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Research Article

A Validation Study Of The Saudi Version Of The Mathematics Confidence Scale Among General Education Students

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ABSTRACT

The purpose of this study was to validate the Saudi version of the Mathematics Confidence Scale among undergraduate students. To achieve this, a sample of 1324 undergraduate students from various schools across Saudi Arabia was selected. The participants' demographics, including gender, grade, and type of school, were considered in order to ensure a representative sample. The participants were given the Mathematics Confidence Scale questionnaire, which consisted of 30 statements related to their confidence in mathematical abilities. Each statement was rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Likert scale was chosen to measure participants' responses because it allows for a more nuanced understanding of their levels of confidence in mathematics. The results indicated That the Saudi Version of the Mathematics Confidence Scale is reliable and valid. This suggests that the scale can be used effectively to assess the confidence levels of undergraduate students in mathematics in Saudi Arabia. Further research should be conducted to investigate the psychometric properties of the Saudi Version of the Mathematics Confidence Scale using IRT models. IRT models can provide more in-depth analysis of item response patterns and help identify specific areas where students may be lacking confidence in mathematics. They can also help determine whether certain items on the scale are functioning as intended and provide insights for improving the scale's overall validity and reliability.

Keywords: Mathematics confidence scale, general education students, Saudi Arabia.

Introduction

Mathematics is one of the crucial sciences in the educational process, often referred to as the queen of sciences, holding this esteemed position since ancient times(Das,2019). The late 1980s saw the emergence of global movements advocating for the improvement of learning and teaching mathematics in light of specific standards to chart the course of this development (Obeid, 2004). Abdullah (2011) notes that the National Council of Teachers of Mathematics (NCTM) is among the world's most renowned institutions dedicated to updating and developing mathematics education. In 2000, this institution issued a set of goals titled Standards or Concepts for the Development of School Mathematics, describing how mathematics should be comprehended and the mathematical skills students should acquire at various educational stages.

Math teachers in many nations throughout the world are nearly forced to seek assistance in order to address the problem of many students who detest or fear mathematics in their courses. They are encouraged to collaborate with professional school counselors in addressing the numerous math-averse children in today's classrooms. Teachers must better equip all students to succeed with and be confidence in their ability to do mathematics in order to compete worldwide in the age of STEM (Science, Technology, Engineering, and Mathematics). It has truly become an epidemic in our society, with so many young people and adults harboring unfavorable views about mathematics training and having had awful prior experiences with it (Beilock & Willingham, 2014; Boaler, 2009; Dowker, Sarkar, & Looi, 2016; Geist, 2010).

Students' perceptions of themselves as learners are closely linked to their general attitudes regarding the discipline in question. Because mathematics is a highly valued subject in school, students who achieve excellence in it are rewarded. It has been discovered that students' attitudes about mathematics and about themselves as math students play a critical impact in their mathematics learning and success (e.g. Schoenfeld 1992). The relevance of beliefs in mathematical education is consistent with constructivist teaching and learning theories. "An individual's understandings and feelings that shape the ways that the individual conceptualizes and engages in mathematical behavior" is how we define beliefs (Schoenfeld 1992, 358). Beliefs about mathematics, beliefs about oneself as a mathematics learner/applier, beliefs about teaching mathematics, and beliefs about studying mathematics are the four fundamental components of mathematical beliefs (e.g. Lester et al. 1989).

