ANALYSIS OF THE INFLUENCE OF MOTIVATION AND AGE ON MATHEMATICS ANXIETY OF SECONDARY SCHOOL STUDENTS

Ukwuije, Chinedu K.
Chinendu.ukwuije@uniport.edu.ng
Department of Educational Psychology, G/C, Faculty of Education, University of Port Harcourt, Rivers State, Nigeria

&

Eteng-Uket, Stella
stella.eteng-uket@uniport.edu.ng
Department of Educational Psychology, G/C, Faculty of Education, University of Port Harcourt, Rivers State, Nigeria

Abstract

Secondary school mathematics, with its ever-increasing complexity, can be a source of both fascination and frustration for students. While some embrace the challenge, others grapple with a debilitating fear: mathematics anxiety which can significantly be influenced by motivation and age hence the need to explore this influence prompted this study that sought to investigate the influence of motivation and age on mathematics anxiety. The study employed the expo-facto research design. The population was 16530 secondary school students in 16 secondary schools in Obio-Akpor LGA of Rivers State. A mullti-stage sampling procedure that employed simple random, stratified and purposive was used to draw a sample size of 212 students. Two instruments, the Mathematics Anxiety Scale and the Motivation Scale was used in obtaining data. Validities were established and using Cronbach alpha, reliability coefficients of .73 and .76 was obtained for the two instruments respectively. The data were analyzed r, beta values, simple regressions, t-test associated with simple regression mean, standard deviation and independent t-test, Result showed an influence of motivation on mathematics anxiety that was not significant, it also showed that age had a significant influence on mathematics anxiety. It was recommended amongst others that there should be tailor support services and interventions to address the unique needs of students of different ages; younger students may benefit from targeted interventions focusing on building foundational mathematical skills and fostering a positive attitude toward mathematics while older students may require support in developing effective coping strategies and managing academic pressures.

Keyword; Mathematics Anxiety, Motivation, Age.

Introduction

Secondary school mathematics, with its ever-increasing complexity, can be a source of both fascination and frustration for students. While some embrace the challenge, others grapple with a debilitating fear: math anxiety. Dreger and Aiken (2017) defined mathematics anxiety as the presence of a syndrome of emotional reactions to arithmetic and mathematic. Tobias and Weissbrod (2010) saw it as the panic, helplessness, paralysis, and mental disorganization

that arises among some people when they are required to solve a mathematical problem. It is both an emotional and cognitive dread of mathematics.

Math anxiety is not simply a dislike for the subject. It's a deep-seated fear that manifests with various symptoms like physiological symptoms like increased heart rate, sweating, dizziness, or nausea during math class or tests. Cognitive symptoms like difficulty concentrating, negative thoughts about math ability, and a sense of impending doom when faced with math problems and behavioral symptoms like avoiding math classes or homework, procrastination, and participation withdrawal in math discussions. These symptoms can significantly hinder a student's ability to learn and perform well in math, creating a negative cycle that reinforces the fear.

The specific etiology of math anxiety is still unclear. Some reasons that have been explored are genetics (Wang et al., 2015), negative experiences in the classroom (Ashcraft et al., 2007; Bekdemir 2010), teacher attitudes towards math (Beilock, et al, 2010), and parent attitudes towards math (Maloney, et al, 2015). Mathematics anxiety can be influence by various factors and two factors that can significantly influence it are motivation and age.

Motivation, age and mathematics anxiety

Motivation can be an influencing factor in mathematics anxiety. According to Ederson (2017) motivation is literally the desire to act and move toward a goal. It's the difference between waking up before dawn to pound the pavement and lazing around the house all day. It's the crucial element in setting and attaining one's objectives Motivation might be extrinsic, whereby a student or individual is inspired by outside forces other people or things that transpire. Motivation might be intrinsic, whereby the inspiration comes from within a person or student.

