

THE QUESTIONNAIRE

The questionnaire was composed of three parts: i) non-identifiable demographic information, ii) the modified Mathematics Anxiety Rating Scale (MARS) (Betz & Hackett, 2012), iii) the Mathematics Self-Efficacy Scale (MSES) (Betz & Hackett, 1983). The demographics section included questions asking participants their school's name, course year

level, age group, and sex. The questionnaire measured general math anxiety and math task self-efficacy; it did not ask students to identify anxiety related to specific paramedic medication-calculation formats, such as weight-based dosing, drip rates, or volume-based calculations. Participants self-reported their sex using the response options male, female, or prefer not to say.

MATHEMATICS ANXIETY RATING SCALE (MARS)

Due to the length of the original 98-item math anxiety rating scale (Richardson & Suinn, 1972), a shorter 10-item scale was used in this study (Hopko et al., 2003). The 10-item scale has good reliability with a Cronbach alpha of .94 (McMullan et al., 2012) and is scored on a 5-point Likert scale for each item (1 = strongly disagree, 5 = strongly agree). The first five items were reverse-coded so that a high score indicates a high math anxiety level. Scores are reported as a total score out of 50 points.

MATHEMATICS SELF-EFFICACY SCALE (MSES)

In this study, the 18-question math task subscale of the MSES was used (Betz & Hackett, 1983). For each item on the math task subscale, individuals were asked to indicate their confidence in their ability to successfully perform the math tasks on a 10-point scale ranging from "no confidence at all" (1) to "complete confidence" (10). The final score for the MSES task subscale can range from 18 to 180 points. The overall scale has good reliability with a Cronbach alpha of .92 (Betz & Hackett, 1983).

THE INTERVIEWS

Interviews were carried out using a structured interview guide that explored participants' perceptions of the effect of self-efficacy on math anxiety. The interviewer was not directly involved in the program development or delivery and was not known to the participants. The interviews were digitally recorded and transcribed verbatim.

ETHICAL STATEMENT

The study was carried out according to the Declaration of Helsinki. The project was approved by the Monash University Human Research Ethics Committee (Project number: 17969) and Jordan University of Science and Technology Institutional Review Board (IRB) (Reference: 33/127/2019). Written informed consent was obtained from all interview participants prior to the interview commencing and data collection. The questionnaire was administered anonymously with no collection of identifiable data, and submission of the completed questionnaire implied consent.

DATA ANALYSIS

PHASE 1: THE QUESTIONNAIRES

Data was compiled, and IBM SPSS Statistics (Version 26) was used for analysis. Data are presented using descriptive statistics, including mean $\pm$ standard deviations (SD), interquartile range (IQR), or frequency and proportions where appropriate. Preliminary analyses were performed to make sure there was no violation of the assumptions of normality, linearity, and homoscedasticity. Independent samples, student's t test, one-way ANOVA, and post-hoc tests were used to compare mean differences between groups where appropriate. Linear regression was used to identify the factors that were associ-

ated with math anxiety. Univariate regression with the dependent variable was used to analyze each predictive independent variable. Variables that were significant at $p < 0.20$ were then entered into a multivariate model. The level of significance was assigned at $p < 0.05$, and the effect size was calculated.

PHASE 2: THE INTERVIEWS

Interviews were conducted by one of the researchers (Khasawneh). First, each participant was reminded of the purpose of the study, the benefits of the research, the research and confidentiality procedures, and their right to withdraw from the study at any time. Consent was obtained in writing and verbally in advance of the interview. All the interviews were audio-recorded with no time limit for ending the interview. Notes were taken by a research assistant during the interviews, which enabled the researcher to track key points to return to later in the interview and for use during data analysis. All recordings were then transcribed verbatim and translated into English. Each interviewee was labeled by the letter J followed by a number for Jordan University of Science and Technology students, for example, interviewee number 1 was labeled as (J1). Each interviewee was labeled by the letter M followed by a number for Monash University students, for example, interviewee number 1 was labeled as (M1). The interviews for Jordanian students were conducted in the Arabic language by Khasawneh, who speaks Arabic and English, and they were sent to a translation agency to be translated into English. The recorded interviews were immediately transcribed as spoken in Arabic. The translation was performed by a professional translator, and the Arabic interviews were translated into English. Using the method of back translation, translators were able to back-translate some of the interview transcripts from English to Arabic to ensure the accuracy of the transcripts (Choi et al., 2012; Driscoll et al., 2007). All data was then checked by Khasawneh by listening to the audio recordings and comparing them to the transcripts (Choi et al., 2012). The interviews for Australian students were conducted in English by Khasawneh.

All transcripts were coded by Khasawneh, and Williams coded a subset of transcripts. Open coding was used throughout, enabling areas requiring additional data and/or new lines of inquiry to be identified. This initial coding remained open to any possibilities that could be discerned in the data, and to reduce the possibility of any conceptual leaps happening during the analysis. The interviews were analyzed using qualitative content analysis. First, transcripts were read through multiple times to gain an overall perspective. Transcripts were then reread and split up into meaning units, each representing a single unit of content (Driscoll et al., 2007).