According to the self-efficacy theory (Bandura,1997), even if students believe that math actions will help them achieve their immediate or long-term goals, they may lack the confidence (or self-efficacy) to carry them out. Past experience with the behavior, the presence of powerful or peer models for the behavior, verbal commentary from others about the individual's skill at the behavior, and physiological conditions that help or hinder the behavior are all sources of an individual's self-efficacy for a specific behavior, such as difficulty with anxiety or anger according to Bandura. Overall Math Confidence has been studied in the United States and was dubbed ‘math self-concept,' but it was not known to have been employed in other nations' literature. The notion or mental image one has of oneself and one's strengths, shortcomings, status, etc.,' according to one definition of the American word Self-concept (Random House Inc., 2006). Topic Confidence is referred to as 'self-efficacy' in the United States. Self-efficacy, according to Bandura (1997), is defined as "people's judgments of their capacities to organize and execute courses of action required to achieve recognized forms of performance." 'Self-concept varies from self-efficacy in that self-efficacy is a context-specific judgment of capacity to accomplish a certain job,' according to Pajares and Miller (1994). 'Self-concept is not tested at that degree of specificity, but it does include self-worth beliefs linked to perceived competence.' As a result,' math self-efficacy' is equated to Topic Confidence, and ‘math self-concept' is equated to the 'Overall Confidence in Mathematics' stated in this study.

The term 'confidence' is prevalent in the realm of mathematics education, often intertwined with competence (Hardy, 2007, 2009). It frequently surfaces in discussions with teachers regarding students' mathematical abilities (Watson, 1996), contributing to a broader societal dialogue about school mathematics. However, the concept of confidence poses challenges. In one of two pivotal studies examining confidence in mathematics education, Hardy (2007) scrutinizes the unquestioned use of 'confidence' in depicting a proficient mathematics learner. Additionally, Burton (2004) discovers discrepancies in how teachers and students employ the term 'confident' and its effects. Burton's interview-based study focuses on contrasting perspectives on confidence, revealing that teachers define confidence behaviorally, emphasizing observable classroom actions like volunteering answers or competitive behaviors as indicators. Conversely, students concentrate on their emotions, linking confidence to the classroom environment, success, knowledge, and understanding. Hardy (2007) also challenges the term 'confidence' using a 'patchwork analytical' approach, drawing from various studies. She delves into how students must outwardly exhibit or 'perform' confidence in the mathematics classroom to be recognized and perceive themselves as adept mathematics learners. Hardy identifies confident behaviors such as speaking out, providing answers or explanations, seeking help, and taking risks. Students construct a performative understanding of confidence (Hardy, 2008, 2009).

Background of the Study

In the landscape of education, mathematics stands as a cornerstone, shaping not only cognitive abilities but also influencing career paths and societal contributions. At the heart of mathematical success lies an often-overlooked yet pivotal aspect: confidence. The beliefs and perceptions individuals hold about their mathematical abilities—commonly referred to as mathematics confidence—play a fundamental role in determining their engagement, persistence, and ultimate achievement in this critical subject(Algani,2022). Within the Saudi Arabian educational context, the development of standardized and culturally adapted measures to assess mathematics confidence emerges as a critical imperative

The validation of the Saudi version of the Mathematics Confidence Scale is the main focus of this study. This is particularly important considering the current state of mathematics education in Saudi Arabia, where there is a gender-segregated education system. The unique structure of the Saudi education system presents an opportunity to explore how variations in system-level factors contribute to observed individual differences in achievement(Elsayed et al.,2022). In terms of developing measures of mathematics confidence, Fogarty, et al.,(2001) validation of a questionnaire designed to measure general mathematics confidence, general confidence with using technology, and attitudes to the use of technology for mathematics learning. A questionnaire was administered to 289 students commencing a tertiary level course on linear algebra and calculus. Scales formed on the basis of factor analysis demonstrated high internal consistency reliability and divergent validity.

Numerous studies have delved into students' attitudes and perceptions towards mathematics and their impact on academic achievement (e.g a Mazana et al,2019; Çiftçi& Yıldız,2019; Hwang & Son,2021; Okyere& Kuranchie.,2013; Suren & Kandemir,2020). For example, a study concentrated on eighth-grade students and discovered that many students often inaccurately assessed their math abilities. Furthermore, the study identified math anxiety as a factor influencing students' motivation to learn in math classes, leading to negative attitudes and decreased achievement levels (Suren & Kandemir,2020). Çiftçi& Yıldız(2019) conducted a study that focused on The Effect of Self-Confidence on Mathematics Achievement using the Trends in International Mathematics and Science Study (TIMSS), The results indicated that self-confidence has a moderate effect on mathematics achievement.