Students who are intrinsically motivated, driven by a desire to learn and understand math concepts, are more likely to persist through challenges and setbacks. Furthermore, motivation plays a vital role in students' engagement with mathematics and their experience of mathematics anxiety. Intrinsic motivation, stemming from a genuine interest and enjoyment in mathematical activities, can buffer against mathematics anxiety by fostering a positive attitude towards learning and problem-solving. Conversely, extrinsic factors such as pressure to perform well on exams or fear of failure can contribute to heightened levels of mathematics anxiety. This is collaborated with, Ali (2019) and Jaesa et al., (2022) study which showed a significant moderate correlation between math anxiety and math motivation. And according to the study by Zakaria and Nordin (2008), research showed a connection between mathematics anxiety and achievement and mathematics anxiety and motivation. Understanding the influence between motivation and mathematics anxiety has become imperative as researches on the influence of motivation and mathematics anxiety is almost non-existent, thus this appears is highly underexplored and thus creates a research gap

The influence of age on mathematics anxiety is multifaceted and is a complex issue. Age is the length of time that a person or thing has existed. According to Eteng-Uket & Iruloh (2023), It is a measure of the time that an individual has been alive, typically measured and expressed in years. Some studies suggest that math anxiety may peak in middle school and decline slightly in secondary school. However, the increasing difficulty of math concepts at the secondary level can also exacerbate anxiety for some students. Additionally, social pressures and the looming

importance of standardized tests can further contribute to anxiety in older students. That is younger secondary school students may experience mathematics anxiety as they navigate the transition from elementary to secondary education, encountering more complex mathematical concepts and increased academic expectations. Conversely, older secondary school students may face heightened mathematics anxiety as they approach crucial academic milestones such as standardized exams or college entrance assessments. Recent evidence has demonstrated children as young as 6 and 7 years old have some level of math anxiety. This has also been collaborated by the assertion of by Tudla (2000) whose position suggested that age provides variability within mathematics anxiety group. Also, Hadfield and Mcneil (1994) found that age level is a significant predictor of mathematics anxiety among elementary students It is claimed that younger children do have mathematics anxiety, which may be as a result of malnutrition during development of the affective system. The magnitude of this deficit is expected to diminish as children grow older. However, Antonio, (2023) and Humbeer (1990) study revealed a no significant influence of age on maths anxiety. Same with a related study of Owolabi & Adejoke (2014)

Mathematics anxiety is a pervasive issue among students in West Africa, exerting a significant influence on their academic performance and career aspirations, particularly in STEM fields. Despite the acknowledgment of mathematics' crucial role in daily life and its necessity for higher education admission, a considerable number of students experience profound fear and avoidance when confronted with mathematical tasks. This anxiety manifests in various ways, including disrupted reasoning abilities, forgetfulness of previously learned material, and subpar performance in tests and examinations.

However, beyond the surface manifestations of mathematics anxiety lie deeper layers influenced by motivational factors and age-related developmental challenges. Motivational aspects, such as intrinsic motivation, play a critical role in how students approach mathematical tasks. Those lacking intrinsic motivation may find it particularly challenging to engage with mathematics, leading to heightened anxiety and avoidance behaviors. Moreover, external pressures, such as the expectations to perform well academically or to meet societal standards, can exacerbate mathematics anxiety among students.

Furthermore, the developmental stages that students undergo as they progress through different age groups can also significantly impact their experience of mathematics anxiety. Younger students may exhibit mathematics anxiety due to the novelty of mathematical concepts and their still-developing cognitive abilities. As they grow older, the pressure to excel academically and the increasing complexity of mathematical concepts can further intensify anxiety levels, especially if students have not developed effective coping mechanisms.