RESULTS

PHASE 1: THE QUESTIONNAIRES

This study involved a total of 505 students; 344 students (68%) participated from Australia (Monash University), and 161 students (31%) participated from Jordan University of Science and Technology. This represents an 81% and 75% response rate from Monash University and Jordan University of Science and Technology, respectively. The demographic profiles of the consenting participants are reported in Table 1. Most of the participants from Monash University were from the first-year cohort (45.9%), female (63.4%), and aged from 20 to 24 years (50.6%). On the other hand, most of the participants from

Jordan University of Science and Technology were from the third-year cohort (32.9%), female (65.2%), and aged 20 to 24 years (54.7%).

MATHEMATICS ANXIETY RATING SCALE

The MARS scores are shown in Table 2. MARS scores for Jordan University of Science and Technology students ranged from 10 to 42 points, while those for Monash University students ranged from 10 to 50 points. The mean (SD) scores for Monash University students (25.7 (± 8.9)) were lower than for Jordan University of Science and Technology students (29.3 (± 4.9)). The independent samples *t* test showed that there was a significant difference in MARS mean scores between Monash University students and Jordan University of Science and Technology students: $t(503) = -4.8$, 95% CI [-5.1, -2.1], $p < 0.001$, $d = 0.50$.

In addition, there was a significant difference in the MARS mean scores for the male students ($t(179) = -4.9$, 95% CI [-8.1, -3.4], $p < 0.001$, $d = 0.84$) and the female students ($t(321) = -2.5$, 95% CI [-4.2, -.5], $p = 0.001$, $d = 1.0$) between Monash University and Jordan University of Science and Technology students. While the independent samples *t* test showed that there was a significant difference in MARS mean scores between males and females ($t(341) = -3.6$, $d = 0.40$, $p < 0.001$ for Monash University students), it showed that there was no significant difference in MARS scores between males and females among Jordan University of Science and Technology students ($t(159) = -0.122$, $d = 0.02$, $p = 0.9$).

In comparing the MARS mean scores of different year levels, the one-way ANOVA showed that there was a significant difference between the two schools in the mean scores for the first-year students ($F(1, 196) = 7.1$, $p = 0.008$) and the third-year students ($F(1, 150) = 10.3$, $p = 0.002$). There was a statistically significant difference in MARS mean scores between Monash University students' year level ($F(2, 341) = 3.8$, $p = 0.02$). However, there was no statistically significant difference in MARS mean scores between Jordan University of Science and Technology students' year level ($F(3, 157) = 2.4$, $p = 0.07$). Post-hoc comparisons using a Gabriel test indicated that the MARS mean score for Monash University students who are at year one level was significantly different from those who are at year two, $p = 0.019$. Year three students' MARS mean scores did not differ significantly from year one and year two students' mean MARS scores.

There was a significant difference in the MARS mean score between the two schools for the students who were aged between 20-24 years ($F(1, 260) = 22.3$, $p < 0.001$). In contrast to Monash University students, whose MARS mean scores were not significantly different between age groups ($F(2, 341) = 0.85$, $p = 0.43$), the Jordan University of Science and Technology students' MARS mean scores were significantly different between age

	Monash University Number (%) n = (100%)	Jordan University of Science and Technology Number (%) n = (100%)
Sex		
Male	125 (36.3)	56 (34.8)
Female	218 (63.4)	105 (65.2)
Prefer not to say	1 (0.3)	---
Age Group		
≤19	125 (36.3)	58 (36.0)
20-24	174 (50.6)	88 (54.7)
≥25	45(13.1)	15 (9.3)
Year Level		
1st Year	158 (45.9)	40 (24.8)
2nd Year	87 (25.3)	46 (28.6)
3rd Year	99 (28.8)	53 (32.9)
4th Year	---	22 (13.7)

Table 1. Demographic data for Monash University and Jordan University of Science and Technology paramedicine students.

groups ($F(2, 158) = 3.2, p = 0.045$). Post-hoc comparisons using a Gabriel test indicated that the MARS mean score for Jordan University of Science and Technology students differed significantly between those who are ≤ 19 years and those who are between 20-24 years old, $p = 0.038$.

MATHEMATICS SELF-EFFICACY SCALE

The MSES scores are reported in Table 2. MSES scores for Jordan University of Science and Technology students ranged from 33 to 167, while for Monash University students from 46 to 180. The mean (SD) MSES scores for Monash University students were 125.7 (29.3), while for Jordan University of Science and Technology students were 110.6 (27.3). The independent samples t test showed that there was a significant difference in MSES mean scores between Monash University students and Jordan University of Science and Technology students; $t(503) = 15.8, 95\% \text{ CI } [9.7, 20.5], p < 0.001, d = 0.53$. There was a significant difference in the MSES mean scores for the male students ($t(179) = 6.7, 95\% \text{ CI } [19.9, 36.5], p < 0.001, d = 0.33$) and the female students ($t(321) = 2.2, 95\% \text{ CI } [9, 14.4], p = 0.001, d = 0.27$) between Monash University and Jordan University of Science and Technology students. While the independent samples t test showed that there was a significant difference in MSES mean scores between males and females ($t(341) = 5.5, d = 0.62, p < 0.001$) for Monash University students, it showed that there was no significant difference in MSES scores between males and females in Jordan University of Science and Technology students ($t(159) = -0.72, d = 0.12, p = 0.90$).