Additionally, it has been observed that there may be significant gender differences in students' attitudes towards mathematics, which warrants further exploration (Bashir,N., Akram,K.& Bashir,R.,2023, Ayebo,A.& Dingel.M.,2021). Hannula and Malmivuori (1997) found that ninth-graders' mathematical beliefs, self-confidence, and achievement on the mathematics test they used were statistically significantly correlated. Both the last mathematics mark and the task scores were substantially correlated with self-confidence. The weak students had the lowest self-confidence and the most defense orientation, while the good students had the opposite, and the average students were in the middle

In light of the decline in Saudi students' performance on international assessments such as TIMSS, it is crucial to comprehend the factors impacting their attitudes towards mathematics (Education & Training Evaluation Commission,2021, Elsayed et al.,2022). The validation study of the Mathematics Confidence Scale will illuminate these attitudes and provide valuable insights for policymakers and educators.

In light of these previous studies, it is clear that attitudes towards mathematics play a significant role in students' academic performance. The validation study of the Saudi version of Mathematics Confidence Scale aims to build upon this existing literature by providing insights into the psychometric properties of the scale within a specific cultural context.

Importance of Confidence in Mathematics

The significance of confidence in mathematics has been well-documented as having a profound impact on students' attitudes and performance in the subject. Research has indicated that students' confidence levels play a pivotal role in influencing their overall achievement in mathematics, particularly during the crucial phase of transitioning into adolescence(Kaur,McLoughlin&Grimes,2022). This has been demonstrated in various studies examining the effect of gender disparities on students' attitudes towards mathematics, revealing that boys tend to exhibit higher levels of confidence as they progress through middle and high school(McMurran, Weisbart&Atit,2023, Mazana et al,2019, Makarova, Aeschlimann& Herzog,2019, Newton,2022). Wourms(2022) indicated that there is a relationship between confidence and performance, as well as ability tracking and confidence. This means that students' ability tracks, confidence levels, and performance all increase with each other. There was a stronger correlation between confidence levels and performance than ability tracks and performance. Because of this, there is no definitive evidence of what begets success. Still, ability tracking is not the ultimate precursor to success and there is more than mathematical content, specifically confidence, that teachers need to nourish in their students. All in all, confidence, ability tracking, and performance have positive relationships with each other, meaning that students need to learn mathematical content but also establish healthy levels of confidence in order to be successful.

Moreover, students' perceptions of the practical utility of mathematics and their previous experiences with the subject can significantly mold their attitudes and confidence levels. Factors such as the real-world applicability of mathematics, career prospects, and familial influences all contribute to shaping students' overall confidence in the subject (Alharthi ,2023,Mazana et al,2019, Mabena, Mokgos & Ramapela,2021, Blotnicky, et al.,2018). Furthermore, positive encounters with mathematics can lead to heightened levels of confidence, while negative experiences may result in diminished confidence(Živković, et al.2023,).

It is worth emphasizing that students' attitudes towards mathematics are multifaceted and interconnected constructs. Students who harbor a genuine fondness for mathematics, recognize its potential positive outcomes, and have faith in their mathematical abilities are more likely to achieve better results in the subject(Parsons, Croft&Harrison,2009).

In conclusion, it is imperative for educators to take into account students' attitudes and confidence levels when teaching mathematics. Offering appropriate assistance and interventions to foster a positive attitude towards mathematics can ultimately enhance students' overall academic performance.

However, the exigent need for scales specifically tailored to the cultural and educational contexts of Arab nations, including Saudi Arabia, remains salient. By synthesizing findings from diverse studies, this research aims to craft culturally sensitive and validated measures that effectively encapsulate the nuances of mathematics confidence within the Saudi educational milieu. Through meticulous adaptation, validation, and cultural considerations, this study aspires not merely to construct scales but to establish a robust and contextualized framework for understanding mathematics confidence within the unique sociocultural landscape of Saudi Arabia.

