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The Impact of Mathematics Anxiety on the Mathematical Value of Secondary School Students in Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Mathematics education transcends the mere acquisition of numerical proficiency; it encompasses a holistic growth encompassing essential values such as rationality, control, and critical thinking. This study examined the impact of mathematics anxiety on the mathematical value of secondary school students in Nigeria, focusing on senior secondary schools in the West of Nigeria. To achieve the objective of this quantitative study, two thousand nine hundred thirty-nine senior secondary school students were selected using convenience and purposive sampling techniques. The primary data was collected using a questionnaire that was administered through Google Forms. Simple linear regression was used to analyse the four variables (Critical Thinking in Mathematics, Rationality in Mathematics, Control in Mathematics, and Mathematics Anxiety) identified through factor analysis. This study found that mathematics anxiety significantly negatively impacts the rationality of decision-making among secondary school students in the southwest of Nigeria; there is a

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significant relationship between mathematics anxiety and the critical thinking abilities of secondary school students in the southwest of Nigeria. Mathematics anxiety significantly negatively influences the ability to control mathematical concepts among senior secondary schools in the West of Nigeria. This study concludes that mathematics anxiety significantly and negatively impacts the mathematical value of secondary school students in Nigeria. The findings have practical implications for educators, policymakers, and curriculum developers, emphasising the need for a holistic approach to education that recognises the emotional well-being of students alongside their cognitive development.

Keywords: Mathematics anxiety; mathematical value; critical thinking; rationality; control in mathematics; Nigeria.

1. INTRODUCTION

Mathematics education transcends mere numerical proficiency; it fosters holistic growth encompassing essential values and qualities in students [1]. This educational journey promotes progress and control and cultivates logical reasoning and problem-solving abilities, nurturing critical thinkers equipped to tackle intricate challenges [2]. However, lurking beneath the surface of this educational pursuit lies anxiety, a significant factor that can profoundly influence the development of these values [3].

According to Halstead and Taylor [4] and Matthews [5], values are guiding principles that direct or influence behaviour. Clarkson and Bishop [6] extend this definition by regarding values as beliefs translated into actions. Mathematical values pertain to the characteristics of various mathematical fields. Mathematical values encompass the guiding principles that shape one's opinions and attitudes towards mathematics. Educators categorise these values into various dimensions. Tapsir et al. [7] classify mathematical values into three categories: ideological, emotional, and sociological values, relating them to social behaviours and actions. Sam and Ernest [8] further categorise mathematical values into four dimensions: epistemological, social, cultural, and personal, focusing on values specific to mathematics and mathematics education. Bishop [9] divides mathematical values into three complementary pairs: rationalism-objectivism, control-progress, and openness-mystery.

Value is impacted by anxiety [10]. Anxiety, a common emotional response triggered by uncertainty or stress, can cast a shadow over the values that mathematics education endeavours to nurture [11]. According to Bishop et al. [12], these values represent the profound emotional characteristics sought to be cultivated by the educational system through mathematics. They constitute a vital element of the emotional atmosphere in the classroom setting. They are intricately woven into the fabric of mathematical learning, susceptible to both subtle and dramatic influences by anxiety [11]. While the interplay between anxiety and these values varies among individuals, recognising its potential impact is crucial to mitigate its effects and create a conducive environment for genuine, value-driven mathematical education.

Exploring how mathematics anxiety influences the development of mathematical values in secondary school students is a crucial undertaking. Adolescence is marked by emotional vulnerability and heightened susceptibility to stressors [13]. Secondary school students, in particular, grapple with academic performance pressures, societal expectations, and self-discovery. Mathematics education, a vital part of their curriculum, imparts mathematical skills and nurtures values that shape them into well-rounded individuals [14].

For several reasons, understanding the intricate ways mathematics anxiety impacts the values cultivated in mathematics education holds significant importance. Firstly, identifying mathematics anxiety triggers and manifestations can inform educators, parents, and policymakers about potential interventions. Tailored strategies to alleviate anxiety can create an environment conducive to students' emotional and educational well-being. Secondly, recognising the potential negative impact of mathematics anxiety on values such as progress, control, critical thinking, and others can guide educators in developing targeted pedagogical approaches [15]. By creating engaging learning experiences that address anxiety-related challenges, educators can help students maintain these values even in the face of stress.

Furthermore, there is a notable dearth of literature regarding mathematical value in

Nigeria. Nigeria is above 218 million people in 2022, making it the most populated nation in Africa [10]. Over 250 ethnic groups comprise Nigeria, exhibiting extraordinary diversity [16]. Nigeria is a country located in West Africa. It shares borders with several countries, including Benin to the west, Niger to the north, Chad to the northeast, and Cameroon to the east. Education holds significant value in Nigeria, both culturally and as a means to address various societal and economic challenges. While extensive research exists on mathematics anxiety and related variables such as performance, there is limited research on the relationship between mathematics anxiety and mathematical value. Moreover, the existing research predominantly originates outside Nigeria, highlighting a gap in this study area.

The significance of this study lies in its potential to shape the educational experiences and trajectories of secondary school students. This research can catalyse positive changes in teaching and learning practices by shedding light on the intricate dynamics between anxiety and the values fostered in mathematics education. Additionally, this study holds the promise of empowerment for secondary school students. Awareness of how anxiety can impact their control, rationalism, and critical thinking can equip them with the tools to recognise and address these challenges. It will normalise discussions about mental health and provide strategies for managing anxiety, promoting resilience and a growth mindset.

Educators also stand to benefit significantly from the outcomes of this study. Armed with insights into how anxiety might hinder the development of specific values, they can tailor their instructional methods to create a supportive learning environment. Strategies for promoting collaboration, mitigating test anxiety, and integrating stress-reduction techniques can be incorporated into teaching practices, enhancing student engagement and well-being [17]. Furthermore, policymakers and curriculum developers can leverage the findings of this study to inform education policies that prioritise emotional well-being alongside academic achievement. A curriculum that acknowledges the impact of anxiety on values can incorporate initiatives to address mental health, promoting a more holistic approach to education.

This study focuses on mathematics students in secondary schools, with a particular emphasis on senior secondary school students in South West of Nigeria. Their distinct developmental challenges justify this focus during this critical period. Their exposure to advanced curriculum, preparation for higher education, encounters with test anxiety, emotional development, increasing autonomy, and the long-term implications for their well-being warrant a closer examination of how anxiety interacts with the values they cultivate in mathematics education.

1.1 Research Aim

This study aims to investigate the impact of mathematics anxiety on the mathematical values of secondary school students. Specifically, the study will focus on three variables: rationalism, control, and critical thinking. The research examines the relationship between these variables and mathematics anxiety and the extent to which mathematics anxiety can influence them.

2. LITERATURE REVIEW

2.1 Mathematics Anxiety

Mathematics anxiety, experienced by some students, can manifest as stress, aversion, dread, and even agony when confronted with mathematical problems [18]. This condition impedes manipulating numbers and resolving mathematical problems in various contexts, from everyday life to academic scenarios [19,20]. Its severity ranges from mild uneasiness to intense dread, leading to adverse reactions towards mathematical concepts and assessments. Namkung, Peng, and Lin [21] stress that mathematics anxiety is closely associated with a “fear of performing mathematical tasks” and correlates with delayed comprehension of fundamental mathematical and numerical concepts, resulting in poor mathematical proficiency. Mathematics anxiety significantly impedes the ability to learn mathematics [22].