In comparing the different year levels' effect on the MSES mean scores, there was a significant difference between the two schools in the mean scores for the first-year students ($F(1, 196) = 11.1, p = 0.001$) and the third-year students ($F(1, 150) = 15.6, p < 0.001$). There was a statistically significant difference in MSES mean scores between Monash University students' year level ($F(2, 341) = 6.8, p = 0.001$). Post-hoc comparisons using a Gabriel test indicated that the MSES mean score for students who are at the year two level was significantly different from those who are at the year one level ($p = 0.001$) and the year three level ($p = 0.001$). Year three students' MSES mean scores did not differ significantly from year one scores. There was no statistically significant difference in MSES mean scores between Jordan University of Science and Technology students' year level ($F(3, 157) = 0.71, p = 0.06$). There was a significant difference in the MSES mean score between the two schools for the students who are aged between 20-24 years ($F(1, 260) = 18.6, p < 0.001$) and those who are aged older than 25 years ($F(1, 58) = 25, p < 0.001$). In contrast to the Monash University students' MSES mean score, which is significantly different between age groups ($F(2, 341) = 9.5, p < 0.001$), the Jordan University of Science and Technology students' MSES mean score was not significantly different between age groups ($F(2, 158) = 2.3, p = 0.109$).

SCALE RELIABILITY

Cronbach's alpha reliability for MARS in this study was 0.88, and the MSES was 0.92. This indicated that both scales had good reliability.

PREDICTING MATH ANXIETY LEVELS

First, the linearity between dependent and independent variables, normality, homoscedasticity, and multicollinearity were assessed. The enter method of entry was used to

enter the independent variables that included school, year level, sex, age, and math self-efficacy level. A multiple linear regression analysis was then carried out. In the multivariable model, higher math self-efficacy was associated with lower math anxiety ($B = -0.14$, $p < 0.001$) and school location was also independently associated with math anxiety ($B = 1.48$, $p = 0.024$). Sex was not statistically significant ($p = 0.158$) (Table 3).

PHASE 2: INTERVIEW EVALUATION

The results of the qualitative phase were based on interviews with 16 students. Ten of the interviews were conducted through a face-to-face method (six students from Jordan University of Science and Technology and four from Monash University), and six interviews via telephone (two from Jordan University of Science and Technology and four from Monash University). Females comprised 75% of the participants. Most interview questions were asked as they were written. However, where appropriate and needed, the researcher followed up questions with open-ended prompt questions such as "Why?" and "Could you please explain more?" This enabled the researcher to gain deeper meaning and a richer understanding of participants' experiences. The themes that emerged from the interviews that were related to math anxiety and self-efficacy included: mathematical concepts and operations, motivation, self-confidence, and practice.

MATHEMATICAL CONCEPTS AND OPERATIONS

Participants had different views regarding the difficulty of certain mathematical methods. For example, some participants argued that division is a more difficult mathematical operation than multiplication because it is a time-consuming procedure; (J4) stated that "I feel dividing needs more time, unlike multiplication, which can be done quickly. The idea is that division needs more time." Another student, (J8), stated that "I guess

	MARS Score		MSES Score	
	Monash University	Monash University	Jordan University of Science and Technology	Jordan University of Science and Technology
	M (SD)	M (SD)	M (SD)	M (SD)
Sex				
Male	23.44 (7.95)*	29.21 (5.7)*	136.71 (25.7)*	108.50 (27.5)*
Female	26.92 (9.10)*	29.31 (4.5)*	119.40 (29.6)*	111.75 (27.3)*
Age Group				
19	26.50 (8.4)	28.06 (4.8)	120.65 (27.9)	116.60 (24.6)
20-24	25.31 (8.9)*	30.12 (4.9)*	125.03 (31.7)*	107.57 (29.4)*
25	24.93 (10)	29.00 (4.5)	142.24 (21.2)*	105.29 (21.3)*
Year Level				
1st Year	24.74 (8.1)*	28.25 (4.1)*	130.21 (26.3)*	114.75 (25.7)*
2nd Year	27.93 (9.1)	28.45 (4.7)	116.14 (32.8)	112.28 (25.8)
3rd Year	25.25 (9.7)*	29.88 (5.6)*	112.86 (29.0)*	107.32 (29.1)*
4th Year	---	31.22 (1.6)	---	107.59 (29.2)

Table 2. A comparison of MARS and MSES scores between Monash University and Jordan University of Science and Technology students.
Note: * Level of significance was assigned at $p < .05$. M: Mean; SD: Standard Deviation.

Factor	Coefficient	95% CI	p-Value
MSES	- 0.14	[- 0.16, - 0.12]	<.001
School location • Monash University • Jordan University of Science and Technology	(Reference) 1.48	[0.2, 2.77]	0.024
Sex* • Male • Female	(Reference) 0.89	[- 0.34, 2.12]	0.158

Table 3. Regression model summary.
Note: * Data from the single participant preferring not to identify sex was removed from the regression analysis. CI: Confidence Interval; MSES: Mathematics Self-Efficacy Scale

division is the hardest calculation.” On the other hand, other participants reported that addition and multiplication are the most difficult mathematical methods; (J5) stated that “I guess addition is the most difficult mathematical operation” and (M4) reported that “Yeah, probably multiplication and stuff. Just stuff without a calculator basically.”

