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Mathematics Phobia among Senior Secondary School Students: Educational Intervention for Sustainable Development in Science Education in Nigeria

[1]**Anthony Pius Effiom**
anthonyeffiom67@gmail.com
https://orcid.org/0009-0002-9114-4191

[1]**Eme Orok Iban Amanso**
emeamanso@yahoo.com
https://orcid.org/0009-0000-7294-5722

[1]**Catherine Boniface Ekarika**
ekarikakate@gmail.com
https://orcid.org/0009-0004-7032-2424
[1]*Faculty of Educational Foundation Studies*
University of Calabar, Calabar

[2]**Mayen Ndaro Igajah**
mayenigajah00@gmail.com
https://orcid.org/0009-0006-9919-2883

[2]**Margaret Sylvanus Umoh**
umohms64@gmail.com
https://orcid.org/0009-0007-4048-060X
[2]*Department Library & Information Science*
University of Calabar, Calabar

Abstract
The study examines the tendency of phobia among senior secondary school students towards mathematics and its implication for sustainable development in science education in Nigeria. The study used a survey design utilizing stratified sampling technique to select 180 Senior Secondary two students from the three Education zones in Cross River State. A fifteen-item questionnaire titled Mathematics Phobia and Sustainable Development (MPSD) which provided indications of how intensely students felt about Mathematics along a four point attitude scale was designed for data collection. An achievement test consisting of twenty items was used to measure the general achievement and sex differences of students with mathematics phobia. Cronbach Alpha was utilized to establish a reliability coefficient of .76, and independent t-test was used in analysing the data collected through the achievement test. The study revealed, among others, that mathematics phobia exists among students. It was recommended, among others, that secondary schools in the state should employ qualified and resourceful mathematics teachers and establish mathematics

laboratories and ICT facilities where students will engage in practical mathematics learning so that the abstract nature of the subject may be mitigated to arouse interests and hence demystify the phobia among the students.
Keywords*:* mathematics, phobia, education, intervention, sustainable.

Introduction

Mathematics as a school subject plays a crucial role in the economic, technological and sustainable development of a nation. The relevance of mathematics has made it a compulsory subject for every student in Nigerian schools especially those in the sciences. In other words, it is the bedrock for studying other subjects especially basic and management sciences. Mathematics provides a wide range of skills in problem solving, logical reasoning, flexible thinking and computational skills that enable students to excel, especially in science related subjects in the present and for future challenges. Ukeje (2002) and Effiom (2021) asserted that no society can have a sustainable development without the effective teaching and learning of mathematics in schools.

Despite the relevance of mathematics in the school curriculum, Nigerian students' inconsistent and abysmal achievement in the subject is worrisome. Research findings have identified phobia as a factor among others that could cause poor achievement of students in mathematics (Gbolagade et al., 2013; Sule et al., 2016). Mathematics phobia is a feeling of anxiety that hinders one from efficiently tackling mathematical problems. Students who have negative attitude towards mathematics tend to exhibit phobia in their approach in solving mathematics problems. Okigbo (2022) contributed that phobia is an academic sickness whose virus has not yet been fully diagnosed for effective treatment in the class, and that symptoms of phobia are usually expressed on the faces of students in the class especially when mathematics is taught. Olaniyan and Salman (2015), Gierl and Bisanz (2022) observed that mathematics phobia is a weakness in students that affects psychological dimension of learning. More so, Tobias and Weissbrod (2019) indicated that mathematics phobia is the panic, helplessness, paralysis, and mental disorganization that arise among some people when they are required to solve mathematical problems. However, Beller and Gafni (2000), Stafshien (2001), and Umoven and Ogene (2006) opined that sex difference is among the factors that account for phobia in mathematics because males and females differ in thought process, attitude, motivation and self-concept.