Purpose of the Study

The primary purpose of the research is to carry out a validation study of the Mathematics Confidence Scale in its Saudi version. This will entail assessing the reliability and factor structure of the scale within a sample of Saudi adults. The purpose is to gather empirical evidence on the psychometric properties of the scale within the Saudi context. Through conducting reliability analysis (Cronbach Alpha), exploratory factor analysis (EFA), and confirmatory factor analysis (CFA), we aim to authenticate and enhance the Mathematics Confidence Scale for application in this specific cultural and social setting. The ultimate objective is to ensure that the scale accurately measures mathematics confidence among Saudi adults, serving as a valuable instrument for future research and educational practice**.**

Method and Procedures

Item Selection and Scale Development

In the present study, Mathematics Confidence Scale (MCS) was administered as the data collection instrument. It was constructed by the researchers considering the combination of excessive literature review about mathematics confidence.

MCS was consisted of two main parts: (a) demographic information and (b) mathematics confidence scale. In the demographic part of the scale, participants' gender, schools, and grade level were asked. In the mathematics related confidence scale part, participants were asked to indicate their agreement with the confidence statements about Confidence in mathematics. Scale was scored as 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, and 5= Strongly Agree. Each participant could get maximum 150 point and minimum 30 point in this scale.

Candidate Items Selection

Before constructing the latest version of the MCS, an extensive literature review was completed. Databases such as EBSCOhost, ERIC, and ULAKBIM were explored to reach studies investigated students mathematics related confidence as well as book chapters, articles, and journals. Few instruments were found specifically designed for assessing the general beliefs of students in mathematics that were prepared by several researchers. Most of the instruments were derivations of each other and were prepared for investigating beliefs & confidence in mathematics on specific areas such as problem solving beliefs (Kayan, 2007) and self-efficacy beliefs (IŞıksal, 2005). The confidence statements in these scales were sought for constructing a confidence scale which would measure confidence about (a) dealing with mathematics, (b) learning mathematics, and (c) achievement in mathematics. Items were prepared based on these dimensions.

Reduction of Items

There were several steps followed during the construction and development of the scale items used in this study. First of all, the items in the scale developed by Haser and Doğan (2009) were reviewed while an extensive literature review on students mathematics related beliefs &confidence were carried out. Their scales was constructed specifically to measure mathematics related beliefs &confidence held by students. There were a 175-item Likert type scale of 5 possible responses ranging from strongly agree to strongly disagree. Items were constructed to assess beliefs &confidence about nature of mathematics, learning mathematics, and teaching mathematics. The comparison of the scales items with the literature review showed that 12 of the items exactly matched the belief & confidence statements addressed in the literature and the other items reflected the beliefs & confidence widely mentioned in the literature. The mathematics related beliefs& confidence that could not be measured by this instrument were sought in the literature and one item was added to the MCS. The suggested changes resulted in a 39-item confidence scale.

Numerous duplicate items were dropped, shortening the list to 175 items. A committee of three researchers evaluated these items intending to develop a shorter list of symptoms that more closely reflect the symptoms associated with confidence in mathematics. The result was a list of 39 items and a draft set of instructions for these items.

Expert Review

The next step of preparing scale items was gaining experts' opinions. The new MCS onsisted of 39 items and these items were reviewed by Five mathematics education researchers for independent review. The experts were asked to independently comment on the appropriateness and sufficiency of the wording of the items and instructions, content and comprehensibility and to suggest modifications. Additional discussions were conducted with two of the experts to clarify their recommendations. This process resulted in further reduction of the items to 30.

Pilot Testing

Pilot study is an important process for developing scales. The construct validity, whether a scale measures or correlates with scientific construct, and reliability of the scale could be tested with pilot study.
The draft 30-item scale was pilot tested with 30 students (15 male ,15 female) through online interviews. Based on the feedback, minor modifications were made in the wording and sequence of the items and the instructions.