One participant argued that failure to have good mathematical competency due to anxiety might lead to some errors in paramedic practice in the field; (J5) stated that “Sure, because there is something called medication calculation. Meaning, there are certain doses that a paramedic needs to pay attention to. If the dose increases, many complications can occur to the patient.” This response linked math anxiety directly to medication safety, suggesting that students viewed mathematical confidence as part of safe paramedic decision-making rather than as a purely academic issue.

MOTIVATION

Motivation is one of the factors that can improve a person’s self-efficacy. Factors that might contribute to increased motivation levels involve role modeling, the impact of peers, and the family. (J1) stated that:

It plays a big role. In terms of personality enhancement, through encouragement can enhance your personality. From an environmental perspective, the people around you influence you, so you find people trying to frustrate you, and you must overcome these things, in addition to the difficulties of life. Meaning that you try as much as you cannot be affected by these things and enhance yourself.

Another student claimed that the community around you can motivate the person to practice more efficiently by enhancing self-efficacy of the person. (J5) stated that “I think motivation has a lot to do with, especially the one that comes from the family and the society. This motivation creates an incentive for the individual to do more.”

Role modeling plays an important role in increasing personal motivation toward achieving goals. (J5) stated that:

This effect is dependent on the role model. If your role model is a person who is successful and has wide knowledge and understanding at work. Then you start feeling that he is perfect, and this encourages you to be like him and feel that you are longing to learn.

Another participant argued that family has the most effect on motivation; (J5) stated that “In my opinion, the family accounts for 80% of motivation.”

SELF-CONFIDENCE

Self-confidence is very important in healthcare practice. Participants reported that self-confidence is related to self-efficacy and can positively impact the math anxiety level; (J2) stated that:

Belief in abilities means believing that you can do something even if it is wrong. In an emergency, if you make a mistake, you will not remain in your place even if you make a mistake one or two times. Frankly, I suffer from this. Belief in abilities means that you do not give up if you make a mistake once because you must try again with training and practise until you reach a level of 100% mastery and get rid of this problem.

Participant (M5) argued that stress can be reduced when you have a higher confidence level. (J1) stated that:

They're almost inseparable. While you try to trust yourself, you fear failure. Here, you must control and convince yourself that there are people who fail only because the stress has taken over. Here, I think you should train to control yourself and not allow anything to provoke you or frustrate you while weighing your self-confidence.

Participant (M3) reported that:

I get nervous simply because it's not something I practice all the time, so it's not my most comfortable strength. So again, because I do get anxious (because it's not my most confident skill) nerves impact any sort of performance.

PRACTICING

Practice is very important to achieve competency in any math-related skill. Participants argued that solving more mathematical problems can improve the ability of the person to perform these skills in all situations. (J3) stated that "mathematics needs intelligence as well as a continuation of solving mathematical calculations." (J6) stated that:

I was able to overcome this problem by practice. Gradually, I began to practice and understand, especially with the solution of many mathematical problems. Here, I discovered that mathematics relied primarily on solving many problems.

Another participant (J8) stated that "Negligence is on the part of the student himself, refraining from practicing such types of calculations, and refraining from following up well may create the problem for him."

One participant argued that self-efficacy and math anxiety is related to the amount of experience and practice that the person can do. (J1) stated that:

They almost complement each other. If you have experience, your faith in your abilities will improve. This has already happened to me. If you have the necessary experiences, you can act in the situations you are exposed to. They are complementary to one another and cannot be separated.

Another participant (M8) stated that:

I would do a lot of practice with a friend who has got a good maths brain and he always just knew it and got it and I just could not. So yeah, I was sort of a bit discouraged that he was so good at it and could just see it and was getting good marks.

The merging of the results from both the qualitative and quantitative analyses indicated that mathematical concepts and operations, motivation, self-confidence and practicing are the main themes that were related to math anxiety and self-efficacy. The participants reported that self-efficacy and math anxiety are important concepts in paramedic practice. When integrated, the results suggest that the negative association between math self-efficacy and math anxiety reported by the quantitative analyses is explained by qualitative themes of confidence, motivation, and practice, while cross-cultural differences are further explained by contextual variations in pedagogical experiences and support provided by the university.

DISCUSSION

To our knowledge, this study is among the first cross-cultural comparative studies in paramedicine to explore math anxiety and math self-efficacy in paramedic students at two universities in different cultural contexts. Our study reported that Jordanian paramedic students have higher levels of math anxiety and lower levels of self-efficacy compared to Australian students. Math self-efficacy level and the school (cultural background) were the contributing factors to math anxiety.

