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MATHEMAPHOBIA AND ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN MATHEMATICS IN RIVERS STATE NIGERIA

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Abstract
The study investigated mathemaphobia and academic performance of senior secondary school students in Mathematics in Rivers State Nigeria. Three objectives, three research questions and three null hypotheses were formulated to give the study a focus. The Taro Yamane method and simple random sampling technique were used to draw a sample of 371 Senior Secondary Class two (SSC2) students from a population of 5,318 in Port Harcourt Local Government Area of Rivers state. The analytic survey research design was used to conduct the study. The three instruments used for the study were the Students' Mathemaphobia Prevalence Questionnaire (SMPQ), Mathemaphobic Diagnostic Questionnaire (MDQ) and Students' Mathematics Grade Inventory (SMGI). The three instruments were validated by experts in Mathematics education before usage. The reliability coefficients of 0.81, 0.76 and 0.73 were established for the instruments SMPQ, MDQ and SMGI respectively. The mean, standard deviation and z-test were the statistical tools used for analysis at 0.05 level of significance. The findings showed that there was a prevalence of mathemaphobia among the male and the female students with no significant statistical difference. It was also revealed that the non-mathemaphobic students had a higher performance in Mathematics than the mathemaphobic students with a statistical significant difference. The male mathemaphobic students performed better than the female mathemaphobic students in Mathematics though with no significant statistical difference. Based on the findings it was recommended that mathematics teachers should endeavour to diagnose the mathemaphobic status of students, counsel the students and thereafter employ innovative strategies for instruction.

Keywords: Mathemaphobia, Performance, Prevalence, Students, Mathematics

Introduction

The aim of teaching mathematics in schools is to produce students that will be capable to further their education and effectively function in society logically, creatively and reasonably by applying problem-solving and critical thinking skills. This indicates that the knowledge of mathematics is useful in all professions and vocations. This may suggest why mathematics is made a core subject at the primary and secondary school levels of education. The knowledge which students gain from mathematics is essential to the individual student and the society at large (The Times of India, August 3, 2015; Das, 2020: Cuemath, 2021). Students who apply mathematical knowledge to solve myriads of problems in society have contributed their quota one way or the other to the national, scientific, technological, vocational and economic growth of the society. It, therefore, becomes necessary that students' performance in Mathematics should be improved upon to attain and sustain the national development of Nigeria.

Despite the key role of Mathematics in national development, students' performance has continued to remain poor (Odili, 2006). The knowledge of Mathematics is necessary for the development of all and sundry. However, so many students shy away from Mathematics because they are not comfortable dealing with mathematical tasks. Santos (2021) posited that one of the reasons which could cause this is anxiety. The anxiety which students exhibit due to mathematical concerns is known as Mathematics Anxiety (MA). MA showcases itself in students in a variety of

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ways such as nervousness, concern, worry, panic, uneasiness, apprehension, fright, horror and fretfulness. Any student who exhibits any of the above mentioned will no doubt develop fear for any task that is mathematical. Hence, the term mathemaphobia. or mathophobia.

Osborn (2019) defined phobia as an irrational fear or horror for something that is likely not in any position to cause harm. Phobia is a psychological phenomenon that makes someone experience intense fear. The word phobia had its origin from the Greek word "Phobos" which means fear. It is important to note that it is not only in Mathematics that phobia is combined with to indicate fear of Mathematics. There are so many other words which when combined with phobia literally indicate the fear for something. Table 1 below shows some words which can be combined with phobia.

Table 1: Types of Phobia

1	Acrophobia	Fear of heights
22	Aerophobia	Fear of flying
3	Agoraphobia	Fear of places or situations
4	Arithmophobia	Fear of numbers
5	Atelophobia	Obsessive fear of imperfection
6	Chromophobia	Fear of colours
7	Claustrophobia	Fear of confined or crowded space
8	Cyberphobia	Fear of computers
9	Dumasaphobia	Fear of people with low intelligence
10	Hydrophobia	Fear of water
11	Numerophobia	Fear of numeracy
12	Phobiaphobia	Fear of phobias
13	Technophobia	Fear of technology

Mathemaphobia simply means the fear of Mathematics. Mathematics phobia causes significant anxiety disorder which results in distress when students are presented with mathematical tasks no matter how simple the task is. This distress may interfere with students' ability to do well in mathematics and also activities at home, work, school and social life. Olaniyan and Salman (2015) posited that mathemaphobia is regarded as a Mathematics weakness in students which deals with psychological dimension of learning. Some of the features which surround mathemaphobic students are panic when solving problems in mathematics, helplessness and mental disorganization which comes to play when students are required to solve mathematical problems. Mathemaphobia which is also known as MA can be said to be a feeling of avoidance and dread when dealing with any situation which is directly or indirectly linked to mathematics. It is a repetitive phenomenon that students experience when they engage in the manipulation of numbers in both academic and everyday life activities.