Mathematics anxiety often develops due to prolonged stress experienced in mathematics classrooms, where time-constrained tests are frequently administered [23]. It may also arise from competitive dynamics at home, such as with siblings or in the workplace[24]. Mathematics anxiety substantially influences students’ mathematical thinking, affecting their reasoning and problem-solving abilities [18].

Atoyebi and Atoyebi [18] attribute the primary causes of mathematics anxiety to past

mathematics failures, mathematical language challenges, and negative beliefs regarding mathematics. Luttenberger et al. [25] emphasise that individuals with heightened math anxiety tend to avoid learning mathematics, cultivate negative attitudes, and possess low self-confidence in their mathematical abilities [26]. Consequently, elevated levels of mathematics anxiety are widely recognised as detrimental to students' learning outcomes [27,28]. Teachers may feel frustrated or helpless when their students struggle with mathematics anxiety. This frustration can lead to emotional exhaustion and contribute to burnout.

To mitigate mathematics anxiety, researchers have proposed various strategies. These include the effective implementation of inclusive mathematics education [29], the integration of digital technology into mathematics instruction [27, 28], and the use of supplementary materials featuring a more communicative language style, often incorporating narratives from real-life case studies or events [30]. Additionally, diverse mathematics teaching approaches, such as problem-based teaching, student-centred methods, inclusive instructional strategies, creative and discovery approaches, and inquiry-based learning, have been identified as effective means to reduce mathematics anxiety [31].

This study aims to investigate the impact of mathematics anxiety on the mathematical value of secondary school students in Nigeria, considering critical thinking, rationality, and control as integral components of this mathematical value.

2.2 Mathematical Value

In educational instruction, value holds a pivotal role alongside cognitive and affective aspects. Cao et al. [32] emphasise that values serve as criteria for assessing significance, occupying a central position in the system of convictions compared to other emotional qualities like attitudes and beliefs. Consequently, these values are instilled within students during educational interactions, whether overtly or covertly, shaping their decision-making and learning processes.

Values are essential in pedagogy and mathematics learning [33]. In mathematics education, values are defined as deep affective qualities integral to the classroom environment [34,35]. Affective qualities refer to profound emotional and attitudinal characteristics or dispositions individuals can develop through their educational experiences. Mathematical value typically refers to the practical and intellectual benefits individuals derive from their engagement with mathematics. Mathematical values encompass traits that reflect the essence of mathematical understanding, intrinsic to the mathematical realm, and indicative of how mathematicians across diverse cultures shape the discipline [36]. These mathematical values intersect with the epistemological dimension of mathematics as a field of study. The scope of mathematical values encompasses distinct categories such as rationalism, objectivity, control, progress, openness, and critical thinking, as outlined by Dollah [37]. Understanding the relationship between mathematics anxiety and mathematical value, particularly in the dimensions of critical thinking, rationality, and control, is essential for parents/guidance, educators and researchers aiming to address and mitigate the adverse effects of mathematics anxiety on students' mathematical value. For this study, Bishop's [9] classification serves as the framework. This study will consider three mathematical values: rationality, control, and critical thinking.

2.3 Relationship between Mathematics Anxiety and Mathematical Value.

The relationship between mathematics anxiety and mathematical value is critical to mathematics education. This study will consider the relationship between mathematics anxiety and rationality, mathematics anxiety and control, and mathematics anxiety and critical thinking.

2.4 Mathematics Anxiety and Rationality.

Rationality pertains to the values individuals hold regarding mathematics. In this context, mathematics encompasses ideas rooted in theory, logic, and hypotheses [35]. Rationalism embodies deductive logic, prioritising the accuracy of outcomes and explanations. According to Liman et al. [38], when individuals experience moderate anxiety about their mathematical abilities, they can engage more deeply with the material and work harder to overcome challenges. The pressure to produce correct results and explanations, as rationalism emphasises [39], can be heightened by mathematics anxiety, motivating individuals to double-check their work, seek additional help, and refine their understanding.

Furthermore, individuals with mathematics anxiety might develop stronger problem-solving

skills. The need to ensure the correctness of their solutions could lead them to approach problems more systematically, relying on logical thinking and deductive reasoning. This aligns with the rationalist perspective on mathematics, where theory and logic are essential components. Students must confidently rely on generalisable mathematical techniques [40].

However, Seah and Bishop [35] suggest that rationality's emphasis on correctness can exacerbate the negative impact of mathematics anxiety. When individuals focus solely on getting the right answers, they may become more anxious about making mistakes. This can lead to a fear of failure, making them hesitant to take risks or tackle challenging problems. Consequently, they might prefer safer, easier tasks that do not promote substantial learning and growth.

2.5 Mathematics Anxiety and Control

The value of control emphasises the application of mathematics to its inherent nature and challenges and solutions within societal contexts [35]. Mathematics produces results with definitive answers subject to verification and oversight [12]. Control in mathematics refers to students' perception of their ability to manage and influence mathematical outcomes. To have control over mathematical outcomes, students need to rely on generalisable mathematical techniques confidently [40].

Mathematics anxiety, paradoxically, can heighten awareness and attention to detail [41]. Students experiencing mathematics anxiety may engage more deeply with mathematical problems, striving to understand concepts and double-checking calculations [20]. This increased sensitivity to detail can foster a greater appreciation for mathematics's precision and certainty. Consequently, students may invest extra effort in mastering mathematical concepts and procedures, ultimately strengthening their sense of control over mathematics. This positive impact is particularly evident when individuals overcome their anxiety and succeed in solving mathematical problems, leading to a sense of accomplishment and increased confidence in their ability to control mathematical outcomes.

Conversely, mathematics anxiety can undermine the sense of control that mathematics typically provides [42]. The fear of making mistakes or failing to grasp concepts can lead to avoidance behaviour. Students may shy away from challenging mathematical tasks, missing opportunities to practice and refine their problem-solving skills. This avoidance can perpetuate a cycle of reduced exposure to mathematics, limiting the development of a strong sense of control. Furthermore, anxiety can interfere with cognitive functioning, making it difficult for individuals to focus on the task at hand [42]. This cognitive interference can lead to errors and inaccuracies, eroding their sense of control over mathematical outcomes.

2.6 Mathematics Anxiety and Critical Thinking

The significance of mathematics in cultivating critical thinking cannot be overstated. Beyond being a compilation of numbers, formulas, and equations, mathematics is a potent tool for nurturing and enhancing critical thinking abilities [12]. Learning mathematics enhances critical thinking. Targeted learning experiences are crucial for students' conceptual understanding, enabling them to employ various concurrent strategies in developing functional thinking [43].

According to Dollah [37], mathematics plays a pivotal role in developing critical thinking skills due to its emphasis on logical reasoning, problem-solving, and analytical thinking. It encourages individuals to approach problems systematically, break them down into manageable steps, and apply various mathematical concepts to arrive at solutions. As noted by Chin and Lin [44], engagement with mathematics can lead to increased self-confidence in problem-solving. As individuals become more proficient in mathematical concepts and their applications, they develop a sense of mastery over challenges. This accomplishment improves mathematical abilities and bolsters self-assurance in tackling complex issues. Mathematical problem-solving serves as a practice ground for building resilience, as each successfully solved problem reinforces the idea that difficult challenges can be overcome with the right approach.

However, Widyaningsih et al. [45] assert that mathematics anxiety can significantly impede the realisation of mathematics' value in critical thinking. Mathematics anxiety refers to feelings of apprehension, tension, and fear associated with mathematical tasks [31]. This anxiety can distort an individual's perception of mathematics, turning it from a tool for critical thinking into a source of stress and discomfort. When math anxiety takes hold, the focus shifts from logical

reasoning to negative emotions, hindering the development of effective problem-solving skills. Additionally, Geist [39] noted that mathematics anxiety can lead to avoidance behaviour, where individuals deliberately shy away from mathematical tasks to evade the associated anxiety. This avoidance perpetuates a cycle where the lack of practice further weakens mathematical skills, which fuels more anxiety. Consequently, students may miss opportunities to refine their critical thinking abilities through mathematical exploration. The link between mathematics anxiety and hindered critical thinking underscores the need to address emotional barriers alongside cognitive ones [45].