Math self-efficacy among Jordanian students was lower than that among Australian students. Our findings contrast with those reported by Mueller and Goic (2003), who found no significant differences in self-efficacy when comparing undergraduate business students in the United States and Croatia. Moreover, our findings were in contrast with Basil and Karatuna's (2017) study, which found that there were no significant differences in the level of self-efficacy between the students of economics and administrative sciences in Poland and Turkey.

We found that as students progressed through their paramedic education in both schools, the mean self-efficacy level decreased. Our finding is unlike Marra et al. (2009) study on engineering students in the US, who found that progression in the year level of study would improve self-efficacy. From the interviews in our study, we found that one factor that might affect self-efficacy level was positive self-confidence. Self-confidence and self-efficacy are often used interchangeably; however, self-confidence does not necessarily mean a positive outcome and refers only to the strength of certainty of a person's belief (Bandura & Lightsey, 1999). For example, a person may be confident in failure. The participants felt that having positive self-confidence can increase self-efficacy because self-confidence has a considerable effect on the outcome and performance (Barrows et al., 2013).

One interesting finding in our study was that, in contrast to the Australian female students, the Jordanian female students had higher self-efficacy levels than their male counterparts. Our finding is inconsistent with a Turkish study involving 1679 students studying at Anadolu University (Satici & Can, 2016). This study reported that male students had higher self-efficacy scores than female students ($t(1677) = 5.47, p < 0.01$), which indicated that sex impacted the self-efficacy level. Another study conducted at an Albanian university found that male students ($M = 3.06, SD = 0.74$) also had higher self-efficacy than female students ($M = 2.67, SD = 0.89$) (Shkullaku, 2013). In the Albanian culture, sex role stereotypes are very powerful, and therefore, females' capacities are undermined by male capacities (Shkullaku, 2013). In Jordan, traditional sex stereotyping and male dominance have started to decrease in the last few decades. This makes the percentage of students in tertiary education who are female (%) in Jordan to be reported at 52.92% in 2017 (Dandan & Marques, 2017).

Our study found that the math anxiety levels were higher in Jordanian students, which indicates that cultural background might impact math anxiety levels. This finding is similar to Hamza and Helal (2013), who studied the math anxiety difference between American and Egyptian students and reported a significant main effect for countries ($F(1, 187) = 11.41, p < 0.001$) on math anxiety levels. Hamza and Helal (2013) argued that the Egyptian educational system might contribute to the difference in math anxiety levels.

Brown et al. (2020) point out that different cultures have different knowledge and values based on different interests, and different countries have different education systems with different policies, curricula content, guidelines, and models based on development agendas and expectations these agendas generate. Brown et al. (2020) also reported that differences in math anxiety between engineering students from Germany and Mexico were attributed to differences in their cultures' attitudes and beliefs. In Jordan, the paramedic program is a four-year program where the students in the first year are enrolled in basic science classes. Math is not part of these basic sciences. This means that students' first use of mathematics related to their paramedic study would be in the third year in the pharmacology class. A study conducted by Kalaycioglu (2015) also suggests that different education systems influence differences in the math anxiety levels of students in different countries. She suggests that Turkey, Greece, and Hong Kong are countries that are more centralized and, as a result, present students with more challenges, such as high-stakes testing to rank and allocate students into schools. In these countries, access to certain schools based on test scores starts when a child is around 11 years old. One of the most widespread studies across cultures was a study by Lee (2009) involving 276,165 students, 15 years of age, from 41 countries, that showed that students from Western Europe obtained scores that showed the strongest connection between math self-concept and math achievement, and students from Asia and Eastern Europe obtained scores that showed the strongest connection between self-efficacy and math achievement. In addition, students from Western and Eastern Europe obtained scores that showed the strongest connection between math achievement and math anxiety (compared with Asian students). Furthermore, students from some of the Western European countries (such as the Netherlands) experience low math anxiety (Lee, 2009).

While our study showed that sex impacted math anxiety levels for Australian students, it did not impact the math anxiety levels for Jordanian students. This finding aligns with a study conducted by Hamza and Helal (2013), who reported that in Egypt and America, math anxiety was not influenced by sex and is inconsistent with the conclusions of Xie et al.'s (2024) meta-analysis study, which reported that females, especially adult women, experience more math anxiety than men. However, a more recent study with American students by Leppma and Darrah (2024) showed that male students experienced less math anxiety than female students. In another study by Khasawneh et al., (2021) with paramedicine students, math anxiety was negatively correlated to self-efficacy, and both of these factors were influenced by sex.

Our study found that self-efficacy and the school location (cultural background) were predicting factors for math anxiety in this sample of paramedic students. This indicates that higher self-efficacy was associated with lower math anxiety in this sample, although causal relationships cannot be inferred from the cross-sectional design. A variety of ways to reduce math anxiety are suggested in the literature, including student-directed learning; supportive, caring, and positive learning environments; and learning that is flexible enough to meet the needs of students with different learning styles (McMullan et al., 2012). Participants in our interviews claimed that math anxiety could be reduced by increasing mathematical competency. Other students claimed that continuous practicing and enriching their personal experience would improve self-efficacy, which would, in turn, decrease the math anxiety level among the students. Moreover, the participants argued that motivation through family positive reinforcement and positive role modeling