Research findings have shown that the fear of Mathematics among students has had a negative impact on their achievement in Mathematics. Kunwar (2020) posited that what increases the mathemaphobia among students is the myths that surround the subject matter of Mathematics. Going with the above, it becomes evident that the information that students receive from their predecessors, peers, siblings and parents concerning Mathematics impact their attitude towards the subject. Other causes of mathemaphoba are the nature of Mathematics tests, nature of Mathematics, the structure of the Mathematics curriculum, teacher attributes, students' study habits, teacher instructional and evaluation techniques.

Mathematics phobia is experienced by students in all manner of shapes and magnitude. Mathematics anxiety can be identified among students in every Mathematics class though in varying dimensions and degrees. The facilitators of Mathematics, therefore, have a significant role to play to reduce the negative influence of MA in students. This can be achieved by adopting appropriate innovative instructional strategies to improve performance in Mathematics. Mahapatra (2020) suggested that the best way to eradicate mathemaphobia from students is for each stakeholder in the triangle (teacher-students-parent) to put in a concerted effort to demystify the dreadful phenomenon. Being positive and studious with mathematical tasks can also help students overcome mathemaphobia (Selvaraj, 2021; Mahanta, 2019; Vidyalaya, 2019).

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Ferguson (2020) opined that Mathematics anxiety which students experience causes a negative emotional reaction towards Mathematics. Negative emotions towards mathematics lead to students' low-esteem in the subject because it influences their perception of the subject. Mathemaphobia can occur at any stage of students learning. This makes it essential for Mathematics instructors to be on the watch when dealing with students mathematically. The research findings of Khatoon and Mahmood (2010) revealed that students who experience mathemaphobia do not achieve high in Mathematics. In a nutshell, MA does not only affect achievement in Mathematics but in other school subjects which are mathematically inclined. This may suggest why Stephen (2007) opined that mathemaphobia is an abnormal and persistent fear for Mathematics. Stephen further described the phenomenon as an academic communicable disease that has had a negative impact on students' performance in Mathematics and other sience subjects. Oyegoke, Oyelabi and Nnaji (2016) carried out a study on mathemaphobia and teaching/learning materials as correlates on pupils' achievement in Mathematics and found out that mathemaphobia contributed significantly to the prediction model while availability, adequacy and utilization of teaching –learning materials contribution were not significant to students; achievement in Mathematics

It is believed that when the inducement which causes the threatening situation of students during mathematical tasks are removed or controlled, the MA tends to reduce or disappear. Stephen (2007) described it as an academic communicable disease because it has also spread and affected the science subjects that are hinged on mathematics. It is the level of science and technology of any nation that determines its economic growth. It, therefore, becomes imperative to investigate the prevalence of mathemaphobia among senior secondary school students and the possible effect mathemaphobia have on the academic achievement of students in Mathematics which is the gateway and queen of sciences.

Problem Justification

The subject matter of Mathematics has continuously ravaged the academic pursuits of so many students. It has been observed by the researcher that the students who are good at Mathematics are indeed good at it, and those who are not good at Mathematics struggle with almost every mathematical task presented to them. This continuous struggle to solve mathematical problems for sure springs up a psychological fear for Mathematics among students. Research evidence has shown that the poor performance of students in Mathematics is attributed to factors such as teacher quality, method of teaching, dearth of instructional materials, students attitude towards mathematics, students study habits, peer group pressure and lack of study materials. Phobia and anxiety among students are other factors that could affect students' performance in Mathematics. Little attention has been paid to the feeling of tension, apprehension or fear which could interfere with the efficient tackling of mathematical tasks of students. Senior secondary school students could be housing mathematical phobia judging from the fact that so many students view Mathematics as a difficult subject. This study was therefore set to investigate the prevalence of mathemaphobia among senior secondary students and the possible effect that fear of Mathematics could have on students' academic performance.

Aim and Objectives of the Study

The study aimed to investigate the prevalence and effect of mathemaphobia on the academic performance of senior secondary school students in Mathematics while the objectives were to:

1. Find out the prevalence of mathemaphobia among male and female senior secondary students in Mathematics.
2. Determine the difference between the achievement of mathemaphobic and non-mathemaphobic senior secondary students in Mathematics.
3. Ascertain the difference between the achievement of male and female mathemaphobic senior secondary students in Mathematics.