3. THEORETICAL BACKGROUND

This study will be anchored on the social cognitive theory.

3.1 The Social Cognitive Theory (SCT)

The Social Cognitive Theory (SCT) serves as a fundamental conceptual framework in psychology and sociology, offering models for behaviour modification and actionable guidance. Developed by Albert Bandura in the latter part of the 20th century [46], SCT posits that personal, behavioural, and environmental factors collaboratively shape individuals' behaviour and influence behaviour change [47].

Within the realm of SCT, the personal aspect encompasses perceived self-efficacy, knowledge, and outcome expectations relevant to behaviour adoption. Specifically, individuals must believe in their capacity to effect change (self-efficacy) for behaviour change to manifest. Furthermore, favourable anticipated outcomes increase the likelihood of engaging in specific behaviours. In mathematics anxiety, students harbouring doubts about their ability to excel may exhibit lower self-efficacy in mathematical tasks, potentially impeding their critical thinking abilities when confronted with mathematical challenges. Consequently, we hypothesise that secondary school students in Nigeria with higher levels of mathematics anxiety will demonstrate diminished levels of critical thinking in mathematics.

As another facet of SCT, knowledge relates to the skills required to execute specific behaviours. As Rotter, Miller, and Dollard discussed, social cognitive theory accentuates the role of observation, imitation, and modelling in learning [48]. Critical thinking, characterised by rational judgment and analytical thinking, complements creative thinking and holds particular significance in evaluating concepts [49]. The influence of critical thinking on creative thinking transpires during this rational thought process [50]. Moreover, individuals with varying critical thinking dispositions exhibit distinct cognitive processing of creative information, delineated by differences in neural mechanisms [51].

The individual's actions, methods, and goals significantly influence behaviour change [52]. Within SCT, a pivotal aspect is a triadic interplay among personal, behavioural, and environmental components. In the context of mathematics anxiety, students questioning their ability to excel may experience reduced self-efficacy in mathematical tasks, potentially obstructing their critical thinking abilities when facing mathematical challenges. This reciprocal determinism is an enduring and dynamic process, consistently moulding individuals' behavioural inclinations [53]. Social support assumes particular importance in nurturing self-efficacy during behaviour change, underscoring the interconnected nature of these variables within the triad [54]. Students benefiting from encouragement and support from teachers or peers may develop a heightened sense of control over their mathematical performance. Conversely, environmental hindrances, such as resource deficits or negative peer influences, may undermine students' perceived control over math-related tasks.

Amaya and Petosa [55] emphasise the cognitive dimension within SCT, illuminating how internal norms and self-evaluative reactions inspire and regulate behaviours and inclinations toward behaviour change. In summation, SCT presents a comprehensive framework for comprehending behaviour, its adaptation, and the pivotal role of cognition in self-regulation [55].

The Social Cognitive Theory accentuates the significance of critical thinking, rationality, and control in learning and decision-making. Consequently, this study postulates that secondary school students in Nigeria afflicted with heightened levels of mathematics anxiety may encounter reduced control over their mathematical outcomes, potentially correlated with diminished rationality in mathematical problem-solving, and manifest lower levels of critical thinking in mathematics. The three null hypotheses of this study are;

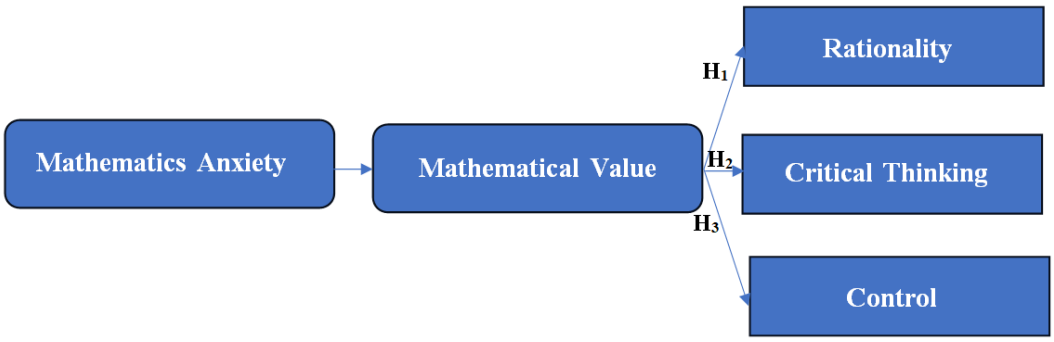

Fig. 1. Proposed model

H_1: Mathematics anxiety does not significantly impact the rationality of decision-making among secondary school students in the South West of Nigeria.

H_2: There is no significant relationship between mathematics anxiety and the critical thinking abilities of secondary school students in the South West of Nigeria.

H_3: Mathematics anxiety among secondary school students in the South West of Nigeria does not significantly influence their ability to control mathematical concepts.

4. METHODOLOGY

4.1 Research Framework

The research framework employed in this study is based on Saunders, Lewis, and Thornhill's [56] "Research Onion diagram." The layers of this diagram were utilised to select the most suitable research strategy, as illustrated in the corresponding chapter.

4.2 Research Philosophy

The choice of a philosophical framework is a critical decision in any research endeavour, as it shapes the approach, methodology, and interpretation of findings. This study has embraced a positivist perspective and employs scientific methods to formulate comprehensive causal-explanatory hypotheses for understanding the relationship between organisational culture and employee performance. Positivism, aligned with methodologies prevalent in the natural sciences, predicates its approach to empirical investigation as the sole route to genuine understanding. Given the study's objectives, this approach is more appropriate than interpretivism and realism. While realists, like positivists, collect and analyse data, they do not apply the same methods as natural scientists [57,58]. Interpretivism, on the other hand, prioritises qualitative research methods over scientific ones when investigating social phenomena [59, 56]. Positivism prioritises empirical evidence and seeks to establish causal relationships through systematic observation and measurement. In the case of mathematics anxiety and its impact, a positivist approach allows for the collection of quantifiable data, such as surveys, standardised tests, and academic performance records, to rigorously assess the relationship between variables.

4.3 Research Approach

The two principal research strategies are deductive and inductive methodologies. Deductive reasoning is the more suitable choice for this study, as its primary aim is to examine and assess the impact of mathematics anxiety on mathematical value. Deductive methods facilitate quantitative concept evaluation and elucidate causal relationships between factors and concepts [60]. In contrast to an inductive approach, which is prone to imperfections and may yield erroneous inferences even from reliable observations, this method provides the researcher with a definitive and conclusive response to the initial question or hypothesis. This deductive approach resonates harmoniously with the tenets of positivist philosophy. A deductive approach facilitates the generalizability of findings beyond the specific case study in South West Nigeria. By testing hypotheses derived from existing theory, this study will draw conclusions that apply to a broader population of secondary school students. This generalizability is crucial for informing educational policies and practices on a national or even international scale.