The repercussions of mathematics anxiety extend beyond individual academic struggles to broader societal implications. The shortage of skilled individuals in STEM fields, fueled in part by students' avoidance of mathematics-related pursuits, poses a significant challenge to societal development in an era increasingly reliant on technology and innovation. Moreover, the impact of mathematics anxiety on students' career aspirations cannot be overlooked. Many students may abandon potential career paths in STEM fields due to their anxiety towards mathematics, thereby

limiting their own potential and contributing to the overall shortage of STEM professionals. Consequently, there is a shortage of skilled individuals in STEM fields, which hampers societal development in an increasingly technology-dependent world. Addressing the interplay between mathematics anxiety, motivational factors, and age is imperative for improving academic outcomes, nurturing interest in STEM, and fostering future societal progress. This research gap created the need for this research that sought to assess the influence of motivation and age on mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State.

The following research questions were guide the study.

1. To what extent does motivation influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State?
2. To what extent does age influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State?

The following null hypotheses were tested at 0.05 level of significance:

1. Motivation does not significantly influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State.
2. Age does not significantly influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State.

Methodology

Research Design

The design for the study is expo facto research design. Expo facto research design involves collecting and analyzing data about some variables retrospectively or about variables which are already in place without manipulating any of them influence, or are related to other variables (Nwankwo, 2013). It is analyzing data after they have occurred. This present study will adopt this design because the researcher equally draw a sample from a larger population and describing the attributes and characteristics and influences and relationships of such sample introspectively (as they have already occurred already, that is students already have mathematics anxiety)

Population of the study and sampling technique

The population for the study is made up of all the 16530 public junior secondary school students in Obio/Akpor Local Government. A sample of 212 secondary school students were used for the study. A multi-stage sampling procedure was used. At the first stage Rivers State was divided into L.G.A cluster, at the second stage simple balloting without replacement was used to draw out 1 L.G.A cluster at the second stage, At the third stage stratified random sampling technique based on gender was used to draw 300 students. At the third stage of sampling the 300 students were administered the Mathematics Anxiety Scale. At the fourth stage therefore, purposive sampling was employed to draw the sample size of 212 students. At this stage 300 mathematics anxiety questionnaire were given and only 212 students who have mathematics anxiety formed the final sample size.

Instruments for Data Collection

The instrument for data collection was the Mathematics Anxiety scale and Motivation scale. The Instrument was divided into two parts; Part A and Part B. Part A contained items that are socio-demographic in nature such as sex, age. Part B was divided into two sections namely Section A-B. Section A of the instrument contains 20-item constructed to elicit students_ response on mathematics anxiety level. The mathematics anxiety questionnaire was structured in Likert Format of very high level (VHL), high extent (HL), low level (LL) and very low level (VLL). A score of 76 – 100 indicates very high level of mathematics anxiety while 50-75 high level, 49-26 low level and 0-25 very low level. Section B was a 15-item questionnaire designed to assess items on motivation structured on Likert format of strongly agree, agree, disagree and strongly disagree.

Validity and Reliability of the Instrument

Face and content validity was ensured by seeking expert judgements. These experts critically analyzed the items for the content, language, clarity, and literacy requirements. The Cronbach alpha method of internal consistency was used to estimate the instruments' reliability. These instruments were pilot tested on a sample other than the sample for the actual study. Each item on the scale was evaluated for quality based on the inter-item analysis. Consequently, Cronbach alpha was used to obtain a reliability coefficient of 0.73 for the Mathematics Anxiety scale and 0.76 for the Motivation Scale.

Method of Data Analysis

Data were analyzed using mean, standard deviation independent t-test, simple regression independent t-test associated with simple regression

Results

Research Question one: To what extend does motivation influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State?

Hypothesis one: Motivation does not significantly influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State?

Table 1: Simple regression coefficient of the influence of motivation on mathematics anxiety among secondary school students

Model	R	R^2	Adj R^2	Std. Error of Estimates
	0.008	0.001	-0.005	13.79908

From the result presented in Table 1on the influence of motivation on mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State, an R-value of 0.008 was which shows a very low and weak positive relationship between motivation and mathematics anxiety. Also, an R^2 value of 0.001 and an adjusted R^2 value of -0.005 was obtained. This show that there is a low positive relationship between motivation and maths anxiety. From the R^2 it can be deduced that motivation accounted for 0.001% of mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State.