Research Questions

The three research questions formulated for this study were:

1. What is the prevalence of mathemaphobia among male and female senior secondary students in Mathematics?
2. What is the difference between the achievement of mathemaphobic and non-mathemaphobic senior secondary students in Mathematics?
3. What difference exists between the achievement of male and female mathemaphobic senior secondary students in Mathematics?

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Hypotheses

Three null hypotheses were tested at 0.05 alpha level.

H_{O1}: There is no significant difference in the prevalence of mathemaphobia among male and female senior secondary school students in Mathematics.

H_{O2}: There is no significant difference between the achievement of mathemaphobic and non-mathemaphobic senior secondary students in Mathematics

H_{O3}: No significant difference exists between the achievement of male and female mathemaphobic senior secondary students in Mathematics.

Materials and Methods

Research Design: The analytic survey research design was used to conduct the study. This design was used because it sought information from the respondents and also hypotheses were tested in the study.

Participants: The population of this study comprised all 5,318 senior secondary class two (SSC2) students in the 24 public senior secondary schools in Port Harcourt Local Government Area of Rivers State, Nigeria. Taro Yamane method for sample size calculation was employed to draw a sample of 371 senior secondary school two students from the population. Thereafter, fifty-three SS2 students were randomly drawn from each of the seven sampled

Instruments for Data Collection: Three instruments were used to collect the data for the study. They are:

1. Students' Mathemaphobia Prevalence Questionnaire (SMPQ).
2. Mathemaphobic Diagnostic Questionnaire (MDQ)
3. Students' Mathematics Grade Inventory (SMGI).

All three instruments had section A which elicited information on sample students' profiles. The first instrument, SMPQ had 10 items that were researcher-constructed. This instrument was used to elicit information from the respondents to ascertain the prevalence of mathemaphobia among senior secondary class two (SSC2) students. It was rated on a 4-point scale of Strongly Agree (SA=4), Agree (A=3), Disagree (D=2), Strongly Disagree (SD=1) with a criterion mean of 2.5.

MDQ which was the second instrument was made up of 50 items that were used to categorize students into mathemaphobic or non-mathemaphobic. MDQ was rated on a 2-point scale of Yes (Y=2) and No (N=1). The criterion mean of 1.5 was used to categorise a student into mathemaphobic or non mathemaphobic.

The third instrument, SMGI was a grid inventory that was prepared by the researcher for the recording of sample students' existing previous results in Mathematics. The instrument had five columns and 371 rows. The columns represented sample students' serial number, name of students, mathemaphobic status of student, Mathematics score and score letter grade while the 371 rows represented the sample size for the study.

Validity of the Instrument: The three instruments were subjected to face and content validation. Thus, three experts in Mathematics education carried out the validation. This was to ensure that the items of the instruments strictly addressed the objectives of the study. The experts were served copies of the three instruments to be validated and were requested to assess and make modifications to the structure, organization, and arrangement of the items. The inputs (suggestions, observations and restructuring of the instrument) of these experts were incorporated into the final copies of the instruments before administration to the sample.

Reliability of the Instrument: The reliabilities of SMPQ and SMGI were obtained using the test-retest method while the Kuder Richardson Formular 20 (KR-20) was used to obtain the reliability of MDQ. The twenty students that were used for the reliability exercise did not participate in the main study. Hence, the reliability coefficients of 0.81, 0.76 and 0.73 were established for the instruments SMPQ, MDQ and SMGI respectively.

Procedure for Data Collection: Data was collected by the researcher with the help of three research assistants. The collection of data was by physical mode. The instruments were collected on the spot from the respondents. The respondents of the study were classified into two groups (mathemaphobic and non-mathemaphobic) with the help of the Mathemaphobic Diagnostic Questionnaire (MDQ). Students were administered the Students' Mathemaphobia Prevalence Questionnaire (SMPQ) to ascertain the prevalence of mathemaphobia among students. The previous existing Mathematics results of the sample students were collected from the school result dossier and copied into the

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Students' Mathematics Grade Inventory (SMGI). The copying was done handwritten because the sample school authority did not permit the researcher to xerox the results.

Method of Data Analysis: Mean and standard deviation were used to answer the research questions while the z-test statistic was used to test the null hypotheses at 0.05 significant level.