Participants and procedure

An online survey was conducted to collect data using a survey link created on a Google Form. It was then distributed via email and social media like Facebook, WhatsApp, etc. A total of 1324 students completed the online survey, Among the 1324 participants, 88.3% were male, 11.7% were female. Detailed information about the participants is presented in Table 1.

Table 1: Characteristics of the study group (N = 1324).

Gender	N	%
male	1169	88.3
female	155	11.7
Grade		
5	206	15.6
6	302	22.8
7	220	16.6
8	181	13.7
9	174	13.1
10	241	18.2
Type		
GOV	1135	85.7
PRIV	189	14.3

Statistical analyses

Descriptive statistics were used to report the sample characteristics. Skewness, kurtosis, and distributions of responses were analyzed with respect to each item. Internal consistency was assessed by Cronbach alpha coefficients (α) and corrected item-total correlations. A Cronbach's α of .70 or higher indicates acceptable reliability (DeVellis 2016; Nunnally and Bernstein 1994). Each item was also assessed in terms of its impact on the overall alpha correlation coefficient. Inter-item correlations and corrected item-total correlations between .30 and .70 suggest medium to strong associations between items (Ferketich 1991).. These analyses were conducted using the IBM SPSS Statistics v 26 software.
We used Exploratory Factor Analysis (EFA) to explore the dimensionality and factor structure of the MCS and Confirmatory Factor Analysis (CFA) to test the model derived from EFA. EFA is ideal for determining the dimensionality of a measure, which can then be confirmed through the use of CFA. EFA factor extraction was done using the maximum likelihood method with Promax rotation. An oblique rotation was selected due to the expectation of correlated factors. The analyses of the present study were run using IBM SPSS Statistics 26.0, Amos Graphics 26.

Results

The correlation matrix was subjected to exploratory factor analysis and 3 factors (subscales) were extracted (eigenvalue greater than 1) using principal component method, they explained 52.94 % of variance. Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO=0.96), Bartlett's Test of Sphericity ($\chi 2$=10467.88, df=435, sig< 0.001) proved that the factor analysis was useful with data. The items (30) loaded on their respective factors, 16 items were loaded on subscale 1, there loadings were ranged from 0.459 (item 5: *I have less trouble learning mathematics than other subjects*) to 0.786 (item 21: *I am not the type to do well in math.*). 10 items were loaded in subscale 2, there loadings were ranged from 0.346 (item 12: *I find many mathematics problems interesting and challenging*) to 0.779 (item 1: *Even if I do not understand a math problem at first, I am confident I will get it eventually*)، and 4 items were loaded on subscale 3, there loadings were ranged from 0.474 (item 17: *I can get good grades in mathematics.*) to 0.600 (item 3 If I get a bad grade on a math test, I Know I can do better next time with more practice.).

Table 2: exploratory factor analysis: explained variance for Three factors

	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
Component	Total	% of Variance	Cumulative %	Total
1	11.691	38.970	38.970	10.174
2	2.880	9.601	48.571	7.689
3	1.311	4.371	52.942	3.617

Table 3: loadings of Items on Three Components

Pattern Matrix[a]

	Component		
	1	2	3
ITEM21	.786		
ITEM22	.780		
ITEM24	.750		
ITEM28	.749		
ITEM20	.739		
ITEM27	.738		
ITEM13	.734		
ITEM9	.733		
ITEM11	.725		
ITEM18	.718		
ITEM7	.674		
ITEM19	.651		
ITEM8	.642		
ITEM25	.625		
ITEM14	.566		
ITEM5	.459		
ITEM1		.779	
ITEM6		.739	
ITEM2		.728	
ITEM16		.697	
ITEM10		.686	
ITEM29		.655	
ITEM4		.632	
ITEM26		.598	
ITEM30		.429	
ITEM12		.346	
ITEM3			.600
ITEM23			.519
ITEM15			.502
ITEM17			.474

Table 4:Correlation between subscales

	SUBSCALE1	*SUBSCALE2*	*SUBSCALE3*	*TOTAL*
SUBSCALE1	*1*	*0.59*	*0.54*	*0.93*
SUBSCALE2		*1*	*0.69*	*0.83*
SUBSCALE3			*1*	*0.73*
TOTAL				*1*

NOTE: All Correlations is significant at the 0.01 level (2-tailed).