Stakeholders in science and mathematics education have viewed phobia among other factors as a persistent threat on students' achievement and developmental strive as a nation. Development in Nigeria's capacity as a nation is to apply technology for the exploitation of the resources of nature. According to Effiom et al. (2021), such exploitation would rely heavily on mathematics for laying the foundation for political, government, military, scientific, technological advancement, economic development

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and socio-cultural environmental peace. Ambali (2014) contributed that development is a participatory process of social change in the society of which is intended to bring both social and material advancement involving greater equality, freedom and other valued qualities for the majority of people through gaining control over the environment. Therefore, education for sustainable development should be locally relevant and culturally appropriate to reflect environmental, economic and social condition of the community. A country like Nigeria wishes to harness both human and material resources to the fullest in order to key into sustainable development measures. There is no doubt that a sustainably developed country should ensure that its citizens acquire both physical and intellectual skills which enable them to create job for themselves and live a meaningful life (Nwigboji & Egbe, 2017). This depends on improving the quality of life for all without undermining the sustainability of natural environment for the needs of the future generations (Ugwuda, 2014; Kurumeh & Igyu, 2015).

From research findings, it is worthy to note that sustainable development is a complex and evolving concept of which many scholars and practitioners have invested many years in trying to operationalize sustainability and envisioning how to achieve it on national and local levels. Sustainable development is a difficult concept to conceive and implement because, it would be a challenging task to totally reorient the entire educational system to achieve its objectives. Therefore, the goal of mathematics education for sustainable development is to make mathematics learning more practical and meaningful to align with the development of 21st century competence such as creativity, communicative, critical thinking and collaboration (Widiati & Juandi, 2019). Such competencies are developed when problems in mathematics are presented in the form of applications in the environment, society and economics to enable students to solve future real life problems.

Furthermore, it is pertinent that sustainable development goals (SDGs) for science education should ensure that activities and materials are developed and exploited to ensure that the objectives are relevant and useful to the teacher and student in schools. Sustainability should inculcate approaches to teaching, learning and appraisals in the subject that would enhance relevance, effectiveness and societal growth. Mathematics education should be transformed to encourage sustainable thinking and practices in line with global best practices. Therefore, sustainable mathematics education should inculcate key concepts like: teaching and learning of relevant world issues, critical thinking, problem-solving and recognizing key relationships. In addition, Nwoke and Ugwuegbulam (2016) identified making connections with decisions, integrating mathematics pedagogy with other disciplines, integrating technology within pedagogy and being aware of one's responsibility to the environment as an aspect of sustainability. For effective teaching and learning of mathematics in science education for sustainable development in Nigeria, the following five strategies have been highlighted by Ekpo (1999):

i. Planning the instruction: At the planning of lesson stage in teaching and learning of mathematics concepts, the teacher has to consider, among other things, the content area to be taught, the age and ability of the learners, the language of instruction to be used, the time and space available to the teacher and the suitable style to be used.

ii. The instructional techniques: Instructional techniques or approaches refer to the different teaching methods and techniques that can be utilized in the teaching of mathematics. There are myriad of these methods and approaches for effective teaching and learning that will mitigate phobia in mathematics. Some of these techniques include, among others, cooperative learning strategy, problem solving strategy, play games strategy and the use of mathematics laboratory.

iii. Teaching and learning environment: Good classroom or learning environment has an impact on the achievement of learners in teaching and learning of mathematics. Hence, the school environment and classrooms should be conducive for learning.

iv. Maintaining discipline: An effective teaching and learning in mathematics is achieved in any class where there is a well-defined discipline. Discipline in a mathematics classroom implies a situation where the teacher is in good control of the students especially in classrooms characterized by over-crowdedness.

v. Evaluation of learners' progress: Evaluation of learning outcomes is regarded as a critical component of effective teaching in science education. The continuous assessment was put in place to replace "one shot" mode of assessment. To enhance effective teaching and learning of mathematics, formative evaluation should be frequently used. This type of evaluation will provide opportunity for stage by stage assessment of what content areas have been taught in mathematics.

Statement of the problem

Considering the relevance attached to the study of mathematics with respect to its contributions in scientific, technological and economic development of the nation, poor achievement in mathematics, which may be due to persistent phobia in the subject, poses great danger for the nation's developmental striving. Mathematics phobia, as earlier mentioned, is the panic, helplessness, paralysis and mental disorganization that arise among students when they are required to solve mathematical problems. Conceptually, in the course of teaching and learning mathematics, teachers are expected to present mathematics contents in such a way that the subject becomes real, concrete, attractive, interesting, captivating, motivating and relevant to life (Azuka & Kurume, 2015). Therefore, to contribute to the achievement of the nation's sustainable developmental goals, this study was carried out to identify mathematics phobia among secondary school students.

