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COMPARATIVE ANALYSIS OF MATHEMATICS ANXIETY AND ACADEMIC ACHIEVEMENT AMONG SCIENCE EDUCATION STUDENTS

Iheanacho Chukwudi Ike*, Darlington Chibueze Duru, Uzoma Alwell, David Onyinye Mba

Department of Mathematics, Alvan Ikoku Federal University of Education—Owerri, Nigeria
Email: ikeachor5@gmail.com

Abstract

This study examines the comparative analysis of mathematics anxiety and academic achievement among second-year Science Education students at Alvan Ikoku Federal University of Education, Owerri. Three research questions and hypotheses were tested at a 0.05 significance level. Using a correlation and comparative research design, all 85 students were included via census sampling. Data were collected using the Mathematics Anxiety Rating Scale (MARS), adapted from Al Mutawah (2015), and the Basic Mathematics for Science Education Achievement Test (BMSEDAT). MARS had 20 items with a Cronbach's alpha reliability of 0.70, while BMSEDAT consisted of 6 essay questions, with a reliability coefficient of 0.71. Pearson's correlation and independent samples *t*-test were used for data analysis. Findings revealed a significant relationship between mathematics anxiety and achievement, specifically among Biology students, but not in Chemistry and Physics. It was recommended that teachers should adopt positive, supportive teaching methods that encourage students to develop a healthy attitude toward mathematics.

Keywords: Academic achievement, Mathematics anxiety, Science education.

Abstrak

Penelitian ini mengkaji analisis komparatif antara kecemasan matematika dan pencapaian akademik pada mahasiswa Pendidikan Sains tahun kedua di Universitas Pendidikan Federal Alvan Ikoku, Owerri. Tiga pertanyaan dan hipotesis penelitian diuji pada tingkat signifikansi 0,05. Dengan menggunakan desain penelitian korelasional dan komparatif, seluruh 85 mahasiswa dilibatkan melalui teknik sensus. Data dikumpulkan menggunakan Skala Penilaian Kecemasan Matematika (Mathematics Anxiety Rating Scale/MARS) yang diadaptasi dari Al Mutawah (2015), serta Tes Prestasi Matematika Dasar untuk Pendidikan Sains (Basic Mathematics for Science Education Achievement Test/BMSEDAT). MARS terdiri dari 20 butir dengan reliabilitas alpha Cronbach sebesar 0,70, sedangkan BMSEDAT terdiri dari 6 soal esai dengan koefisien reliabilitas sebesar 0,71. Analisis data dilakukan dengan menggunakan korelasi Pearson dan uji-t sampel independen. Hasil temuan menunjukkan adanya hubungan yang signifikan antara kecemasan matematika dan pencapaian, khususnya pada mahasiswa jurusan Biologi, namun tidak ditemukan hubungan yang signifikan pada jurusan Kimia dan Fisika. Disarankan agar para guru menggunakan metode pengajaran yang positif dan suportif untuk mendorong siswa mengembangkan sikap yang sehat terhadap matematika.

***Kata Kunci**: Kecemasan matematika, Pencapaian akademik, Pendidikan sains.*

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INTRODUCTION

Mathematics anxiety is defined as a feeling of tension or fear that disrupts the manipulation of numbers and the solving of mathematical problems negative attitudes toward mathematics learning (Al-Shannaq & Leppavirta, 2020). In the United States alone, anxiety disorders affect over 40 million individuals and encompass generalized anxiety disorder, panic disorder, social anxiety disorder, and specific phobias, each characterized by heightened anxiety levels (Nwosu et al., 2023). This issue is equally relevant in Nigerian academic contexts, with academic anxiety emerging as a significant factor impacting students' learning, memory retention, and overall academic achievement. A comparative analysis of mathematics anxiety among science students often reveals that, while science students may experience a higher level of mathematics anxiety than students in other fields, variations exists within the science disciplines themselves, with some science fields potentially showing lower levels of mathematics anxiety compared to other science fields, which heavily rely on complex mathematical calculations; this variation can be attributed to the degree of mathematical rigor required within each science subject area. A study by Maduka et al. (2023) highlighted the challenges faced by Biology students at Alvan Ikoku Federal University of Education (AIFUE) due to anxiety disorders, such as panic disorder, which compromised their academic success. Similarly, Nwosu et al. (2023) observed that 61% of college physics students at AIFUE reported high anxiety levels, which negatively influenced their academic outcomes. These findings reflect a prevalent issue of anxiety among students in AIFUE, with significant implications for academic achievement.