Confirmatory factor analysis (CFA)

Table 5: 4 models were assessed

Index	*Uni dim*	*3dim(ind)*	*3dim(corr)*	*BIFACTOR MODEL*
CMIN/DF	*8.59*	*6.15*	*4.38*	*2.63*
GIF	*0.591*	*0.786*	*0.838*	*0.904*
CIF	*0.699*	*0.796*	*0.867*	*0.941*
TLI	*0.678*	*0.781*	*0.865*	*0.931*
RMSEA	*0.109*	*0.090*	*0.073*	*0.050*

Table5 presents an overview of the CFA models of MCS along with the corresponding goodness of fit indices. The first step was to test if a mathematics confidence is uni-dimensional, we assumed one factor underlying all 30 items, and the one factor model demonstrated a poor fit.

Next we confirm the results of EFA, the analysis were conducted to multidimensional models (3 subscales), three models were checked; 3 independent subscales, 3 correlated subscales, and bifactor model. Last model appeared to be the best fitting model. Figure 1 illustrates the parameters of last model. All loadings were significant (P<0.001), Standardized Regression Weights of items in scale ranged from 0.404(item7) to 0.808(item23) except item 5(0.144).

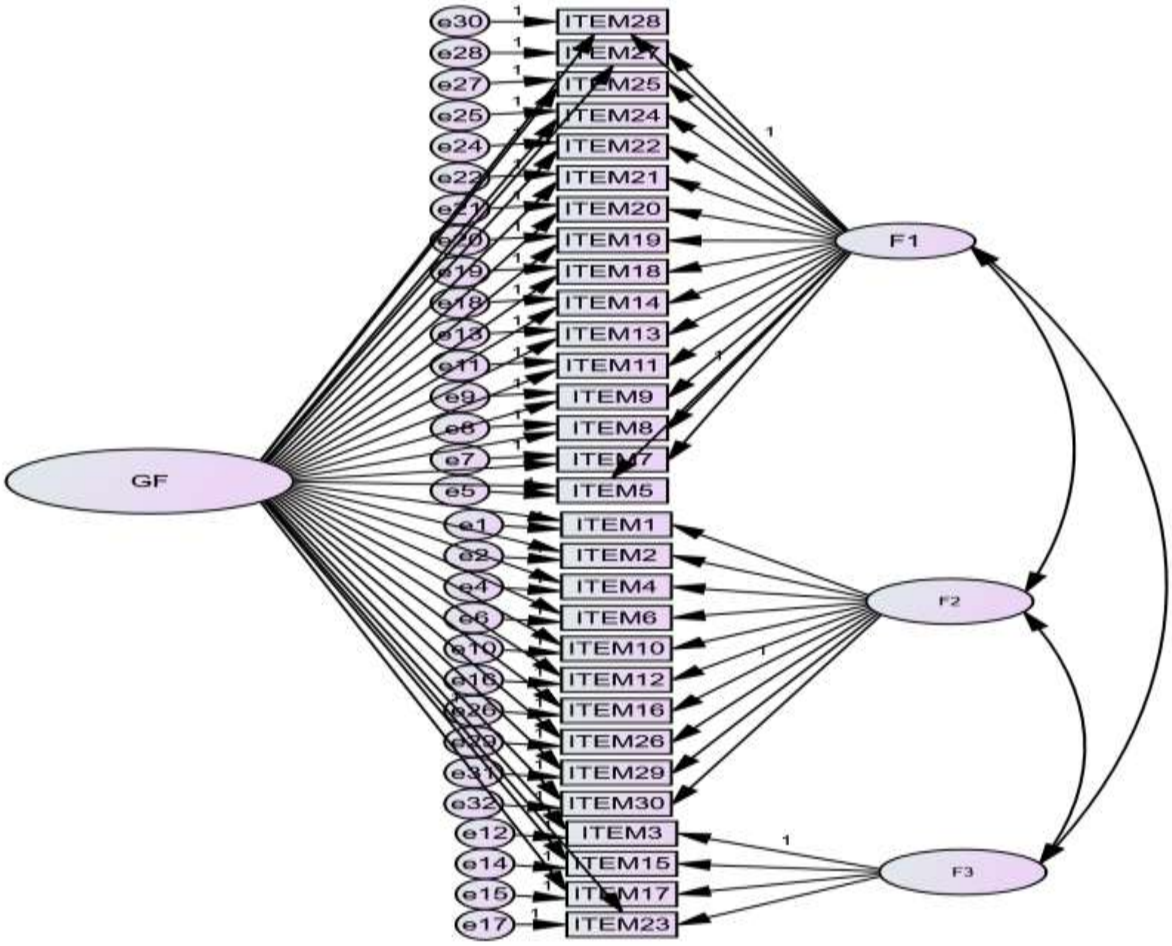

Figure 1. The Results of the Final Confirmatory Factor Analysis (CFA) for Three Correlated Factors for the Mathematics confidence Scale

Table 6: Cronbach's alpha

Subscale	*α*
1	*0.92*
2	*0.89*
3	*0.78*
total	*0.94*