Table 2: Independent samples t-test associated with simple regression on the influence of motivation on mathematics anxiety among secondary school students

Model	Unstandardized Coefficients	Standardized Coefficients	B	T	Sig
	B	Std. Error	Beta		
MOTIVATION	.016	.137	.008	.114	.909

The result further showed that the beta of .008 and a t-value of .114 was obtained when the obtained regression coefficient was tested for significance, based on the sig-value of .909 which is greater than the alpha. This result therefore indicates that there is a no significant relationship and influence of motivation on mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State. The null hypothesis was therefore rejected

Research Question Two: To what extent does age influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State?
Hypothesis Two: Age does not significantly influence mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State?
The answer to research question independent sample t-test was deployed to find out the influence of age on the mathematics anxiety of students. The result obtained is displayed in Table 3below

Table 3: Independent sample t-test of the influence of age on the mathematics anxiety of students

Age	Mean	SD	N	T	P-Value	Alpha	df	Decision
9-12	67.88	14.12	33	0.90	0.000	0.05	211	Reject
13-16	65.25	13.70	179					Ho5

From the result presented in Table 3 on the influence of age on mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State, student who are within the age bracket of 9-12 had a mean score of 67.88 (SD =14.12) while those within the age bracket of 13-16 had a mean score of 65.25 (SD=13.70) this is to say that students within the age bracket of 9-12 had more mathematics anxiety than those within the age bracket of 13-16. When the scores obtained for age 9-12 and 13-16 on mathematics anxiety was tested using independent sample t-test the score obtained was 0.90. Further testing of the associated hypothesis yielded a p-value of 0.000, which was less than the chosen alpha level of 0.05. This result showed that there is a significant difference on the influence of age on mathematics anxiety among secondary school students in Obio-Akpor Local Government Area of Rivers State. The null hypothesis was therefore rejected.

Discussion of Findings

From the analysis of research question one and the corresponding null hypothesis in table 1 it was shown that there is no significant influence of motivation on mathematics anxiety among secondary school students in Obio/Akpor Local Government Area of Rivers State. This influence was found to be statistically not significant when tested at 0.05 level of significance. Researches on the influence of motivation and mathematics anxiety is almost non-existent in literature as earlier mentioned. This result is somewhat similar to the researches by by Ali (2019) and (Jaesa, 2022) where they found a positive relationship between motivation and mathematics anxiety However, point of divergence was that this positive relationship was insignificant in this current study while a significant relationship was obtained by Ali (2019) and (Jaesa, 2022). Divergence in this result could be cause by areas of study and difference in measurement instruments in obtaining data for the study and differing demographics.

Several possible explanations can be considered to contextualize this finding. Extrinsic factors such as pressure to perform well on exams or fear of failure can contribute to heightened levels of mathematics anxiety. Also, it is plausible that other factors beyond motivation may exert a stronger influence on mathematics anxiety among students. Factors such as self-efficacy beliefs, prior academic achievement, or teaching methodologies may play significant roles in shaping students' experiences with mathematics anxiety. The absence of control over these potential confounding variables in our study design might have obscured the direct relationship between motivation and mathematics anxiety. Additionally, the multidimensional nature of mathematics anxiety and motivation warrants consideration. While motivation is recognized as a key determinant of academic performance, it may not directly address the intricate cognitive, emotional, and situational components that contribute to mathematics anxiety. Factors such as fear of failure, negative past experiences, or cognitive biases may influence mathematics anxiety independently of motivation. Furthermore, the bidirectional nature of the relationship between motivation and mathematics anxiety cannot be overlooked. It is conceivable that mathematics anxiety may influence motivation as much as motivation influences mathematics anxiety. Focusing exclusively on the influence of motivation on mathematics anxiety may overlook the reciprocal effects of mathematics anxiety on motivation, contributing to the lack of significant findings observed in our study.