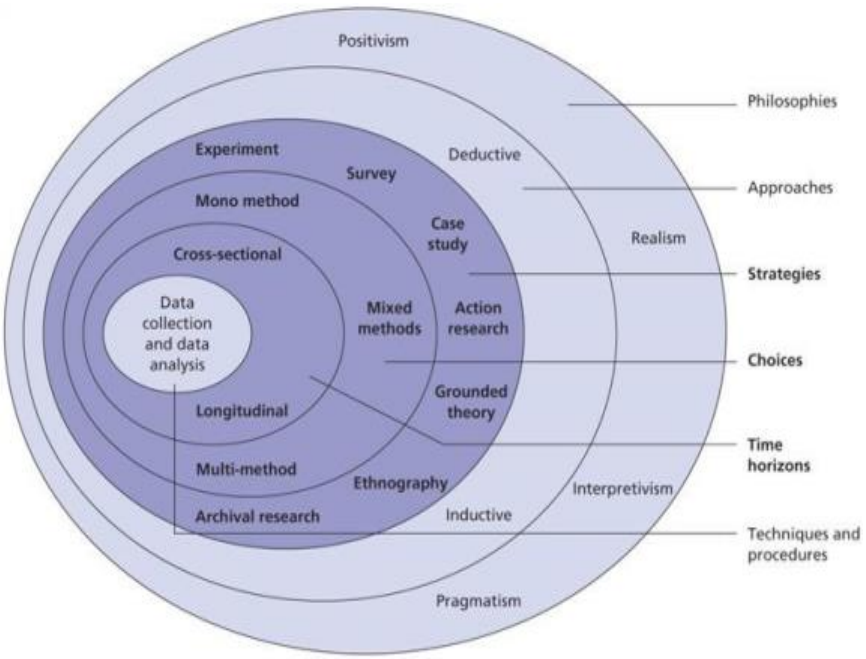

Fig. 2. The Research Onion Source [56]

4.4 Research Strategy

For this study, the chosen research method is survey research. This approach is favoured over other research methods due to its ability to efficiently collect data from a sizable cohort and access-tested models, enabling the acquisition of substantial and reliable data [61]. The survey research strategy primarily employs quantitative data collection methods, which align well with measuring mathematics anxiety and its impact on mathematical value. Surveys allow for the systematic measurement of variables through standardised scales, which is critical for assessing the extent and nature of these impacts in a structured and quantifiable manner. The survey approach is well-suited for generating data informing practical interventions and educational policies. The findings will provide actionable insights into addressing mathematics anxiety in secondary school settings, potentially improving students' mathematical abilities and cognitive skills.

4.5 Research Choices

This study adopts the mono method as a research choice because this study focuses on quantifying relationships and assessing the impact of mathematics anxiety on students' mathematical values straightforwardly and objectively. A mono-method approach is considered to be appropriate for straightforward quantitative assessments. The mono-method approach aligns with objective measurement and hypothesis testing principles, which are fundamental in deductive research.

4.6 Time Dimension

This study adopts cross-sectional as a time dimension. Conducting a longitudinal study would require tracking the same group of students over an extended period, which may involve repeated data collection and follow-ups. However, this study will collect data from different students at a single point in time. This efficiency is especially important because primary data will be collected from secondary school students who are expected to have a busy academic schedule. This study addresses issues of mathematics anxiety and its impact on students' mathematical abilities; it is important to obtain timely results. Cross-sectional data collection and analysis provide a more immediate understanding of current affairs, which may be essential for informing educational practices and interventions.

4.7 Sampling

In this research, non-probability sampling was employed to investigate real-world phenomena. This approach involves the deliberate selection

of participants from the target population. The choice of this sampling strategy was driven by its compatibility with the time constraints imposed by research projects. Convenience sampling and purposive sampling techniques were used for this study. This study collected data from 130 secondary schools in the Southwest geopolitical zone of Nigeria. Nigeria is the most populous in Africa [62]. The southwestern region of Nigeria is one of the country's six geopolitical zones and is known for its rich cultural heritage, economic significance, high interest in education, and diverse population. The southwestern region comprises six states: Lagos, Ogun, Oyo, Osun, Ekiti, and Ondo. The minimum sample size for each state is 500 senior secondary school students. There are 30 observed variables in this study; therefore, for each state, the minimum sample size is 10 x 30 = 300.

4.8 Data Collection Methods

For this study, which aims to investigate the impact of mathematics anxiety on mathematical value, the primary data collection method was done using a questionnaire administered online through Google Scholar. This approach has been chosen to gather data, allowing for more precise and dependable results compared to secondary data collection [61]. The questionnaire confers advantages by fostering respondent anonymity and adhering to the principles of the positivist paradigm, wherein data collection is executed objectively and subsequently subjected to descriptive analysis [63]. Primary data collection is advantageous because it is closer to the source, reducing potential inaccuracies with secondary data, which relies on third parties. Additionally, obtaining precise information directly from the respondents is expected to simplify the data collection process [64]. Using Google Forms, an online survey tool, facilitated the development of the self-administered questionnaire, ensuring participant responses were collected with minimal researcher interference while maintaining participant anonymity. Subsequently, a pilot test involving five schools in Osogbo, Osun state, validated the questionnaire's clarity and assessed instrument validity and reliability.

4.9 Questionnaire Administration

To better understand organisational culture, this study explores the psychological attributes, beliefs, values, social perspectives, and behaviours of secondary school students in South West of Nigeria on mathematics anxiety. These aspects will be assessed by examining three key pillars of mathematical value: Rationality, Critical Thinking, and Control. To assist with disseminating the online survey, mathematics teachers and school principals were contacted through their different associations. After explaining the study's goals to the contact persons in the secondary schools in Nigeria and seeking their consent, the link to the questionnaire was delivered by email and WhatsApp groups and the principals and mathematics teachers were asked to share the link with their students and encourage the students to take it home to their parents to inform their parents about the survey if the parents and the student connect to the survey, the questionnaire should be filled.

4.10 Data Analysis

The study analysed data collected from students in 130 secondary schools in the South West of Nigeria through an online survey using SPSS, Jamovi, and SAS. The demographic information was described using percentages to fulfil the study's objectives. Descriptive statistics are suitable for identifying data patterns and evaluating multivariate hypotheses.

The following stages are used to analyse the collected data:

This study evaluates the validity of the variables using Cronbach's Alpha test. In this study, the criteria for assessment entail removing observation variables with a correlation coefficient of less than 0.3, as these variables provide minimal contribution to the measured concept. In selecting the scale for this study, the reliability of Cronbach's Alpha exceeding 0.6 was a key consideration. Exploratory Factor Analysis (EFA) was also used to ensure no data was lost. These conditions encompass Bartlett's test significance at 0.05, a factor loading of at least 0.5, and a variance percentage exceeding 50%. The four variables identified were further analysed using simple linear regression, which establishes a regression equation by assessing the effect of mathematics anxiety on mathematical value variables. In this study, the dependent variable is mathematics anxiety, while the independent variables comprise Critical Thinking in Mathematics, Rationality in Mathematics, and Control in Mathematics. Jamovi software, SPSS, and SAS aid in analysing survey data that enables generalisable findings concerning respondents' responses. The

Variance Inflation Factor (VIF) was used to assess multicollinearity in the regression analysis. Multicollinearity is a statistical issue that arises when two or more independent variables in a regression model are highly correlated. A VIF between 1 and 3 is generally considered acceptable, with low multicollinearity.

5. RESULTS

The descriptive analysis provides valuable insights into the effect of mathematics anxiety on secondary school students in the South West of Nigeria, focusing on three mathematical value elements. Table 1 suggests gender-related disparities in class preferences among students; however, the three arms of senior secondary schools in Nigeria participated in this study. The highest percentage of students, 64.9%, falls within the age group of 15 to 17 years because most of the respondents are in the last stage of secondary school. The data reveals that the majority of students, 60.3%, come from families with a size ranging from 3 to 6 members. Students with older siblings who are anxious about mathematics might be influenced by their siblings' negative beliefs about mathematics. The data shows that 60.0% of students liked mathematics, while 40.0% did not. This information is crucial in understanding the psychological aspect of mathematics anxiety and can aid in developing strategies to alleviate it.

