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INVESTIGATING THE RELATIONSHIP BETWEEN MATHEMATICS PHOBIA AND ACADEMIC ACHIEVEMENT IN CHEMISTRY AMONG SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS IN OTUOCHA EDUCATION ZONE

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ABSTRACT

This study investigated the relationship between mathematics phobia and academic achievement in chemistry among senior secondary school students in Otuocha Education Zone. Four research questions and three hypotheses guided the study. Correlational survey research design was employed. Simple random sampling technique was used to select 243 senior secondary school chemistry students from a total population 620 SS2 students in Otuocha Education Zone. Mathematics Phobia Scale (MPS) and Chemistry Achievement Test (CAT) which were validated by experts, were instruments used for data collection. Data were analyzed using Pearson product moment correlation coefficient and the null hypotheses were tested at .05 level of significance. Results revealed that 52.7% of chemistry students experienced mathematics phobia. A significant negative relationship existed between mathematics phobia and chemistry achievement (β = -0.168, P < .05). No significant relationship was found between mathematics phobia and chemistry achievement based on gender (β = -0.121, P > .05). Implications for chemistry teachers, students, curriculum developers, examination bodies, authors, government, and future researchers are discussed. Recommendations were however made.

Keywords: Relationship, Phobia, Mathematics, Chemistry, Students, Academic achievement.

Introduction

Science is a systematic pursuit of knowledge about the natural world, essential for addressing human challenges and fostering national development. In other words, science is the act of craving for knowledge about nature through a systematic approach. Ibe, Obikezie and Chikendu (2021) maintained that science is of immense importance in the development of any nation. This is because science is directly linked to the tackling of the problems of humanity. The

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contributions of science and technology to the overalldevelopment of nations cannot beoveremphasized. This is the reason science holds an important position in the curriculum of the nation's educational system. Science according to Njoku in Ibe*et.al.,*(2021) is the rational and systematic study of the environment through observation and experimentation with a view to understanding the environment and manipulating the resources of nature for human development. The world we live in on a daily basis depends on discoveries in science for growth and development (Ihekwaba, Nwokocha and Onuike, 2020). Pure science refers to the academic disciplines that derive new knowledge through scientific approach. Therefore, there are three branches of pure science, namely: chemistry, physics and biology.

Chemistry as one of the three branches of pure science plays a central role in the field of science; as it seeks to know the compositions, structures and properties (physical and chemical) of every physical substance that surrounds our environment as well as the changes they undergo. In other words, chemistry is a branch of pure science which craves to know the composition, behaviour and uses of every physical substance around us and how one substance can be converted to another. According to Samuel (2021), chemistry is the study of the composition, properties, structure, interaction and transformation of aggregates of matter either in isolation or in combination. Chemistry is a physical science which is of immense application to man. All activities of man on earth can be explained through the help of scientific laws and concepts most of which bother on different branches of chemistry. The knowledge of chemistry is imperative and indispensable to man as it bothers the totality of man's existence on earth. Right at the moment we sleep till we wake up, infinite chemical reactions are occurring in each cell of our body. All our daily activities such as drinking water, taking a shower, cooking of food, cleaning our bodies, laughing, crying and others are all guided by different chemical processes. In fact, man cannot do without chemistry because most of the articles man uses on a daily basis, ranging from his clothes, shoes, vehicles, home gadgets and others are all polymeric products produced through the knowledge of chemistry. For man to live a healthy life, it is expedient that he should gain proper understanding of the physical and chemical processes that occur within him and his environment.

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Without an iota of doubt, chemical industries today play a sizeable role in the economic growth and development of every nation. These chemical industries such as Fertilizer industries, plastic industries, pharmaceutical industries, glass industries, cement industries, soap and detergent, metallurgy, ceramics industries, paint industries, amongst others, are indispensable in both human and national development and none of these industries can ever function without chemistry as they all depend on the knowledge of chemistry for their operations. The indispensable nature of chemistry to man is such that professionalization in science and technological fields such as Engineering, Medicine, Pharmacy, Agriculture, Food Technology, Biological Sciences, etc., cannot be done without at least a credit pass in chemistry at O' level. According to Samuel (2021), chemistry connects all other sciences to each other such as biology, physics, geology, environmental science, agricultural science, medical science, textile science, synthetic science, pharmacy, chemical technology, printing technology and home economics. Nnoli (2024) holds the view that chemistry is a field driven by human endeavor, therefore active participation of students and teachers is crucial to ensure firsthand experiences that guarantee the acquisition of the most vital and enduring qualities.