The table in 3 shows there is significant influence of age on mathematics anxiety among students that were studied. This result implies that students who younger in age are prone to score high in mathematics anxiety. This is in line with Hadfield and Mcneil (1994) result which found that age level is a significant predictor of mathematics anxiety among elementary students. Also, it is somewhat in line with the findings of Tudla (2000) whose position suggested that age provides variability within mathematics anxiety group. Tudal (2000) claimed that younger children do have mathematics anxiety, which may be as a result of malnutrition during development of the affective system. It is claimed that younger children do have mathematics anxiety, which may be as a result of malnutrition during development of the affective system. The magnitude of this deficit is expected to diminish as children grow older. However, Antonio, (2023) and Humbeer

(1990) study revealed a no significant influence of age on maths anxiety. Same with a related study of Owolabi & Adejoke (2014)

This result is mot surprising as firstly, it is plausible that developmental factors play a significant role in shaping mathematics anxiety across different age groups. As students_ progress through adolescence, their cognitive and emotional development undergoes notable changes. Younger secondary school students may lack the cognitive maturity and emotional regulation skills needed to effectively cope with the challenges inherent in mathematics education, potentially leading to heightened levels of anxiety. In contrast, older students may have developed more robust coping mechanisms and problem-solving skills over time, thereby exhibiting lower levels of mathematics anxiety. Moreover, cumulative learning experiences may contribute to differences in mathematics anxiety across age groups. Older secondary school students have likely accumulated more extensive experiences with mathematics education, including both positive and negative encounters. These past experiences can profoundly influence students' attitudes and perceptions toward mathematics, potentially impacting their anxiety levels. Older students may have developed greater confidence and resilience through exposure to diverse mathematical concepts and problem-solving scenarios, thereby mitigating their anxiety levels compared to younger counterparts. Furthermore, Social factors, such as peer influence and social comparison, may also play a role in shaping mathematics anxiety across age groups. Adolescence is characterized by heightened social comparison, and older secondary school students may compare themselves more frequently to their peers in terms of academic achievement and mathematical abilities. Peer interactions and group dynamics within the classroom can impact mathematics anxiety, with older students potentially exhibiting greater resilience to social pressures.

Moreover, differences in maturity and coping strategies among students of different ages may contribute to variations in mathematics anxiety levels. As students mature, they typically develop more effective coping mechanisms for managing stress and anxiety. Older secondary school students may possess better self-regulation skills, problem-solving abilities, and cognitive flexibility, allowing them to navigate mathematical challenges with greater ease and confidence. These enhanced coping mechanisms may serve as protective factors against mathematics anxiety. Lastly, older students may have a clearer understanding of the relevance and utility of mathematics in their academic and professional pursuits. Recognizing the practical applications of mathematics in various domains, such as STEM fields, older students may perceive mathematics as less threatening and anxiety-inducing compared to younger students who may struggle to see its relevance.

Conclusion

The study has shown that that motivation does not significantly impact mathematics anxiety among secondary school students, while age emerges as a significant influencing factor. These findings underscore the importance of considering age-related dynamics in addressing mathematics anxiety

Recommendations

Based on the results of the study, the following recommendation were made

Psychometricians and educational psychologists can work with teachers to develop individualized intervention plans tailored to students' specific needs, incorporating evidence-based strategies for addressing cognitive, emotional, and behavioral difficulties associated with mathematics anxiety.

It is also recommended that there should be tailor support services and interventions to address the unique needs of students at different stages of adolescence by teachers. Younger students may benefit from targeted interventions focusing on building foundational mathematical skills and fostering a positive attitude toward mathematics. Older students may require support in developing effective coping strategies and managing academic pressures.