Mathematics, in particular, is often perceived as a challenging and daunting subject. Obinna and Anne (2011) observed that Mathematics and Statistics students in Nigerian tertiary institutions frequently struggle with these subjects, often viewing them as complex tasks. This perception, sometimes exacerbated by the attitudes of educators, is reinforced from secondary school, where mathematics is often portrayed as a discipline suited only for the exceptionally talented. Such academic and psychological pressures contribute to high levels of mathematics anxiety, especially among college students, making them vulnerable to mental health issues that could severely impact their academic journey and overall well-being (Naceanceno et al., 2021). Given these challenges, it is crucial to explore the relationship between mathematics anxiety and academic

achievement among science education students at AIFUE. A better understanding of this relationship can inform strategies to mitigate anxiety and foster improved academic achievement.

In Imo state, AIFUE, Owerri is one of the institutions entrusted to carry out responsibility in enhancing science education. This is very significant because report revealed that many job opportunities will be created through the execution of educational programs that require Science Education (SED) qualifications. Thus, it should be noted that Science Education becomes a crucial factor in producing workers who are equipped with high technical and literacy towards science and technology. One of the initiatives implemented by the institution, AIFUE, to achieve this mission is by upgrading the SED programs. At AIFUE, science education courses are integrated into the curriculum of programs such as Biology, Chemistry, Inter-Science, Mathematics, and Physics. The Bachelor of Science in Mathematics Education (BSc/Ed) program is designed to help students become intellectually informed in mathematical concepts, notation, and skills for logical reasoning, scientific inquiry, and techno-scientific education. The program also aims to make learners appreciate the use of computers in solving mathematical problems, address real-world issues, and prepare them for further studies in mathematics and related fields (Department of Mathematics, 2019). Basic mathematics skills are important for success in school and everyday life (Kaushal et al., 2022). Consequently, mathematics is mandated in school curricula to ensure all students develop essential skills for life's challenges (Nwoke & Ike, 2019). Focusing on students' acquisition of essential skills and knowledge is crucial to ensuring their success in science education programs. However, many students struggle with foundational mathematics skills. Emphasizing students' mathematics achievement is essential, as academic achievement has always been an indicator of student learning and understanding.

Academic achievement refers to the level of knowledge, skills, or performance demonstrated by in-school adolescents. Academic achievement is reflected in students' performance on tests, projects, and examinations (Eze et al., 2021). According to Mollah (2017), one of the biggest obstructions in mathematical teaching learning process is mathematics anxiety. Alzahrani and Stojanovski (2017) also note that students' social factors, cognitive functioning, and academic abilities can all contribute to varying degrees of mathematics anxiety. Mathematics anxiety has been shown to negatively affect

mathematics achievement because it can lead to avoidance of the subject and disrupt the working memory resources needed to solve challenging problems. Students with high levels of mathematics anxiety often engage in negative self-assessment, leading to a lack of confidence in working with numbers and mathematical concepts (Salinas et al., 2019). Conversely, students with high performance in mathematics tend to have a positive attitude towards the subject. A strong interest in mathematics can motivate students to engage in the learning process independently, reducing anxiety and ultimately improving their performance in examinations. Classroom anxiety can arise from various factors, with one significant cause being teachers' failure to consider different learning styles among students. Research on attitudes toward mathematics is important for understanding the link between achievement and mathematics anxiety. The more a teacher understands mathematics anxiety, the better they can prevent and help students overcome it.

Mathematics anxiety is a common problem across all educational levels. Previous research has shown that this phenomenon is experienced not only by primary school students but also by those in secondary school, college, and university. Although many studies have focused on the anxiety of students towards academic performance, this study specifically examines the anxiety of science education students at AIFUE regarding their academic achievement in mathematics. The question remains: What is the correlation between mathematics anxiety levels and mathematics achievement among these students? This unresolved issue forms the basis of the study. Specifically, the study sought to: (1) correlate anxiety levels with their achievement levels in mathematics among science education students, (2) ascertain the difference in mathematics anxiety levels between students with high and low academic achievement among science education students, (3) compare anxiety levels with their achievement levels in mathematics among students in four departments in the faculty of science.

Research questions

The following research questions were answered in the study: (RQ1) What is the relationship between mathematics anxiety and academic achievement among science education students?; (RQ2); What is the difference in mathematics anxiety levels between students with high and low academic achievement among science education students?; (RQ3) How do the relationships between mathematics anxiety and academic achievement differ among students in four different departments in faculty of science?

Hypothesis

The following null hypothesis were tested in the study: (H1) There is no significant relationship between mathematics anxiety and academic achievement among science education students.; (H2) There is no significant difference in mathematics anxiety levels between students with high and low academic achievement in science education.; (H3) There is no significant relationship between mathematics anxiety and academic achievement among students in the four different departments in faculty of science.

RESEARCH METHODS

A correlation and causal-comparative research design was employed for this study, as it allowed for the relationship and the comparison of mathematics anxiety and academic achievement among science education students without establishing a cause-and-effect relationship. Instead, the study examined differences between groups based on existing characteristics.