Achievement in a simple term is a remarkable something someone has succeeded in doing after a lot of effort. Therefore, academic achievement of a student is the extent to which the student has achieved the mapped out learning objectives which could be ascertained through evaluations. Amoke (2020) opined that academic achievement is the level of attainment of the predetermined learning objectives by the learner. This is mainly shown by the results of either internal examinations in the school or external examinations like Senior School Certificate Examination (SSCE).

Academic achievement describes the extent to which a student has achieved the learning goals. According to Ali cited in Onwusa(2021), academic achievement is a measure of the degree of success in performing specific tasks in a subject or area of study by students after a learning experience. It is the outcome of education that indicates how well a student or class of students achieved academically. Therefore, measuring academic achievement is a significant part of the education process and informs educators of students' ability and progress toward educational goals. Yusuf, Onifade and Bello in Kumar, and Agarwal (2021) maintained that Academic

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achievement is the quantifiable and apparent behavior of a student within a definite period and is an aggregate of scores fetched by a scholar in various evaluations through class tests, mid and end semester examinations. The Academic achievement of students is immensely significant as the economic as well as the social development of any country are both attributable to the academic achievement of the students. The better the students perform academically, the better are the prospects of the development of a fine manpower, which will contribute to the economic and social development of the nation (Kumar,andAgarwal, 2021). Students performing better than the expectations and norms set by the society are mostly expected to contribute to the growth, development and sustainability of the society (Akinleke, 2017).

The term **'phobia'** is abstracted from the Greek word **"phobos"** meaning fear, panic, or terror (Rajendra, 2020). In simple term, Phobia is an extremely strong dislike or fear of someone, something, place or situation. According to Oxford Advanced Learner's Dictionary, phobia is defined as a strong unreasonable fear or hatred of a particular thing. in other words, phobia is a type of anxiety disorder that causes an individual to experience extreme, irrational fear about a situation, living creature, place, or object. People with phobia always shape their lives to avoid the thing they are afraid of. American Psychological Associatin (APA) in Ihekwaba*et al*. (2020) remarked that the affected person will go to great lengths to avoid the situation or object and if the feared object or situation cannot be avoided, the affected person will have significant distresses. Tillfors in Rajendra (2020) defined phobia as learned emotional responses and it causes frequent severe and intense anxiety. So, students with mathematics phobia will likely suffer panic attacks at the sight of every form of calculation.

Mathematics phobia can be seen as a feeling of tension or fear which interferes with mathematics performance. In order words, mathematics phobia as a feeling of anxiety that stops one from efficiently tackling mathematical problems.Ashcraf in Suleiman (2022) opined that highly anxious mathematics students will try to avoid situations in which they have to perform mathematical calculations. Unfortunately, math avoidance results in less competency, exposure and math practice, leaving students more anxious and mathematically unprepared to achieve. Mathematics phobia is a feeling of anxiety that appears due to the fears of solving different mathematical problems. Some people regard mathematics phobia as a tension, panic,

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helplessness and mental disorganization. So, it is pretty obvious that mathematics phobia has a sizeable effect on the academic achievement of students in chemistry seeing that chemistry itself is also mathematics inclined.Therefore, it is expedient that every chemistry student should possess adequate background knowledge of mathematical concepts. However, calculations in chemistry unlike physics are quite peculiar as it does not have direct mathematical formulae but requires mental reasoning. Therefore, a student who has phobia for mathematics will likely perform poorly in chemistry because mathematics itself is a common language of chemistry.

Statement of the Problem

The exigency of chemistry for the growth and development of the nations and humanities cannot be over emphasized. Chemistry plays inevitable roles in medicine, agriculture, food processing, clothing, and environmental management and in other various sectors. Akanbi (2016) vehemently maintained that the signature of chemistry is observed in almost all facets of human endeavour. Mathematics serves as a fundamental component in understanding chemistry concepts, yet many students experience anxiety and fear associated with mathematical tasks. This phobia can hinder their performance and engagement in chemistry, potentially leading to lower academic achievement. Despite the importance of mathematics in the study of chemistry, there is limited research exploring how mathematics phobia specifically impacts chemistry students' performance in this educational context. Understanding this relationship is crucial, as it could inform interventions aimed at improving both mathematical skills and overall academic outcomes in chemistry. By addressing this gap, this study seeks to contribute valuable insights into how educators and policymakers can better support students facing these challenges

Purpose of the Study

Generally, this research work is on the relationship between mathematics phobia and academic achievement in chemistry among senior secondary school chemistry students in Otuocha Zone.