It is also recommended that teachers should foster students' intrinsic motivation and engagement with mathematics by highlighting real-world applications and interdisciplinary connections.

They should Link mathematical concepts to students' interests, career aspirations, and everyday experiences to enhance relevance and minimize anxiety associated with abstract concepts

Limitations of the Study

The sample of the study was draw from only one local government areaa, thus the sample was relatively small, however, a representative sample was obtained and result can be generalized.

Suggestions for Further Study

The study can be carried out using a larger sample size drawn from an entire state or a geographical zone of the country. Future study should endeavour to incorporate higher schools in the investigation of factors influencing mathematics anxiety.

References

Ali, N. A. M., & Hassan, N. C. (2019). Mathematics Anxiety and Mathematics Motivation among Students in the Faculty of Science of a Public University in Malaysia. *International Journal of Academic Research in Progressive Education and Development*, 8(4),952–963. http://dx.doi.org/10.6007/IJARPED/v8-i4/6786

Ashcraft, M. H, (2007). Working memory, math performance, and math anxiety. *Psychonomic Bulletin & Review*, *14*, 243–248.

Bekdemir, M. (2010). The pre-service teachers_ mathematics anxiety related to depth of negative experiences in mathematics classroom while they were students. *Educational Studies in Mathematics*, 75(3), 311-328.

Beilock S. L., & Willingham, D. T. (2014). Math anxiety: Can teachers help students reduce it? *American Educator*, *38*(2), 28-32.

Cemen, B. (2017). Relationship between Students' Readiness and Learning Achievement. *Scientific Counseling Journal*. 2(1): 27-31

Dreger R. M., Aiken L. R. (1957). The identification of number anxiety in a college population. *Journal of Educational Psychology, 48*, 344–351.

Eteng-Uket, S., & Iruloh, B.-R. N. (2023). Differential and interactional influence of socio- demographic variables on intellectual ability. Journal of Pedagogical Research, 7(4), 111- 130. https://doi.org/10.33902/JPR.202320992

Hadfield, O. D., & McNcil, K. (1994). The relationship between Myers-Briggs personality type and mathematics anxiety among preservice elementary teachers. *Journal of Instructional Psychology*, 21(4), 375.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. Journal for Researchin Mathematics Education, 21(1), 33−46.

Jaesa L. Garcia, K., & F. Banayo, A. (2022). Motivation and Mathematics Anxiety Among College Students. *International Journal of Research Publications*, *108*(1). https://doi.org/10.47119/ijrp1001081920223876

Maloneyet, S. (2012). Differences in Mathematics Learning Achievement in terms of Student Personality Types in Mathematics Learning. *SAP journal*. 2(2), 127-133

Owolabi J, & Adejoke E.1, (20140), ―Effect of Gender, Age and Mathematics Anxiety on College Students‖ Achievement in Algebra.‖ American Journal of Educational Research,2,(7) 474-476.http//doi.org.10.12691/education-2-7-7

Tudla, P.P. (2000). Dimensions of Mathematics Anxiety, Self-efficacy, beliefs, self-concept and persistence: Relationship to achievement in mathematics. Dissertation. Araullo University, Cabanatuan CityTobias, S. & Weissbrod, C. (2010). Anxiety and mathematics: An update. *Harvard Educational Review. 50*, 95- 104.

Wang, Z., Sarah, L., Sara, A. H., Ian, M. L., Lee, A. T., Yulia, K., Michèle, M., Mazzocco, M., Robert, P., and Stephen A. P. (2015). Is Math Anxiety Always Bad for Math Learning? The Role of Mathematics Motivation. https://doi.org/10.1177/0956797615602471

Zakaria, E, & Nordin N. M. (2008). The effects of Mathematics anxiety on Matriculation students as related to motivation and achievement. *Eurasia Journal of Mathematics, Science & Technology Education*, 4 (1), 27-39