could increase the self-efficacy level. This was consistent with a McMullan et al.'s (2012) study on British nursing students who reported that constructive feedback, evaluative feedback (i.e., effort or ability), and encouragement all help to increase self-efficacy and/or achievement. More recent approaches to improve math self-efficacy and reduce math anxiety in students include mindfulness, growth mindset interventions (Samuel & Warner, 2021), activities to improve working memory (Pellizzoni et al., 2022), contextualized, practical and collaborative learning approaches (Pettigrew et al., 2020), gaming apps that develop numeracy (Abdul-Mumin et al., 2025), and web-based tools that teach logic and make math accessible, and even humorous (Fronberg, 2021). For paramedicine educators, these findings suggest several practical curriculum considerations. First, medication numeracy should be introduced early and revisited regularly, rather than being concentrated only in pharmacology subjects. Second, practice should use authentic paramedic examples, including weight-based dosing, infusion calculations, unit conversion, and volume-based medication calculations. Third, educators should normalize math anxiety, provide low-stakes practice before assessment, and give feedback that builds self-efficacy as well as technical accuracy. These educational strategies may help students develop calculation confidence before entering high-pressure clinical environments.

LIMITATIONS AND FUTURE RESEARCH

There are a number of limitations to our research. This study used a convenience sample approach, which may hinder the generalization of results. Self-reporting questionnaires could also be seen as a limitation, where results are dependent entirely on how students respond to items and assumptions about student honesty. Furthermore, using a thematic analysis approach could mean a narrower insight into study concepts. Another limitation of this study relates to the translation of interviews conducted with Jordanian students, as the translation process may have posed a threat to validity by limiting the nuanced representation of participants' original meanings (Choi et al., 2012). The study also did not examine whether students experienced anxiety with particular medication-calculation types, nor did it collect data on whether any students failed or were delayed in the program because of math anxiety or medication-numeracy performance. These issues should be examined in future paramedicine education research.

Future research should examine practicing paramedics to better understand how math anxiety influences clinical performance and math-dependent skills such as drug dose calculations. Further work could also explore the relationship between math anxiety, self-efficacy, numerical ability, and cognitive processing across different cultural contexts. In addition, intervention studies should evaluate whether strategies such as structured medication-calculation teaching, repeated simulation-based numeracy practice, and early identification of low math self-efficacy can reduce anxiety and improve calculation performance.

CONCLUSION

This study, which was conducted in Australia and Jordan paramedic schools, explored the relationship between self-efficacy and math anxiety among paramedic students. Math self-efficacy showed a negative correlation to math anxiety in paramedic students. Math self-efficacy and math anxiety levels differ between the two schools according to sex, age groups, and the study year level. Future research should focus on studying the

effect of self-efficacy on math anxiety for practicing paramedics at national and international levels. Moreover, developing teaching or training strategies to reduce the math anxiety level among paramedic students should be tested in future studies by exploring the role of other factors, such as motivation, self-confidence, mindfulness, collaborative learning, as well as improving working memory, practicing skills, and self-reflection. Based on these findings, paramedicine programs should consider embedding regular medication-calculation practice across the curriculum, using clinically relevant examples, supportive feedback, and early identification of students who report low math self-efficacy.

REFERENCES

- Abdul-Mumin, K. H., Arrifin, I. S. M., Austerberry, J., Johnston, J., & McKenna, L. (2025). Exploring mathematics anxiety among nursing and midwifery students and the impacts on pharmacological knowledge: A qualitative study. *Nurse Education Today*, 153, 106810. <https://doi.org/10.1016/j.nedt.2025.106810>
- Arslanoglu, A. & Ercan, Z. (2017). The effect of Montessori sensorial education on children's developmental areas. *Educational Research and Practice*, 28.
- Bandura, F., & Lightsey, R. (1999). *Self-Efficacy: The Exercise of Control*.
- Barroso, C., Ganley, C. M., McGraw, A. L., Geer, E. A., Hart, S. A., & Daucourt, M. C. (2021). A meta-analysis of the relation between math anxiety and math achievement. *Psychological Bulletin*, 147(2), 134–68. <https://doi.org/10.1037/bul0000307>
- Barrows, J., Dunn, S., & Lloyd, C. A. (2013). Anxiety, self-efficacy, and college exam grades. *Universal Journal of Educational Research*, 1(3), 204-208. <https://doi.org/10.13189/ujer.2013.010310>
- Basil, O., & Karatuna, I. (2017). Entrepreneurial self-efficacy of university students: A cross-cultural study. *Management*, 27-40. <https://doi.org/10.26493/1854-4231.12.27-40>
- Beilock, S. L., & Maloney, E. A. (2015). Math anxiety: A factor in math achievement not to be ignored. *Policy Insights from the Behavioral and Brain Sciences*, 2(1), 4-12. <https://doi.org/10.1177/2372732215601438>
- Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior*, 23(3), 329-345. [https://doi.org/10.1016/0001-8791\(83\)90046-5](https://doi.org/10.1016/0001-8791(83)90046-5)
- Betz, N. E. & Hackett, G. (1983). Mathematics Self-Efficacy Scale [Dataset]. In (Editor), *PsycTESTS Dataset*. American Psychological Association (APA). <https://doi.org/10.1037/t01563-000>
- Blanch, D. C., Hall, J. A., Roter, D. L., & Frankel, R. M. (2008). Medical student gender and issues of confidence. *Patient Education and Counseling*, 72(3), 374-381. <https://doi.org/10.1016/j.pec.2008.05.021>
- Brown, J. L., Ortiz-Padilla, M., & Soto-Varela, R. (2020). Does mathematical anxiety differ cross-culturally? *Journal of New Approaches in Educational Research*, 9(1), 126-136. <https://doi.org/10.7821/naer.2020.1.464>
- Caffey, M. R., Crane, J. W., & Ireland M. F. (2016). Paramedic student anxiety levels towards topics in applied pharmacology at a regional university in Australia. *Australian Journal of Paramedicine*, 13, 1-9. <https://doi.org/10.33151/ajp.13.4.491>