In conclusion, this descriptive analysis provides a comprehensive overview of the demographics and preferences of secondary school students in South West Nigeria about mathematics anxiety. It underscores the need for targeted interventions and educational approaches that consider gender, age, family size, and students' attitudes towards mathematics to address and mitigate mathematics anxiety effectively.

5.1 Reliability Test

The Cronbach's Alpha analysis results provide valuable insights into the impact of mathematics anxiety on the mathematical value of secondary school students in South West Nigeria. This study involved a substantial sample size of 2,939 secondary school students, enhancing the findings' reliability.

Table 1. Descriptive analysis of demographic data

Criteria			Gender	
			Male	Female
Arm of class	Arts class	Frequency	332	185
		Percentage	64.2%	35.8%
	Commercial class	Frequency	302	182
		Percentage	62.4%	37.6%
	Science class	Frequency	1144	794
		Percentage	59.0%	41.0%
Age of students	Below 13 years	Frequency	8	0
		Percentage	100.0%	0.0%
	13 -15 years	Frequency	530	445
		Percentage	54.4%	45.6%
	15 – 17 years	Frequency	1014	548
		Percentage	64.9%	35.1%
	Above 17 years	Frequency	226	168
		Percentage	57.4%	42.6%
Family Size	Less than 3	Frequency	32	8
		Percentage	80.0%	20.0%
	3 – 6	Frequency	1042	685
		Percentage	60.3%	39.7%
	More than 6	Frequency	704	468
		Percentage	60.1%	39.9%
Do you like mathematics	Yes	Frequency	1406	937
		Percentage	60.0%	40.0%
	No	Frequency	372	224
		Percentage	62.4%	37.6%

Table 2. Analysis of Cronbach's Alpha

Variables	Number of Items	Cronbach's Alpha
Critical Thinking in Mathematics	6	0.785
Rationality in Mathematics	5	0.827
Control in Mathematics	6	0.808
Mathematics Anxiety	8	0.769

As presented in Table 2, Critical Thinking in Mathematics, with a Cronbach's Alpha of 0.785, demonstrates a reasonably high level of internal consistency, suggesting that the six items used to assess this construct are reliable indicators. Similarly, the Rationality in Mathematics construct exhibits a high internal consistency, with a Cronbach's Alpha of 0.827 for the four items used. This suggests that the questions related to rationality in mathematics consistently measure this aspect among the surveyed students. Control in Mathematics, consisting of six items, also demonstrates a strong internal consistency with a Cronbach's Alpha of 0.808. This indicates that the questions used to assess control in mathematics are reliable measures and consistently reflect the construct. Mathematics Anxiety shows a Cronbach's Alpha of 0.769, suggesting a reasonable internal consistency level among the eight items assessing mathematics anxiety. This indicates that the questionnaire items related to mathematics anxiety generally measure this construct reliably within the study context.

In summary, Cronbach's Alpha values across all constructs are above 0.7, indicating good internal consistency for the items measuring each variable. These results strengthen the credibility of the study's findings and suggest that the questionnaire used in this research is a reliable tool for assessing critical thinking, rationality, control, and mathematics anxiety among secondary school students in South West Nigeria.

5.2 Factor Analysis for the Independent Variable

Based on the aforementioned assessment of scale reliability, we performed a factor analysis of the variables. The results of the KMO measure of sampling adequacy and Bartlett's Test of Sphericity hold significant implications for the impact of mathematics anxiety on the mathematical value of secondary school students in South West Nigeria, as studied with a substantial sample size of 2,939 respondents.

Table 3 reveals a KMO coefficient of 0.825, falling within the range of 0.5 to 1, signifying excellent suitability for factor analysis. In addition, Bartlett's test resulted in a value of 33367.095 with a significance level (Sig.) of 0.000, below the customary threshold of 0.05. These outcomes collectively affirm the appropriateness of the data employed for factor analysis.

Table 4 illustrates that four factors were extracted from the observational variables with Eigenvalues exceeding 1 through the varimax rotation method. This factor extraction approach

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.825
Bartlett's Test of Sphericity	Approx. Chi-Square	33367.095
	df	300
	Sig.	.000

Table 4. Eigenvalues and covariance deviations

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	6.508	26.033	26.033
2	3.158	12.631	38.664
3	2.017	8.068	46.732
4	1.851	7.403	54.135

Table 5. Summary of Regression Analysis of mathematics anxiety on rationality of decision-making

	Unstandardised Coefficients		t Value	Pr > |t|	Model Summary		VIF
Variable	**Parameter Estimate**	**Standard Error**					
Intercept	4.073	.053	76.254	.000	**R-Square**	0.7991	
Mathematics anxiety	-.300	.017	-17.883	.000	**Adj R-Square**	0.7990	1.248

a. Predictors: Mathematics anxiety.
b. Dependent Variable: Rationality of decision-making

resulted in a total variance of 54.135%, surpassing the recommended threshold of 50%. Eigenvalues represent the variance explained by each component in the factor analysis. In this case, the initial Eigenvalues for the first four components are 6.508, 3.158, 2.017, and 1.851, respectively. These values reveal the proportion of variance attributed to each component. The first component accounts for 26.033% of the total variance, followed by the second component at 12.631%.

5.3 Testing of hypotheses

H_1: Mathematics anxiety does not significantly impact the rationality of decision-making among secondary school students in the South West of Nigeria.

The R-squared value is 0.7991, as presented in Table 5. This represents the proportion of variance in the rationality of decision-making that can be explained by mathematics anxiety in the model. In this case, approximately 79.91% of the variance in rationality can be explained by mathematics anxiety. The remaining 20.09% account for other mathematical values that can be influenced by mathematics anxiety but are not included in this model. The VIF for mathematics anxiety is 1.248, indicating that multicollinearity is not a significant issue in this regression analysis.

5.4 Rationality of decision-making = 4.073 - 0.300 (Mathematics anxiety) Equation 1

As presented in Table 5, the intercept is 4.073. This represents the estimated rationality of decision-making when mathematics anxiety equals 0. It implies that when there is no mathematics anxiety, the estimated rationality score is 4.073. The coefficient for mathematics anxiety is -0.300. This indicates the change in the estimated rationality of decision-making for each unit increases in mathematics anxiety. Equation 1 suggests that as mathematics anxiety rises, the rationality of decision-making tends to decrease.

The "t Value" for the predictor variable "Mathematics anxiety" is -6.278. And the critical t-tabulated value ($t_{0.05,\ 2928}$) is 1.96. This means that mathematics anxiety has a statistically significant impact on the rationality of decision-making among secondary school students in the South West of Nigeria. Therefore, the null hypothesis is rejected, and it can be concluded that mathematics anxiety significantly negatively impacts the rationality of decision-making among secondary school students in the South West of Nigeria.

H_2: There is no significant relationship between mathematics anxiety and the critical thinking abilities of secondary school students in the South West of Nigeria.