Cronbach's alpha was computed for each subscale. All of the subscales possessed high reliability coefficient, they ranged from 0.78 to 0.92, and the total scale reliability was 0.94. the corrected item-subscale total correlation were strongly, and ranged from 0.58 and 0.78 for items in subscale 1, from 0.65 to 0.71 for items in subscale2, and from 0.52 to 0.62 for items in subscale3.

Table 7: Corrected item-total correlation

Subscale1				*Subscale2*				*Subscale3*			
Items	*M*	*SD*	*corr*	*Items*	*M*	*SD*	*corr*	*Items*	*M*	*SD*	*corr*
7	*2.79*	*1.15*	*0.66*	*1*	*2.57*	*1.09*	*0.65*	*3*	*3.51*	*.78*	*0.52*
8	*2.33*	*1.31*	*0.58*	*2*	*2.67*	*1.15*	*0.58*	*15*	*3.44*	*.83*	*0.62*
9	*3.05*	*1.15*	*0.73*	*4*	*2.98*	*.99*	*0.64*	*17*	*3.36*	*.82*	*0.61*
11	*2.58*	*1.29*	*0.71*	*6*	*2.82*	*.97*	*0.71*	*23*	*3.50*	*.72*	*0.58*
13	*2.24*	*1.28*	*0.69*	*10*	*3.06*	*1.09*	*0.68*				
14	*2.99*	*1.14*	*0.61*	*12*	*3.06*	*.99*	*0.45*				
18	*2.96*	*1.17*	*0.75*	*16*	*2.72*	*1.08*	*0.69*				
19	*2.56*	*1.18*	*0.63*	*26*	*2.77*	*1.06*	*0.64*				
20	*2.71*	*1.21*	*0.74*	*29*	*2.50*	*1.10*	*0.70*				
21	*2.74*	*1.28*	*0.78*	*30*	*3.00*	*1.01*	*0.54*				
22	*2.90*	*1.29*	*0.76*								
24	*2.80*	*1.19*	*0.72*								
25	*2.45*	*1.27*	*0.68*								
27	*2.43*	*1.28*	*0.71*								
28	*2.61*	*1.28*	*0.67*								