- Choi, J. Eastlick Kushner, K., Mill, J., & Lai, D. W. L. (2012). Understanding the language, the culture, and the experience: Translation in cross-cultural research. *International Journal of Qualitative Methods*, 11(5), 652-665. <https://doi.org/10.1177/160940691201100508>
- Dandan, M. M., & Marques, A. P. (2017). Higher education leadership and gender gap in Jordan. *Asian Development Policy Review*, 5(3), 131-139. <https://doi.org/10.18488/journal.107.2017.53.131.139>
- Driscoll, D., Appiah-Yeboah, A., Salib, P., & Rupert, D. (2007). Merging qualitative and quantitative data in mixed methods research: How to and why not. *Ecological and Environmental Anthropology*, 18. https://www.researchgate.net/publication/280073958_Merging_Qualitative_and_Quantitative_Data_in_Mixed_Methods_Research_How_To_and_Why_Not
- Eastwood, K., Boyle, M., Kim, V., Stam, N., & Williams, B. (2015). Mathematical ability of first year undergraduate paramedic students—A before and after study. *Nurse Education Today*, 35(11), 1125-1129. <https://doi.org/10.1016/j.nedt.2015.05.024>
- Evans, R. H. (2014). Cultural effects on self-efficacy beliefs. In R. Evans, J., Luft, C. Czerniak, & C. Pea (Eds.), *The Role of Science Teachers' Beliefs in International Classrooms* (pp. 35–48). Rotterdam: Sense Publishers.
- Fan, X., Hambleton, R. K., & Zhang, M. (2019). Profiles of mathematics anxiety among 15-year-old students: A cross-cultural study using multi-group latent profile analysis. *Frontiers in Psychology*, 10, 1217. <https://doi.org/10.3389/fpsyg.2019.01217>
- Fronberg, E. (2021). *LogicTown: Combating math anxiety with logic, accessibility, and humor* [Master's thesis, Mills College].
- Gürefe, N., & Bakalım, O. (2018). Mathematics anxiety, perceived mathematics self-efficacy and learned helplessness in mathematics in faculty of education students. *International Online Journal of Educational Sciences*, 10(3). <https://doi.org/10.15345/iojes.2018.03.010>
- Hamza, E., & Helal, A. (2013). Maths anxiety in college students across majors: A cross-cultural study." *Educational futures*, 5(2). https://www.researchgate.net/publication/291833588_Math_anxiety_in_college_students_across_majors_across_culture_study
- Hopko, D. R., Mahadevan, R., Bare, R. L., & Hunt, M. K. (2003). The Abbreviated Math Anxiety Scale (AMAS): Construction, validity, and reliability. *Assessment*, 10(2), 178-182. <https://doi.org/10.1177/1073191103010002008>
- Johnson, J., Kareem, A., White, D., Ngwakongnwi, E. M., Mohammadpour, M., Rizkika, N., Ouattas, R., Shahrour, Y., Ali, R., & Roshanuddin, J. (2020). Nursing students' perspectives on learning math for medication calculations in a canadian nursing program in Qatar. *Nurse Education in Practice*, 49, 102885. <https://doi.org/10.1016/j.nepr.2020.102885>
- Kalaycioglu, D. (2015). The influence of socioeconomic status, self-efficacy, and anxiety on mathematics achievement in England, Greece, Hong Kong, the Netherlands, Turkey, and the USA. *Educational Sciences: Theory & Practice*. <https://doi.org/10.12738/estp.2015.5.2731>
- Kaskens, J., Segers, E., Goei, S. L., Van Luit, J. E. H., & Verhoeven, L. (2020). Impact of children's math self-concept, math self-efficacy, math anxiety, and teacher competencies on math development. *Teaching and Teacher Education*, 94, 103096. <https://doi.org/10.1016/j.tate.2020.103096>