Specifically, this study aims at finding out;

1. The proportion of chemistry students who have phobia for mathematics.

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2. The relationship between mathematics phobia and academic achievement in chemistry among senior secondary chemistry students.
3. The relationship between mathematics phobia and academic achievement of students in chemistry based on gender.

Research Questions

To guide the study, the following research questions were raised:

1. What is the proportion of chemistry students with phobia for mathematics in Otuocha Education Zone?

2. What is the relationship between mathematics phobia and academic achievement in chemistry among senior secondary chemistry students in Otuocha Education Zone?

3. What is the relationship between mathematics phobia and academic achievement of chemistry students based on gender in Otuocha Education Zone?

Hypotheses

The following null hypotheses were formulated to guide the study:

1. There is no significant relationship between mathematics phobia and academic achievement in chemistry among senior secondary chemistry students.
2. There is no significant relationship between mathematics phobia and academic achievement of chemistry students based on gender.

Method

Correlation survey was used for this study. According to Nworgu (2015), correlation survey design is a type of research design that seeks to establish the relationship that exists between independent and dependent variables.Thestudy was carried out in Otuocha Education Zone of Anambra State, Nigeria. Otuocha Education Zone is one of the six education zones in Anambra State. It comprises of three Local Governments namely, Anambra East, Anambra West and

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Ayamelum Local Government Areas. There are twenty-eight (28) governments owned secondary schools in Otuocha Education Zone comprising of twenty-six (26) co-educational secondary schools and two (2) single sex schools. The population of the study comprised 620 (261 males and 359 females) SS 2 students in the three Local Government Areas in Otuocha Education Zone. The sample of the study consists of 243 SS 2 students drawn from 12 co-educational public secondary schools selected from the 26 co- educational public secondary schools in Otuocha Education zone. The sample of the study was obtained using multi- stage sampling techniques.

Two instruments were used for this study: Mathematics Phobia Scale (**MPS**) and Chemistry Achievement Test (**CAT**). The instruments were validated by three experts and were subjected to reliability. The reliability of **MPS** was found to be .96 and that of **CAT** was 0.85 using Cronbachs' Alpha coefficient.In analyzing the data, Pearson Product Moment Correlation coefficient was used to answer the research questions. While t-Test of correlation analysis was used to test the hypotheses at 0.05 alpha levels.

Results

Research question 1: What is the proportion of chemistry students with phobia for mathematics in Otuocha Education Zone?

Table1: Frequency table showing the rate of Mathematic phobia among Chemistry students.

Mathematics Phobia	Frequency	Percentage (%)
Do not have phobia for mathematics	115	47.3%
Have phobia for mathematics	128	52.7%
Total	**243**	**100**

Table 1 shows the prevalence of mathematics phobia among secondary school chemistry students in Otuocha Education Zone. Research findings indicate that 52% (n = 128, N = 246) of Chemistry students were observed to have mathematics phobia.

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Research question 2: What is the relationship between mathematics phobia and academic achievement in chemistry among senior secondary chemistry students in Otuocha Education Zone?

Table2: Moderated regression analysis (Process Macro) showing the relationship between mathematics phobia and chemistry achievement.

Variable	B	SE	T	P.value	LLCI	ULCI
Mathematics Phobia	-0.168	0.047	-3.552	.000	-0.261	-0.075

Outcome variable: Chemistry Achievement

Findings in **table 2** indicate there's a significant negative relationship between mathematics phobia and Chemistry achievement among secondary school chemistry students in Otuocha Education Zone (β = -0.168, $P < .05$). The negative relationship observed imply that high level of mathematics phobia is associated with poor academic achievement in chemistry whereas absence of mathematics phobia is associated with high academic achievement in chemistry.

Research question 3: What is the relationship between mathematics phobia and academic achievement of chemistry students based on gender in Otuocha Education Zone?

Table 3: Moderated regression analysis (Process Macro) showing the relationship between mathematics phobia and chemistry achievement based on gender

Variable	B	SE	T	P.value	LLCI	ULCI
Math Phobia X Gender	-0.121	0.097	-1.240	.216	-0.312	-0.071

Outcome variable: Chemistry Achievement

Based on research findings in **table 3**, it was observed that mathematics phobia has no significant relationship with chemistry achievement based on gender among secondary school chemistry students in Otuocha Education Zone (β = -0.121, $P > .05$).This finding implies that gender of

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students does not play a significant role in moderating the relationship between mathematic phobia and achievement of students in chemistry.