Table 6. Summary of Regression Analysis of mathematics anxiety on critical thinking abilities

	Unstandardised Coefficients		t Value	Pr > |t|	Model Summary		VIF
Variable	**Parameter Estimate**	**Standard Error**					
Intercept	3.614	.063	57.642	.000	R-Square	0.5451	
Mathematics anxiety	-.115	.018	-6.438	.000	Adj R-Square	0.5450	1.589

a. Predictors: Mathematics anxiety
b. Dependent Variable: Critical thinking abilities

As presented in Table 6, the R-Square (0.5451) represents the proportion of the variance in critical thinking abilities that the regression model explains. It is approximately 54.51% of the variance in critical thinking abilities can be explained by mathematics anxiety. The remaining 45.49% account for other mathematical values that can be influenced by mathematics anxiety but are not included in this model. The VIF for mathematics anxiety is 1.589, indicating that multicollinearity is not a significant issue in this regression analysis.

5.5 Critical Thinking Abilities = 3.614 - 0.115 (Mathematics anxiety) Equation 2

The intercept (3.614) represents the estimated value of critical thinking abilities when the mathematics anxiety is zero. It suggests that the estimated critical thinking ability score is 3.614 when mathematics anxiety is zero. The t-value of 6.438 is highly significant because it is bigger than the critical t-tabulated value ($t_{0.05,\ 2928}$) = 1.96, indicating that the intercept is significantly different from zero. The coefficient for mathematics anxiety (-0.115) represents the change in the predicted value of critical thinking abilities for each unit change in mathematics anxiety. In this study, as mathematics anxiety increases by one unit, critical thinking abilities are predicted to decrease by 0.115 units. The t-value of 9.045 is highly significant ($t_{0.05,\ 2928}$=1.96), indicating that the relationship between mathematics anxiety and critical thinking abilities is statistically significant.

In summary, the results of this simple linear regression model suggest a significant and negative relationship between mathematics anxiety and critical thinking abilities among secondary school students in South West Nigeria. The model accounts for a substantial portion of the variance in critical thinking abilities (approximately 54.51%), and the intercept and mathematics anxiety coefficients are highly significant, indicating the strength of this relationship. The null hypothesis, which states no significant relationship, can be rejected based on these results.

H_3: Mathematics anxiety among secondary school students in the South West of Nigeria does not significantly influence their ability to control mathematical concepts.

As presented in Table 7, the R-squared value (0.6964) represents the proportion of variance in the ability to control mathematical concepts that can be explained by mathematics anxiety. Approximately 69.64% of the variance in the ability to control mathematical concepts is explained by mathematics anxiety. This suggests a moderately strong relationship between mathematics anxiety and the ability to control mathematical concepts. The VIF for mathematics anxiety is 1.526, indicating that multicollinearity is not a significant issue in this regression analysis.

5.6 Ability to Control Mathematical Concepts = 3.745 - 0.184 (Mathematics Anxiety) Equation 4.3

The intercept (3.745) represents the estimated value of the ability to control mathematical concepts when mathematics anxiety is zero. The t-value of 10.512 is highly significant ($t_{0.05,\ 2928}$ is 1.96), indicating that the intercept significantly differs from zero. The coefficient for mathematics anxiety is -0.184. This suggests that for each unit increase in mathematics anxiety, the ability to control mathematical concepts decreases by 0.184 units. The negative sign suggests an inverse relationship, meaning higher mathematics anxiety is associated with a lower ability to control mathematical concepts. The t-value of 10.512 is also highly significant ($t_{0.05,\ 2928}$=1.96), indicating that mathematics anxiety significantly affects the ability to control mathematical concepts.

Table 7. Summary of Regression Analysis of mathematics anxiety on the ability to control mathematical concepts

	Unstandardised Coefficients		t Value	Pr > |t|	Model Summary		VIF
Variable	**Parameter Estimate**	**Standard Error**					
Intercept	3.745	.054	68.810	.000	R-Square	0.6964	
Mathematics anxiety	-.184	.017	-10.512	.000	Adj R-Square	0.6963	1.526

a. Predictors: Mathematics anxiety

b. Dependent Variable: Ability to control mathematical concepts

In conclusion, the null hypothesis is rejected based on the results of this simple linear regression analysis. The highly significant negative coefficient for mathematics anxiety suggests that there is a significant negative influence of mathematics anxiety on the ability to control mathematical concepts among senior secondary schools in the South West of Nigeria.

6. RESULTS AND DISCUSSION

In line with existing literature, this study establishes the prevalence of mathematics anxiety among secondary school students in South West Nigeria, consistent with prior research [18]. It characterises mathematics anxiety as a pervasive phenomenon marked by apprehension, tension, and fear in response to mathematical tasks. The prevalence of mathematics anxiety in this study aligns with global trends, highlighting its widespread presence as a psychological barrier to mathematical learning. This study's finding is consistent with studies showing that mathematics anxiety is associated with cognitive failure, including a lack of concentration [64]. Moyo [65] found that mathematics anxiety can significantly impact mathematics performance. Also, Salahot [66] found a positive relationship between mathematics anxiety and mathematics literacy self-efficacy, indicating that higher anxiety levels are associated with lower self-efficacy in mathematics. Dağdelen & Yildiz [67] found that mathematics anxiety has a negative effect on mathematical proficiency, while cognitive independence has a positive effect.

One key research finding concerns the impact of mathematics anxiety on secondary school students' decision-making rationality. It reveals that students experiencing moderate mathematics anxiety demonstrate heightened rationality in mathematical problem-solving, in line with Liman, Ibrahim, and Ismail's [36] argument that moderate anxiety can motivate deeper engagement with mathematical material and prioritise accuracy. However, excessive mathematics anxiety, leading to a fear of failure, may discourage students from taking risks and tackling challenging problems. This aligns with research indicating that mathematics anxiety impedes logical reasoning and problem-solving [2]. The theoretical framework of the SCT further supports this finding by emphasising the role of self-efficacy in behaviour modification.

This study unveils a significant and negative relationship between mathematics anxiety and critical thinking among secondary school students, confirming the research by Widyaningsih, Waluya, and Kurniasih [44], which suggests that mathematics anxiety can hinder critical thinking skill development in mathematics education. This underscores the importance of addressing emotional barriers posed by mathematics anxiety alongside cognitive skill development to nurture well-rounded mathematical thinkers. This finding aligns with the literature review's emphasis on mathematics' role in nurturing critical thinking skills [35] and how mathematics anxiety can impede logical reasoning and problem-solving [16]. The findings of this study also support the findings of Allen and Vallée-Tourangeau [68], who found that anxiety constrains working memory capacity and attentional functions, which can impede performance in arithmetic tasks.

The study's results highlight mathematics anxiety's substantial and significant impact on students' control of mathematical concepts. It concurs with the works of Bishop [40] and Pearn and Stephens [38], suggesting that mathematics anxiety can either motivate individuals to invest extra effort in mastering mathematical concepts or, conversely, lead to avoidance behaviour and reduced exposure to mathematics. This underscores the importance of addressing anxiety-related challenges in the classroom to support students in developing a strong sense of control over mathematical outcomes. This finding is also consistent with the literature, which emphasises the value of control in mathematics education [33] and highlights how mathematics anxiety can disrupt an individual's sense of control over mathematical outcomes [40].

7. CONCLUSION

The culmination of this research on the impact of mathematics anxiety on the mathematical value of secondary school students in Nigeria, particularly within the South West region, offers valuable insights into the complex interplay between emotions and educational outcomes. Drawing upon the comprehensive analysis of results and an extensive exploration of the existing literature, this conclusion encapsulates the key findings and their broader implications for the field of education.

As a multifaceted process, education encompasses more than knowledge and skills acquisition; it entails the intricate interplay of

psychological factors that shape individuals' engagement with and absorption of educational experiences. In light of the empirical evidence presented in this study, it is evident that mathematics anxiety is a critical factor that significantly influences the mathematical value cultivated among secondary school students in Nigeria. The study's findings corroborate the existing body of literature, emphasising the profound impact of mathematics anxiety on students' rationality, critical thinking abilities, and control over mathematical concepts.