Results

Research Question 1: What is the prevalence of mathemaphobia among male and female senior secondary students in Mathematics?

Table 1: Mean and standard deviation on the prevalence of mathemaphobia among senior secondary school students by gender

S/n	Item	Male n = 159		Female n= 212	
		Mean	Std. Dev.	Mean	Std. Dev.
1	I am bad at Mathematics	3.72	0.81	2.84	0.84
2	I do not like Mathematics	3.18	0.74	2.77	0.57
3	I sweat whenever I solve Mathematics problems	2.51	0.82	2.35	0.63
4	I experience a racing heart when I solve problems in Mathematics	1.73	0.69	1.11	0.78
5	Mathematics is difficult	2.88	0.73	2.72	0.75
6	Too many calculations make me dislike Mathematics	3.02	0.77	3.85	0.80
7	Mention of Mathematics panics me	3.15	0.85	3.02	0.71
8	Mathematics calculations throws me off balance	2.78	0.72	3.58	0.63
9	I always bite my nails during problem-solving in Mathematics	1.04	0.58	2.35	0.88
10	I develop passive attitude during math instruction and tests.	2.67	0.92	3.51	0.67
11	Mathematics test makes me develop watery palm	2.63	0.65	2.32	0.82
12	Mathematics tests makes me sick	2.85	0.83	2.86	0.75
	Grand Mean	**2.68**	**0.84**	**2.77**	**0.78**

Criterion Mean = 2.50

Table 1 showed the mean response of male and female senior secondary students on the prevalence of mathemaphobia. From the table, it was revealed that there was prevalence of mathemaphobia among the male students (Grand mean = 2.68 > 2.50, Std. Dev. = 0.84) and the female students (Grand mean = 2.77 > 2.50, Std. Dev. = 0.78)

Research Question 2: What is the difference between the achievement of mathemaphobic and non-mathemaphobic senior secondary students in Mathematics?

Table 2: Achievement mean score of mathemaphobic and non-mathemaphobic students in Mathematics

Group	n	Minimum Score	Maximum Score	Performance Mean	Std. Dev.
Mathemaphobic	254	35	47	44.16	15.63
Non-mathemaphobic	117	51	92	67.31	14.82
	371				

Table 2 showed the difference between the achievement scores of the mathemaphobic and the non-mathemaphobic students in Mathematics. The table showed that the minimum and maximum scores obtained in the mathemaphobic students' group were 35% and 47% respectively while that of the non- mathemaphobic students' group were 51% minimum score and 92% maximum score. The students in the mathemaphobic group had an achievement mean score = 44.16, Std. Dev. = 15.63 while the non-mathemaphobic students had a performance mean score = 67.31, Std.

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Dev. = 14.82. The non-mathemaphobic students had a higher performance mean score than the mathemaphobic students in Mathematics.

Research Question 3: What difference exists between the achievement of male and female mathemaphobic senior secondary students in Mathematics?

Table 3: Performance mean score of the male and the female mathemaphobic students in Mathematics

Gender	n	Minimum Score	Maximum Score	Mean Score	Std. Dev.
Male	94	39	47	45.47	13.85
Female	160	35	45	44.16	16.42
	254				

Table 3 showed the difference between the performance of male and female mathemaphobic students in Mathematics. The table showed that the minimum and maximum scores obtained by the male mathemaphobic students were 39% and 47% respectively while that of the female mathemaphobic students were 35% minimum score and 45% maximum score. The table showed that the male mathemaphobic students had a performance mean = 45.47, Std. Dev. = 13.85 while the female mathemaphobic students had a performance mean = 44.16, Std. Dev. = 16.42. The male mathemaphobic students had a higher performance mean score than the female mathemaphobic students in Mathematics.

Ho_1: There is no significant difference in the prevalence of mathemaphobia among senior secondary school students by gender.

Table 4: z-test analysis on the prevalence of mathemaphobia among senior secondary school students by gender.

Group	N	Mean	SD	Df	Sig level	zcal	Zcri	Decision
Male	159	2.68	0.84	369	0.05	1.04	1.96	Retain H_{01}
Female	212	2.77	0.78					

Table 4 showed the z-test analysis on the prevalence of mathemaphobia among senior secondary school students by gender. From the table, it is evident that Zcal = 1.04 < Zcri = 1.96 at df =369 and 0.05 significant level. H_{O1} was therefore retained and this implies that there is no significant difference in the prevalence of mathemaphobia among senior secondary school students by gender.

Ho_2: There is no significant difference between the achievement of mathemaphobic and non-mathemaphobic students in Mathematics.