- Khasawneh, E., Gosling, C., & Williams, B. (2021). The effect of self-efficacy on maths anxiety among paramedic students. *Australasian Journal of Paramedicine*, 18, 1-7. <https://doi.org/10.33151/ajp.18.814>
- LeBlanc, V. R., MacDonald, R. D., McArthur, B., King, K., & Lepine, T. (2005). Paramedic performance in calculating drug dosages following stressful scenarios in a human patient simulator. *Prehospital Emergency Care*, 9(4), 439-444. <https://doi.org/10.1080/10903120500255255>
- Lee, J. (2009). Universals and specifics of math self-concept, math self-efficacy, and math anxiety across 41 PISA 2003 participating countries. *Learning and Individual Differences*, 19(3), 355-365. <https://doi.org/10.1016/j.lindif.2008.10.009>
- Leppma, M., & Darrah, M. (2024). Self-efficacy, mindfulness, and self-compassion as predictors of math anxiety in undergraduate students. *International Journal of Mathematical Education in Science and Technology*, 55(4), 883-898. <https://doi.org/10.1080/0020739X.2022.2054740>
- Maloney, E. A., & Retanal, F. (2020). Higher math anxious people have a lower need for cognition and are less reflective in their thinking. *Acta Psychologica*, 202, 102939. <https://doi.org/10.1016/j.actpsy.2019.102939>
- Marra, R. M., Rodgers, K. A., Shen, D., & Bogue, B. (2009). Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy. *Journal of Engineering Education*, 98(1), 27-38. <https://doi.org/10.1002/j.2168-9830.2009.tb01003.x>
- McMullan, M., Jones, R., & Lea, S. (2012). Math anxiety, self-efficacy, and ability in British undergraduate nursing students. *Research in Nursing & Health*, 35(2), 178-186. <https://doi.org/10.1002/nur.21460>
- Mueller, S., & Goic, S. (2003). East-west differences in entrepreneurial self-efficacy: implications for entrepreneurship education in transition economies. *International Journal of Entrepreneurship Education*, 1(4). https://www.researchgate.net/publication/284210812_East-West_differences_in_entrepreneurial_self-efficacy_implications_for_entrepreneurship_education_in_transition_economies
- O'Cathain, A., Murphy, E., & Nicholl, J. (2008). The quality of mixed methods studies in health services research. *Journal of Health Services Research & Policy*, 13(2), 92-98. <https://doi.org/10.1258/jhsrp.2007.007074>
- Olango, M. (2016). Mathematics anxiety factors as predictors of mathematics self-efficacy and achievement among freshmen science and engineering students. *African Educational Research Journal*, 4(3), 109-123. <https://files.eric.ed.gov/fulltext/EJ1216175.pdf>
- Pellizzoni, S., Cargnelutti, E., Cuder, A., & Passolunghi, M. C. (2022). The Interplay between math anxiety and working memory on math performance: A longitudinal study. *Annals of the New York Academy of Sciences*, 1510(1), 132-144. <https://doi.org/10.1111/nyas.14722>
- Pettigrew, J., Stunden, A., & McGlynn, S. (2020). Contextualising numeracy skill development and assessment in a first year undergraduate nursing subject: A mixed methods research study. *Nurse Education Today*, 92, 104426. <https://doi.org/10.1016/j.nedt.2020.104426>
- Richardson, F. C., & Suinn, R. M. (1972). The Mathematics Anxiety Rating Scale: Psychometric data. *Journal of Counseling Psychology*, 19(6), 551-554. <https://doi.org/10.1037/h0033456>

- Samuel, T. S., & Warner, J. (2021). "I can math!": Reducing math anxiety and increasing math self-efficacy using a mindfulness and growth mindset-based intervention in first-year students. *Community College Journal of Research and Practice*, 45(3), 205-222. <https://doi.org/10.1080/10668926.2019.1666063>
- Satici, S. A., & Can, G. (2016). Investigating academic self-efficacy of university students in terms of socio-demographic variables. *Universal Journal of Educational Research*, 4(8), 1874-1880. <https://doi.org/10.13189/ujer.2016.040817>
- Shkullaku, R. (2013). The relationship between self-efficacy and academic performance in the context of gender among Albanian students. *European Academic Research*, 1. <https://www.euacademic.org/UploadArticle/33.pdf>
- Smith, C., & Penazzi, D. (2020). Triggering language and maths anxiety in non-medical prescribing students. *Journal of Prescribing Practice*, 2(5), 226-232. <https://doi.org/10.12968/jprp.2020.2.5.226>
- Williams, B., & Davis, S. (2016). Maths anxiety and medication dosage calculation errors: A scoping review. *Nurse Education in Practice*, 20,139-146. <https://doi.org/10.1016/j.nepr.2016.08.005>
- Xie, Y., Lan, X., & Tang, L. (2024). Gender differences in mathematics anxiety: A meta-analysis of Chinese children. *Acta Psychologica*, 248, 104373. <https://doi.org/10.1016/j.actpsy.2024.104373>
- Zakariya, Y. F. (2022). Improving students' mathematics self-efficacy: A systematic review of intervention studies. *Frontiers in Psychology*, 13, 986622. <https://doi.org/10.3389/fpsyg.2022.986622>



JOIN NEMSMA

With nearly 800 members, NEMSMA represents CEOs, chiefs, and managers from every state and type of service, offering voice and vision for professional development and leadership.

NEMSMA is a frequent participant in panels, workgroups, and boards involving EMS in both governmental and non-governmental sectors.



NATIONAL
EMS
MANAGEMENT
ASSOCIATION