Hypothesis Testing

Hypothesis 1: there is no significant relationship between mathematics phobia and academic achievement in chemistry among senior secondary chemistry students.

Based on the observations in **table 2**, data suggests that a negative significant relationship exists between mathematics phobia and chemistry achievement among chemistry students. Sequel to this finding, the research hypothesis is rejected ($\beta = -0.168$, $P < .05$).

Hypothesis2: There is no significant relationship between mathematics phobia and academic achievement of chemistry students based on gender.

Data in **table 3** show no significant relationship between mathematic phobia and chemistry achievement of students based on gender, indicating that gender does play a moderating role in the observed relationship between study variables. Based on this finding, the research hypothesis is not rejected ($\beta = -0.121$, $P > .05$).

Discussion of Findings

The findings of this study revealed that mathematics phobia has a significant negative impact on students' achievement in chemistry. In mathematics phobia test, 52% of chemistry students in Otuocha Education Zone were observed to have mathematics phobia while 42% of the students do not have mathematics phobia. With 52.7% of the surveyed students reporting a phobia for mathematics, it's clear that math phobia is a significant issue affecting students studying chemistry. The study aligns with that of Mukadder and Medine (2023) which showed that the results of the quantitative analyses revealed that 62% (n = 285) of the students stated that mathematical skills had an influence that considers the chemistry course a difficult subject. Also, the finding confirms with that of Jegede (2007) which revealed that about 96% of them feared chemistry because it demands too much of calculation while 95% were of the opinion that it is difficult to understand chemical equation and arithmetic. This finding is in agreement with the

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findings of Yakubu, Bisandu and Zachariah (2019) which showed that mathematics phobia exist among senior secondary II students. In another study, Edoho, Idoko, Abubu and Igwe (2021) showed that the result of the analysis revealed that mathematics phobia has significant effect on effective learning of mathematics.

The finding of this study also showed that there is a significant negative relationship between mathematics phobia and Chemistry achievement among secondary school chemistry students in Otuocha. The findings of this study is in alignment with the findings of Yakubu, Bisandu and Zachariah (2019). The findings revealed that there is negative relationship between anxiety and achievement. The study further stated that phobia has its high impact on students' achievement. Jambee and Joji (2023) also agree with the findings of this studyshowing that students' experience of mathematics phobia is not closely related to their academic achievement. The study is in agreement with the findings of Puteh and Khalin (2016) which showed that there is a negative relationship between mathematics anxiety and students' achievement.

Conclusion

This study highlights a critical educational issue: the relationship between mathematics phobia and academic performance in chemistry among senior secondary students in the Otuocha Education Zone. The findings reveal that a significant portion of students,52.7% experience mathematics phobia in Otuocha Education Zone which correlates negatively with their chemistry achievement. This indicates that higher levels of mathematics phobia are linked to lower achievement in chemistry. Importantly, the study finds no significant differences in the impact of mathematics phobia based on gender, suggesting that both male and female students are equally affected. These insights underline the need for targeted interventions. Educators and policymakers should consider implementing strategies to support students struggling with mathematics phobia, such as enhanced tutoring, counseling services, and curriculum revisions aimed at making learning more engaging and accessible

Recommendations

Based on the findings of this study coupled with its educational implications, the following recommendations were made:

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1. The Nigerian government and education authorities should develop and implement policies aimed at reducing mathematics phobia in mathematics classes, ensuring proper training for teachers on their effective utilization. Secondly, the Nigerian Union of Teachers (NUT) and other teacher organizations should develop and implement professional programs to train educators in addressing mathematics phobia and promoting chemistry learning.
2. The Nigerian Ministry of Education should establish a monitoring and evaluation system to track the impact of mathematics phobia on student performance in chemistry over time with a focus on improving outcomes in Nigerian schools.
3. Nigerian researchers and institutions should conduct further research to explore the relationship between mathematics phobia and chemistry achievement in Nigerian contexts, investigating the impact of mathematics phobia on other areas of science education in Nigeria. Also, the National Institute for Educational Planning and Administration (NIEPA) should develop and test interventions aimed at reducing mathematics phobia and improving chemistry achievement in Nigerian schools.

These recommendations aim to address the findings of the study and provide actionable suggestions for improving chemistry education and reducing mathematics phobia in Nigeria.

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