Purpose of the study

1. To find out the difference between the achievement of students with phobia and those without phobia in mathematics.

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2. To find out the influence of gender in the achievement of students with phobia in mathematics.

Research questions

1. What is the difference between the achievements of students with mathematics phobia and those without phobia?
2. What is the difference in the achievements of male and female students in relation to their phobia in mathematics?

Hypotheses

Ho1: There is no significant difference between the achievements of students with mathematics phobia and those without.

Ho2: There is no significant difference between the achievements of male and female students with mathematics phobia.

Methodology

The study adopted survey research design. Stratified sampling technique was used to select, purposively, one hundred and eighty (180) Senior Secondary II students from the three education zones in Cross River State namely; Calabar, Ikom and Ogoja. That is sixty (60) students (30 males and 30 females) were taken per zone which made up the sample size of 180 students used for the study.

A questionnaire of 15 items titled "Mathematics Phobia and Sustainable Development (MPSD)" which provided indications of how intensely students felt about mathematics along a four point attitude scale was designed for data collection. The MPSD has three sections of five items each with the response options of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Also a Mathematics Achievement Test (MAT) consisting of 20 items was used to measure the general achievement and sex differences of students with mathematics phobia. Both instruments were administered to the students simultaneously.

Cronbach Alpha was utilized to establish a reliability coefficient of .76 and validation of the instruments were ascertained by test expert from Measurement and Evaluation unit, University of Calabar. Data collected from these instruments were analyzed using mean and standard deviation to answer the research questions while independent t-test was used to test the research hypotheses at .05 level of significance.

Presentation of results

Research questions 1: What is the difference between the achievements of students with mathematics phobia and those without phobia?

Table 1: Mean and Standard deviation of students with phobia and those without

Group	N	Mean	SD
With Phobia	90	46.27	6.362
Without Phobia	90	51.38	6.635
Differences		5.11	0.273

Result from table 1 shows a mean score difference between students with mathematics phobia and those without phobia as 5.11 and standard difference of 0.273.

Ho1: There is no significant difference between the achievements of students with mathematics phobia and those without.

Table 2: Independent t-test analysis of mean scores of students with and without phobia

Group	N	Mean	SD	Df	t-cal	t-crit	Remarks
Phobia	90	46.27	6.36				
				178	32.47	2.57	Significant
Without Phobia	90	51.38	6.63				

Result on table 2 shows that at .05 level of significance with df = 178, the t-calculated (32.47) is greater than the t-critical (2.57). The null hypothesis 1 is rejected indicating that there is a significant difference in the mean scores of students with phobia and those without phobia in mathematics.

Research question 2: What is the difference in the achievements of male and female students in relation to their phobia in mathematics?

Table 3: Mean and standard deviation of male and female students with phobia

Group	N	Mean	SD
Male	45	28.43	3.254
Female	45	21.07	3.011
Difference		7.36	0.243

Result from table 3 shows a mean score difference between male and female students with mathematics phobia of 7.36 and standard difference of 0.243.

Ho2: There is no significant difference between the achievements of male and female students with mathematics phobia.

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Table 4: Independent t-test analysis of mean scores for male and female students with phobia

Group	N	Mean	SD	Df	t-cal	t-crit	Remarks
Male	45	28.43	3.25				
				88	24.31	1.86	Significant
Female	45	21.07	3.01				

Result from table 4 shows that at .05 level of significance with df= 88, the t-cal (24.31) is greater than the t-cri (1.86). Therefore, the null hypothesis 2 is rejected indicating that there is significant difference between the achievement of male and female students with mathematics phobia.