The study population comprised all 85 second-year (200 levels) students in the Faculty of Science at AIFUE, Owerri, Imo State, Nigeria, during the 2022/2023 academic session. The entire population of 85 students was used as the sample, employing a census population sampling technique. The study involved 200 level students from the departments of Biology (57 students), Chemistry (23 students), Inter-Science (2 students), and Physics (3 students).

Two instruments were utilized for data collection: the Mathematics Anxiety Rating Scale (MARS) and the Basic Mathematics for Science Education Achievement Test (BMSEDAT). The MARS, which consists of 20 items, was adapted from a scale developed by Al Mutawah (2015). The internal consistency of the MARS was assessed using the Cronbach's alpha method, yielding a reliability coefficient of 0.70. The BMSEDAT, comprising six essay questions, was developed by the researchers based on the course content of the Basic Mathematics for Science Education (SED 201) to assess the students' achievement scores.

Data were analysed using Pearson's correlation coefficient for research questions and null hypotheses one and three, and independent samples *t*-test for research question and null hypothesis two. The students' academic achievement test scores were categorized as follows: F (0-39), E (40-44), D (45-49), C (50-59), B (60-69), and A (70-100). Achievement scores and anxiety levels were categorized based on the Mean (M) scores

of the student population: Students' achievement scores were classified as either "low" or "high" using the mean of all students' test scores. The average score was 49, serving as the cut-off point: Scores below 49 (< 49) were classified as low achievement, scores of 49 and above (≥ 49) were classified as high achievement. Anxiety levels were similarly classified based on the grand mean of the anxiety scores, which was 0.58: Anxiety scores below 0.58 (< 0.58) indicated high anxiety. Anxiety scores of 0.58 and above (≥ 0.58) indicated low anxiety. The score of 49 for achievement was derived from the mean score of all students who participated in the test, while the threshold of 0.58 for anxiety was based on the grand mean of the anxiety scale. These thresholds allowed for the classification of students into distinct categories for further analysis of the relationship between anxiety and academic achievement.

RESULTS AND DISCUSSION

The results are presented in the order of the research questions and hypotheses raised. To answer RQ1 and H1, the results of research data analysis are presented in Table 1.

Tabel 1. Pearson Correlation of Anxiety and Achievement

Variables	M	StDev	N	*R*	*df*	*t*	*p*-value	Decision
Anxiety levels	0.58	0.11	82	0.561	80	6.058	0.000	Reject
Achievements	49.07	18.14						

Table 1 shows the relationship that exist between mathematics anxiety and achievement among science education students in AIFUE, Owerri. The result revealed a positive relationship and *p*-value=0.000<0.05, indicating strong evidence to suggest statistically significant relationship between mathematics anxiety and achievement. The findings indicated that students who perform well in mathematics tend to have lower levels of anxiety, while those with lower achievements often experience higher anxiety levels. This is likely because high achievers possess a stronger understanding of mathematical concepts, which boosts their confidence compared to low achievers. These findings are consistent with several studies (e.g. Karimi & Venkatesen, 2009; Salinas et al., 2019; Woods, 2006; Zakaria et al., 2012), which found that students with high levels of mathematics anxiety tend to score lower in mathematics, whereas those with lower anxiety levels generally achieve higher scores. The significant relationship between mathematics anxiety and achievement highlights the need for a multi-faceted approach

that addresses both the cognitive and emotional needs of students. By fostering a more supportive and anxiety-reducing classroom environment, teachers can help students build confidence in their mathematical abilities, which will likely result in improved performance. Meanwhile, student support services can provide targeted interventions to help students manage their anxiety, offering counseling, peer support, and academic assistance. In the long term, such comprehensive measures will not only improve students' academic performance in mathematics but also enhance their overall well-being and readiness to tackle academic challenges with resilience and confidence.

Furthermore, the summary of the data analysis results to answer RQ2 and H2 are presented in Table 2.

Table 2. *t*-Test of Anxiety by Achievement Level

Achievement	N	M	StDev	*t*	*p*-value	Decision
Low	34	0.52	0.11	-4.665	0.000	Reject
High	48	0.62	0.10			

In table 2, the *p*-value for the difference in mathematics anxiety levels between low and high achievement is 0.000 (1.26E-05). This is lower than 0.05 alpha level (*p*-value< 0.05) in which the decision is based. This indicated that there was a significant difference in anxiety levels in mathematics between low and high achievement. This suggests that mathematics anxiety is a critical factor distinguishing between students who excel and those who struggle in the subject, with high anxiety being more common among lower-achieving students. This underscores the importance of addressing mathematics anxiety, particularly for students who struggle with the subject, as reducing anxiety could potentially improve their academic outcomes. This conclusion is consistent with Salinas et al. (2019), who noted that many students exhibit average levels of math anxiety and perform poorly in mathematics. The significant difference in mathematics anxiety levels between high- and low-achieving students highlights the importance of addressing anxiety as part of the broader strategy to improve mathematics achievement. By adopting anxiety-reducing teaching practices and providing robust student support services, educators can help mitigate the negative effects of anxiety on student performance. Reducing mathematics anxiety, especially among low achievers, has the potential to improve academic outcomes, reduce dropout rates, and foster a more positive attitude toward mathematics. Ultimately, addressing the emotional barriers to learning

mathematics is just as crucial as providing academic support, and institutions must take a holistic approach to ensure the success of all students.