Table 5: Z-test analysis on the difference between the achievement of mathemaphobic and non-mathemaphobic students in Mathematics.

Group	N	Mean	SD	Df	Sig level	Zcal	Zcri	Decision
Mathemaphobic	254	44.16	15.63	369	0.05	2.05	1.96	Reject H_{O2}
Non-mathemaphobic	117	67.31	14.82					

Table 5 showed the Z-test analysis on the difference between the achievement of mathemaphobic and non-mathemaphobic students in Mathematics. From the table, it is evident that Zcal = 2.05 > Zcri = 1.96 at df =369 and 0.05 significant level. H_{O2} was therefore rejected and this implies that there is a significant difference between the performance of mathemaphobic and non-mathemaphobic students in Mathematics.

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H_{O3}: There is no significant difference between the achievement of the male and the female mathemaphobic students in Mathematics.

Table 6: z-test analysis on the difference between the achievement of the male and the female mathemaphobic students in Mathematics

Gender	n	Mean	SD	Df	Sig level	Zcal	Zcri	Decision
Male	94	45.47	13.85					
				252	0.05	1.12	1.96	Retain H_{O3}
Female	160	44.16	16.42					

Table 6 showed the z-test analysis on the difference between the performance of male and female mathophobic students in Mathematics. From the table, it is evident that Zcal = 1.12 < Zcri = 1.96 at df =252 and 0.05 significant level. H_{O3} was therefore retained and this implies that there is no significant difference between the performance of mathophobic and non-mathophobic students in Mathematics.

Discussion of Findings

Prevalence of Mathophobia among Students: Table 1 showed the mean response of male and female senior secondary students on the prevalence of mathemaphobia. From the table, it was revealed that there was prevalence of mathemaphobia among the male students (Grand mean = 2.68 > 2.50, Std. Dev. = 0.84) and the female students (Grand mean = 2.77 > 2.50, Std. Dev. = 0.78). When subjected to statistical test it was revealed that there was prevalence of mathemaphobia among senior secondary school students by gender. From the table, it is evident that Zcal = 1.04 < Zcri = 1.96 at df =369 and 0.05 significant level. This is in agreement with the findings of Olaniyan and Salman (2015) established that mathemaphobia is a Mathematics weakness in students which deals with psychological dimension of learning.

Performance of Mathemaphobic and non-mathemaphobic students in Mathematics: Table 2 showed that the minimum and maximum scores obtained in the mathemaphobic students' group were 35% and 47% respectively while that of the non-mathemaphobic students' group were 51% minimum score and 92% maximum score. The students in the mathemaphobic group had a performance mean score = 44.16, Std. Dev. = 15.63 while the non-mathemaphobic students had a performance mean score = 67.31, Std. Dev. = 14.82. The non-mathemaphobic students had a higher performance mean score than the mathemaphobic students in Mathematics. When subjected to statistical analysis, it found out that there is a significant difference between the performance of mathemaphobic and non-mathophobic students in Mathematics. This agrees with the findings of Khatoon and Mahmood (2010).

Performance of Mathemaphobic students in Mathematics by gender: This finding showed that the minimum and maximum scores obtained by the male mathemaphobic students were 39% and 47% respectively while that of the female mathemaphobic students were 35% minimum score and 45% maximum score. The table showed that the male mathemaphobic students had a performance mean = 45.47, Std. Dev. = 13.85 while the female mathemaphobic students had a performance mean = 44.16, Std. Dev. = 16.42. The male mathemaphobic students had a higher performance mean score than the female mathemaphobic students in Mathematics. When subjected to statistical test, it showed that. There is no significant difference between the performance of mathemaphobic and non-mathemaphobic students in Mathematics.

Conclusion

This study concluded that there was a high prevalence of Mathematics anxiety which leads to mathemaphobic experiences among senior secondary school students and that the non-mathemaphobic students had a higher performance in Mathematics than those who are mathemaphobic. It was also concluded based on the findings that the male mathemaphobic students outperformed their female counterpart in Mathematics, though without any statistical significant difference.

Recommendations

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It was recommended that:

1. Mathematics teachers should endeavor to diagnose students' state of phobia in Mathematics.
2. Mathematics teachers should also employ innovative instructional strategies which are capable of catering for the needs of the mathemaphobic students.
3. Guidance and counselling of students by Mathematics teachers with regards to tips on trampling on the anxiety which students have in Mathematics should be a continuous process during in-class and after-class instruction.

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