Summary of Findings

The current study aimed to validate the Saudi Version of the Mathematics Confidence Scale among undergraduate students, and the findings revealed several key insights. The results of the study provide valuable insights on the reliability and validity of the Saudi version of the Mathematics Confidence Scale among undergraduate students. These findings contribute to the existing literature on the measurement of mathematics confidence and support the use of the scale in future research and educational settings. Furthermore, the study highlights the importance of cultural adaptation and translation in ensuring the applicability and accuracy of psychological scales in different contexts. The findings also suggest that the Saudi Version of the Mathematics Confidence Scale can be a useful tool for assessing mathematics confidence among undergraduate students in Saudi Arabia. In addition, the study reveals important implications for educators and policymakers in Saudi Arabia in terms of enhancing students' mathematics self-confidence and promoting their academic success. By understanding the psychometric properties and factor structure of the Saudi Version of the Mathematics Confidence Scale, educators and policymakers can develop targeted interventions and strategies to support students in building their mathematics confidence and ultimately improving their academic performance. This knowledge can inform the development of educational programs that aim to foster a positive learning environment and promote self-efficacy in mathematics among undergraduate students in Saudi Arabia.

Recommendations for Future Research

The intriguing outcomes of this research provide the impetus for several exciting avenues for future investigations. It would be enlightening to assess the applicability of the Saudi edition of the Mathematics Confidence Scale across a broader spectrum of educational environments and diverse population cohorts. Delving deeper, future studies could explore the interplay of mathematics confidence with the students' academic performance and potential interventions designed to boost it. Examining potential correlations of mathematics confidence with different variables- including gender, socioeconomic strata, and previous mathematical achievement- could yield meaningful insights. Such forward-thinking research imperatives would invariably enrich the scholarly narrative around mathematics confidence, nurturing a nuanced comprehension of this invaluable construct within the Saudi Arabian milieu. Moreover, investigating the longitudinal effects of mathematics confidence on students' persistence in pursuing mathematics-related careers would provide valuable insights for policymakers and educators. This could pave the way for targeted interventions and support systems that foster the development of mathematics confidence and ultimately contribute to the growth of the STEM workforce in Saudi Arabia. Furthermore, future research could delve into the potential relationship between mathematics confidence and other psychological constructs, such as self-efficacy and motivation, to gain a comprehensive understanding of the factors that influence students' attitudes towards mathematics. Understanding the complex interplay between mathematics confidence, self-efficacy, and motivation would shed light on the underlying mechanisms that shape students' perceptions and behaviors in mathematics-related contexts. Additionally, future research could Investigate the psychometric properties of the Saudi version using IRT models. Utilizing IRT models would provide a more in-depth analysis of the Saudi version of the Mathematics Confidence Scale, allowing for a thorough examination of its reliability, validity, and item characteristics. Moreover, exploring the potential differential item functioning (DIF) across different demographic groups, such as gender and educational level, would enhance the psychometric properties of the scale and ensure its fairness and accuracy in measuring mathematics confidence among undergraduate students in Saudi Arabia.

Limitations of the Study

While this study successfully validated the Saudi Version of the Mathematics Confidence Scale among undergraduate students, it is important to acknowledge its limitations in order to provide a comprehensive understanding of the research findings. One limitation of this study is the limited sample size, which may limit the generalizability of the findings to a larger population of undergraduate students in Saudi Arabia, Especially regarding the female sample. Another limitation of the study is the potential bias introduced by the use of self-reported data, which may affect the accuracy and reliability of the results. Additionally, the reliance on self-reported data may also lead to social desirability bias, where participants may be inclined to respond in a way that is perceived as more socially acceptable. Furthermore, the lack of control over external factors, such as participants' previous mathematics background or their study habits, could also impact the validity of the results. For instance, students with a strong mathematics background may have higher confidence levels regardless of the intervention, whereas students with poor study habits may show lower confidence levels regardless of the scale's effectiveness. Moreover, the study did not consider other factors that could influence students' mathematics confidence, such as cultural beliefs or the quality of mathematics instruction in their educational institutions. Therefore, future research should consider these factors in order to provide a more comprehensive understanding of the factors influencing mathematics confidence among undergraduate students in Saudi Arabia.

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