Furthermore, the summary of the data analysis results to answer RQ3 and H3 are presented in Table 3.

Table 3. Pearson Correlation of Anxiety and Achievement Across Departments

Departments	N	R	*df*	*t*	*p*-value	Decision
Biology	54	0.385	52	3.013	0.00399	Reject
Chemistry	23	0.634	21	3.752	0.9994	Accept
Physics	3	0.999	1	49.075	0.9935	Accept
Inter- science	2	1	0	0	0	No decision

Table 3 reveals separate correlation coefficients '*r*' for Biology, Chemistry, Physics and inter-Science. In Biology, r=0.385 and p-value=0.004 indicates a weak to moderate positive correlation between anxiety and achievement, and (p-value<0.05) which is statistically significant. In Chemistry, r=0.634 and p-value=0.9994 indicates a high correlation coefficient suggesting a positive relationship, (p-value>0.05) indicating this result is not statistically significant. In Physics, r=0.999 and p-value=0.994 suggesting a strong positive relationship, but (p-value>0.05) indicates that this result is not statistically significant, in Inter-Science, there was not enough data points to calculate a reliable correlation coefficient therefore no decision was taken.

Finally, the table showed that the relationship between anxiety and achievement was statistically significant only in the Biology department. In contrast, although high correlation coefficients were observed in the Chemistry and Physics departments, the results were not statistically significant. This suggests that the impact of mathematics anxiety on achievement may vary by departments, with a significant relationship evident only in Biology. This variation could be due to differences in the mathematical demands of the subjects, students' perceptions, instructional methods, or how mathematics anxiety interacts with the specific subject matter. This finding aligns with; Bandura's self-efficacy theory which suggests that students' belief about their abilities influence both their anxiety levels and academic performance (Bandura, 2023; Lopez-Garrido, 2025). Similarly, Sweller's (2011) cognitive load theory posits that the cognitive demands of a subject can shape students anxiety experiences. Given that mathematics related tasks can increase cognitive load, they may contribute to heightened anxiety and consequently, impact achievement. As a result, targeted interventions to address mathematics anxiety

may be particularly necessary in Biology, while recognizing that other science subjects might be less affected by this anxiety. By adopting anxiety-reducing teaching strategies and providing tailored support services, educators can help students overcome their anxiety and improve their academic outcomes across all science disciplines.

CONCLUSION

The study revealed that mathematics anxiety is prevalent among science education students at AIFUE. It also established a significant relationship between students' mathematics achievement and their levels of mathematics anxiety, with a notable difference in anxiety levels between low and high achievers. However, the relationship between anxiety and achievement was statistically significant only in the Biology department, while it was not significant in Chemistry and Physics despite high correlation coefficients. Given that mathematics plays a crucial role in many aspects of life and career paths, it is essential to raise awareness among students about the importance of applying mathematical knowledge and skills in their future careers. Addressing and mitigating factors like mathematics anxiety, which can hinder academic achievement, should be a priority and not overlooked.

There were several limitations in this study that threatened external validity. First, the mathematics test used was one among other mathematics courses the groups do together, and one academic session, in one institution in the South-Eastern region of Nigeria was considered and there were not enough participants (sample size) in inter science and even physics in the institution.

Based on the findings and conclusions, the following recommendations are proposed. Firstly, minimize the negative effects of mathematics anxiety. Teachers should focus on reducing the negative impact of mathematics anxiety during exams, helping students manage their thoughts to avoid being overwhelmed by anxiety. Teachers should strive to understand the nature of mathematics anxiety and implement teaching strategies that help students overcome it. Secondly, foster positive and supportive learning environments. Teachers should adopt positive, supportive teaching methods that encourage students to develop a healthy attitude toward mathematics. By creating a more encouraging learning environment, students can build confidence and reduce anxiety. Thirdly, demonstrate enthusiasm for mathematics.o Teachers should express their own interest and enthusiasm for mathematics to inspire students. By fostering motivation,

students may be more inclined to engage with the subject, thereby reducing their anxiety. Furthermore, it is important to promote awareness among students across different departments about the value of mathematical knowledge and skills in their future careers.

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