Discussion of the findings

Result from table 1 shows that students without phobia achieved more in mathematics than those with phobia. This view is consolidated by the result in table 2 which shows that there is a significant difference in the mean scores of students with phobia and those without phobia in mathematics. One of the major causes of poor achievement in mathematics among secondary schools students in the current study is phobia in students offering mathematics. The findings corroborate Sule et al. (2016) who conducted a study on Mathematics phobia among senior secondary school students: Implication for manpower development in science education in Nigeria. These authors basically revealed, among others, that students without phobia achieved more in mathematics than those with phobia. In a related development, Nwoke and Ugwuegbulam (2016) in the study on causes and solutions of Mathematics phobia among secondary school students, revealed that students who tend to achieve poorly in mathematics is as a result of factors like teachers' method of teaching, teacher-students relationship, use of abusive words on students; and these cause mathematics phobia among students. More so, Gbolagade et al. (2013), in the study on demystifying Mathematics phobia in schools for transforming Nigeria in attaining Vision 2020, supported that unnecessary phobia on the part of the students affects their achievement and that students who do not exhibit fear, anxiety, depression and stress excel in mathematics.

Table 3 shows the mean achievement score of male and female students with mathematics phobia in favour of the male. That is to say, male students with phobia achieve more in mathematics than their female counterparts. Also, Table 4 established that there is significant difference between the achievement of male and female students with mathematics phobia. Sule et al. (2016) and Umoven and Ogbene (2006), in their study on gender difference and achievement in mathematics, observed that female students achieves lower in mathematics than the male. According to them, mathematics is a masculine subject which belongs to selected few and that historically, there have been more male mathematicians than female ones. Stafshien (2001) corroborates that male and female students differ in mathematics strategies, thought processes, self-

concept and motivation. Males are better in retaining new quantitative information than the females when testing for immediate recall and research skill techniques. Beller and Gafni (2000) also affirmed the finding of the present study when in their study, they reported that there is significant difference in the mean achievement scores of male and female students in multiple choice test item formats in mathematics. According to them, the males achieved higher than females in multiple choice items than in constructed response format.

Conclusion

The continuous awareness of mathematics phobia in students is detrimental to the Nigeria's developmental strides especially in manpower development in science education sector, which may lead to backwardness in the technological advancement of the nation. In the current study it was found that there is a significant difference between students with phobia and those without phobia in mathematics. It shows that students without phobia achieve more in mathematics than those with phobia; more so, a significant difference between male and female students with mathematics phobia was observed in favour of the male. The increasing relevance and contribution of mathematics to bring about a sustainable development in science education should be well articulated in schools. Stakeholders should take a critical look into the factors that are responsible for poor teaching and learning of mathematics by teachers and students respectively and therefore suggest ways of mitigating and demystifying the phobia of which would enhance achievement in mathematics especially at the primary and secondary school levels of education where a good foundation for learning the subject is expected.

Implications of the findings of the study

The findings of the study have obvious educational implications for teachers and students. The nation's technological development depends on both the quality and quantity of professional mathematics teachers that can effectively impart the knowledge to the students. However, with the continuous phobia in mathematics by students, the society would continue to experience inadequate manpower development in science education, which may lead to backwardness in the technological advancement of the entire nation.

Recommendations

1. There should be regular recruitment of qualified professional teachers to teach mathematics.
2. Mathematics laboratories and ICT facilities should be established in schools with relevant instructional aids. The student's interest is attracted to physical/visual objects when utilized in teaching and learning mathematics concepts.
3. Teachers should be regularly re-trained on resourcefulness in designing phobia-reducing techniques in teaching mathematics to students.

4. The Guidance and Counselling unit in schools should be established to re-direct students' thinking about mathematics and also ensure good teacher-student relationship in the system
5. Academic visits/excursions to important places such as National Mathematical Centre and so on, should be organized in schools. This attracts students' interest towards mathematics.
6. Educational programmes like quizzes and debates in mathematics and other basic science subjects should be broadcast in television and radio to boost students' interest in mathematics.
7. Scholarship schemes should be made available to students who further their studies in mathematics and other basic sciences.
8. Mathematics associations and clubs should regularly organize workshop, seminars and conferences particularly on mitigation and demystification of mathematics phobia in schools especially at the primary and secondary school levels of education.
9. There should be prompt payment of teachers' salary and other incentives to encourage them to put in their best.

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