The relationship between mathematics anxiety and rationality is multifaceted. While moderate levels of anxiety can motivate students to engage more deeply with mathematical problems, the fear of making mistakes or failing can hinder rational thought processes. This dichotomy highlights the need for educators to strike a delicate balance between promoting accuracy in mathematical outcomes and fostering an environment where students are encouraged to take calculated risks in problem-solving.

Critical thinking, a pivotal component of mathematical value, is undeniably affected by mathematics anxiety. The study elucidates how anxiety can divert students' focus from logical reasoning to negative emotions, impeding the development of effective problem-solving skills. Furthermore, the study underscores the importance of recognising that students experiencing mathematics anxiety may engage more deeply with mathematical problems, striving to understand concepts and double-check calculations. Harnessing this heightened attention to detail can be a potential avenue for educators to promote critical thinking skills. Control over mathematical concepts is intricately linked to mathematics anxiety, as evidenced by the study's results. While anxiety can motivate students to invest extra effort in mastering mathematical concepts, it can also lead to avoidance behaviour, perpetuating a cycle of reduced exposure to mathematics and eroding students' sense of control. This highlights the need for tailored interventions that address anxiety-related challenges while encouraging students to approach mathematical tasks confidently.

In the broader context of the education sector in Nigeria, this study carries profound implications. It calls for increased awareness of mathematics anxiety among educators, policymakers, and educational stakeholders. Strategies to destigmatise mathematics anxiety and provide targeted support for affected students are paramount. Curriculum reforms should prioritise emotional well-being as a fundamental aspect of education, and teacher training programs should equip educators with the tools to address anxiety-related challenges effectively.

In conclusion, this study illuminates the significant role played by mathematics anxiety in shaping the mathematical value of secondary school students in Nigeria. It emphasises the need for a holistic approach to education that recognises students' emotional well-being and cognitive development. By addressing mathematics anxiety and its effects, educational institutions can foster an environment conducive to the growth of well-rounded individuals equipped with the skills and values necessary for success in mathematics and beyond.

8. RECOMMENDATIONS

Educators should incorporate inclusive mathematics education practices that cater to diverse learning needs. This will also help the teachers not to feel stressed. When teachers feel overwhelmed and stressed, they are more susceptible to burnout, characterised by emotional exhaustion, reduced personal accomplishment, and depersonalisation. Inclusive mathematics education practices may involve differentiated instruction, personalised support for students with mathematics anxiety, and real-life examples to make mathematical concepts relatable and engaging for all students.

Educators should reconsider traditional assessment practices and explore alternative approaches that reduce mathematics anxiety. This may involve implementing formative assessments, peer assessments, open-book assessments, or other methods that allow students to demonstrate their understanding without the added pressure of time constraints.

Educational institutions should offer teacher training programs that equip educators with the skills to recognise signs of mathematics anxiety among students and implement strategies to create a supportive learning environment. This training should also emphasise promoting self-efficacy and a growth mindset.

Policymakers should develop education policies that recognise and address the emotional aspects of learning. These policies should prioritise holistic education and support initiatives that foster emotional well-being among students,

thereby creating an environment conducive to the development of mathematical value.

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

1. Seah WT. Values in mathematics education: Its conative nature, and how it can be developed. Research in Mathematical Education. 2019;22(2):99-121.
2. Jablonka E. Critical thinking in mathematics education. Encyclopedia of mathematics education. 2020;159-163.
3. Olango M. Mathematics Anxiety Factors as Predictors of Mathematics Self-Efficacy and Achievement among Freshmen Science and Engineering Students. African Educational Research Journal. 2016;4(3): 109-123.
4. Halstead M, Taylor MJ. Values in education and education in values. Routledge; 2005.
5. Matthews BM. The relationship between values and learning; 2001.
6. Clarkson PC, Bishop A. Values and mathematics. In A. Ahmed, J. Kraemer & K. Williams (Eds.), Cultural diversity in mathematics education. Chichester, U.K.: Horwood; 2000:239-244.
7. Tapsir R, Nik Pa, NA, Zamri SNABS. Reliability and validity of the instrument measuring values in mathematics classrooms. Malaysian Online Journal of Educational Sciences. 2018;6(2):37-47.
8. Sam LIMC, Ernest P. Values in mathematics education: What is planned and what is espoused. British Society for Research into Learning Mathematics. 1997;37.
9. Bishop AJ. What values do you teach when you teach mathematics?. Teaching Children Mathematics. 2001;7(6):346-346.
10. Atoyebi SB, Awodutire PO, Igbalajobi MM, Anifowose OO. Survival Times of Breast Cancer Patients in Nigeria. Asian Journal of Immunology. 2023;6(1):209–223.
11. Jordan JA, McGladdery G, Dyer K Dyslexia in higher education: implications for maths anxiety, statistics anxiety and psychological well-being. Dyslexia. 2014; 20(3):225–240.
12. Bishop A, FitzSimons G, Seah WT, Clarkson P. Values in Mathematics Education: Making Values Teaching Explicit in the Mathematics Classroom; 1999.
13. Stange JP, Hamilton JL, Abramson LY, Alloy LB. A vulnerability-stress examination of response styles theory in adolescence: Stressors, sex differences, and symptom specificity. Journal of Clinical Child & Adolescent Psychology. 2014;43(5):813-827.
14. Remillard JT, Heck DJ. Conceptualising the curriculum enactment process in mathematics education. Zdm. 2014;46: 705-718.
15. Angelidis A, Solis E, Lautenbach F, van der Does W, Putman P. I'm going to fail! Acute cognitive performance anxiety increases threat-interference and impairs WM performance. PloS one. 2019;14(2): e0210824.
16. Atoyebi SB, Olayiwola MF, Oladapo JO, Oladapo DI. Forecasting Currency in Circulation in Nigeria Using Holt-Winters Exponential Smoothing Method. South Asian Journal of Social Studies and Economics. 2023;20(1):25-41
17. Geist E. The anti-anxiety curriculum: Combating math anxiety in the classroom. Journal of Instructional Psychology. 2010; 37(1).
18. Atoyebi OM, Atoyebi SB. A Meta-analytic Review of the Relationship between Mathematics Anxiety and the Mathematical Thinking of Africa Students. Archives of Current Research International. 2022; *22*(7):15-28.
19. Dowker A, Sarkar A, Looi CY. Mathematics anxiety: What have we learned in 60 years?. Frontiers in psychology. 2016;7: 508.
20. Atoyebi OM, Atoyebi SB. The causes of anxiety in mathematics among private secondary school students: A case study of students in Egbedore Local Government, Osun State, Nigeria. Adeleke University Journal of Science. 2022;1(1): 267-280.
21. Namkung JM, Peng P, Lin X. The relation between mathematics anxiety and mathematics performance among school-aged students: A meta-analysis. Review of Educational Research. 2019;89(3):459-496.

22. Buckley S, Reid K, Goos M, Lipp OV, Thomson S. Understanding and addressing mathematics anxiety using perspectives from education, psychology and neuroscience. Australian Journal of Education. 2016;60(2):157-170.
23. Tobias S. Overcoming math anxiety. WW Norton & Company; 1993.
24. Posamentier AS, Smith BS, Stepelman J. Teaching secondary mathematics: Techniques and enrichment units. (No Title); 2010.
25. Luttenberger S, Wimmer S, Paechter M. Spotlight on math anxiety. Psychology research and behavior management. 2018;311-322.
26. Wei Q. Dissertation: The effects of pedagogical agents of mathematics anxiety and/or learning. Logan: Utah State University; 2010.
27. Atoyebi OM, Atoyebi SB. Do technology–based approaches reduce mathematics anxiety? A Systematic literature. International Journal of Research and Innovation in Social Science (IJRISS). 2022;6(10):502-509.
28. Öztop F. Effectiveness of Digital Technology Use in Mathematics Instruction on Reducing Students' Mathematics Anxiety: A Meta-Analysis; 2023.
29. Mahmud MS, Zainal MS, Pa WAMW. August. Challenges of Special Education Teachers in Inclusive Mathematics Teaching in Primary Schools: A Preliminary Study. In Proceeding of International Conference on Special Education in South East Asia Region. 2023;2(1).
30. Abdillah A. Strengthening Preservice Teachers Conceptual Understanding of Linear Algebra by Using the Supplementary Book Integrated with the GeoGebra and Maple Applications. *Mathline:* Jurnal Matematika dan Pendidikan Matematika. 2023;8(2):705-724.
31. Atoyebi SB, Atoyebi OM. The link between mathematics teaching strategies and students' anxiety. Asian Journal of Education and Social Studies. 2022;33(4): 48-57.
32. Cao Z, Seah WT, Bishop AJ. A comparison of Mathematical values conveyed in Mathematics textbooks in China and Australia; 2005.
33. Seah WT. Exploring teacher clarification of values relating to mathematics education. Valuing mathematics in society. 2002:93-104.
34. Seah WT, Wong NY. Thematic issue on Values in East Asian mathematics education—The third wave. ZDM. 2012; 44:1-2.
35. Seah WT, Bishop AJ. Values in Mathematics Textbooks: A View through Two Australasian Regions; 2000.
36. Bishop AJ. Can values awareness help teachers and parents transition preschool learners into mathematics learning?. In Mathematics Education in the Early Years: Results from the POEM2 Conference, Springer International Publishing. 2016; 2014:43-56.
37. Dollah MU. Challenges in inculcation of the mathematical values in teaching Mathematics for secondary school (Challenges of application of mathematical value in secondary school mathematics teaching). Malaysian Science & Mathematics Education Journal. 2012;2(1): 38 – 50.
38. Liman MA, Ibrahim MB, Ismail Y. Exploration and evaluation of the mathematical values inculcation instrument. Journal of Language and Culture. 2013;4(1):10-17.
39. Lounsbury M. Institutional rationality and practice variation: New directions in the institutional analysis of practice. Accounting, organisations and society. 2008;33(4-5):349-361.
40. Pearn C, Stephens M. The importance of fractional thinking as a bridge to algebraic reasoning. Australian Association of Mathematics Teachers Inc. 2015;103.
41. Dede Y. Mathematics education values questionnaire for Turkish preservice mathematics teachers: Design, validation, and results. International Journal of Science and Mathematics Education. 2011;9(3):603-626.
42. Bishop AJ. Teachers' mathematical values for developing mathematical thinking in classrooms: Theory, research and policy. The Mathematics Educator. 2008;11(1/2): 79-88.
43. Wilkie KJ, Clarke DM. Developing students' functional thinking in algebra through different visualisations of a growing pattern's structure. Mathematics Education Research Journal. 2016;28:223-243.
44. Chin C, Lin FL. Values and values statement emerged in students

preferences on test items: A Case Study from Mathematical Induction. In W.S. Horng, & F.L. Lin (Eds.), Proceedings of the HPM 2000 Conference on History in Mathematics Education. Taipei, Taiwan: National Taiwan Normal University; 2000.

45. Widyaningsih E, Waluya SB, Kurniasih AW. Analysis of critical thinking ability of VII grade students based on the mathematical anxiety level through learning cycle 7E model. In Journal of Physics: Conference Series. 2018;983(1): 012-117.
46. Burney VH Applications of social cognitive theory to gifted education. Roeper Review, 2008;30(2);130-139.
47. Dennis EA, Potter KL, Estabrooks PA. Davy BM. Weight gain prevention for college freshmen: comparing two social cognitive theory-based interventions with and without explicit self-regulation training. Journal of obesity; 2012.
48. Krcmar M. Social cognitive theory. In Media Effects. Routledge. 2019;100-114
49. Jabarian B, Sartori E. Critical Thinking Via Storytelling; 2023.
50. Eslami AA, Norozi E, Hajihosseini M, Ramazani AA, Miri MR. Social cognitive theory as a theoretical framework to predict sustained abstinence 6 months after substance use treatment. Journal of substance use. 2018;23(3):300-306.
51. Miller NE, Dollard J. Social Learning and Imitation, 1941. New Haven; 1941.
52. Ramirez E, Kulinna PH, Cothran D. Constructs of physical activity behaviour in children: The usefulness of Social Cognitive Theory. Psychology of Sport and Exercise. 2012;13(3):303-310.
53. Munro S, Lewin S, Swart T, Volmink J. A review of health behaviour theories: how useful are these for developing interventions to promote long-term medication adherence for TB and HIV/AIDS?. BMC Public Health. 2007;7(1): 1-16.
54. Ginis KA, Hicks AL, Latimer AE, Warburton DER, Bourne C, Ditor DS, Goodwin DL, Hayes KC, McCartney N, McIlraith A, Pomerleau P. The development of evidence-informed physical activity guidelines for adults with spinal cord injury. Spinal cord. 2011; 49(11):1088-1096.
55. Amaya M, Petosa RL. An evaluation of a worksite exercise intervention using the social cognitive theory: A pilot study. Health Education Journal. 2012;71(2):133-143.
56. Saunders M, Lewis P, Thornhill A. Study methods for business students; 2019.
57. Bell E, Bryman A, Harley B. Business research methods. Oxford university press; 2022.
58. Hair Jr J, Page M, Brunsveld N. Essentials of business research methods. Routledge; 2019.
59. Slevitch L. Qualitative and quantitative methodologies compared: Ontological and epistemological perspectives. Journal of quality assurance in hospitality & tourism. 2011;12(1):73-81.
60. Saunders M, Lewis P. Doing research in business and management. Pearson; 2017.
61. Malhotra A, Bajaj K. A survey on various malware detection techniques on mobile platform. Int J Comput Appl. 2016;139(5): 15-20.
62. Atoyebi SB. Survival Times of Lung, Breast, Cervical, and Prostate Cancer Patients in Africa. Journal of Cancer and Tumor International. 2023; 13(1):9-28
63. Rehman AA, Alharthi K. An introduction to research paradigms. International Journal of Educational Investigations. 2016;3(8): 51-59.
64. Mosahab A. The Effect of Mathematics Anxiety on Cognitive Failures Among High School Students. European Journal of Education and Pedagogy. 2023;4(2):205-208.
65. Caleb Moyo. Secondary School Students' Mathematics Anxiety: A Zimbabwean Perspective. South American journal of academic research; 2023.
66. Salahot ED. The Effects of Mathematics Anxiety on Mathematics Performance among Secondary School Students in Tanzania: A Case of Arusha City Council. International Journal of Scientific Research and Management. 2022;10(12)
67. Dağdelen M, Yildiz A. The relationship between the secondary school students' mathematics anxiety and mathematical literacy self-efficacy. Journal of Computer and Education Research. 2022;10(20): 636 -655.

68. Allen M, Vallée-Tourangeau F. Interactivity defuses the impact of mathematics anxiety in primary school children. International Journal of Science and Mathematics Education. 2016;14:1553-1566

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