



DOES MATH-ANXIETY AFFECT SENIOR SCHOOL STUDENTS' MATHEMATICS PERFORMANCE? EVIDENCE FROM EKITI STATE, NIGERIA

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Abstract

This study identified mathematics anxiety and its effects on students' in performance in Mathematics among Senior School Students in Ekiti State, Nigeria. The sample consisted of 238 SSSII students and 25 math-teachers that were randomly and purposively selected respectively. A questionnaire adapted from the Fennema-Sherman Mathematics Attitudes Scale (FSMAS) was used for the study. Descriptive statistics was used to answer the research questions while t-test was used to test the hypotheses. The study showed that mathematics anxiety exist among senior school students in the study area, which is characterized by feverish feelings in Mathematics class, difficulty in understanding math problem, failure to contribute in Mathematics class, truancy in Mathematics class among others. The study showed that there is a difference in the performance of Mathematics anxious and non-mathematics anxious students as revealed from the t-test. Also, the mean score of the math-anxious student and non-math anxious students were found to be 31.84% and 61.31% respectively. It is concluded from the study that Mathematics anxiety affects students' performance in Mathematics. Concerned stakeholder should implement policies at secondary school level to extend the time of Mathematics class on time table, provide conducive environment and engage innovative teaching methods for the teaching of Mathematics.

Keywords: gender, mathematics anxiety, Nigeria, performance, senior school

A. Introduction

Mathematics is important to everyday life; it is described as the queen and servant of Sciences. Mathematics is a core subject in Nigerian secondary schools. The study of the subject was established in schools in order to produce competent persons who are skilful in applying

mathematical knowledge in solving everyday life problem. This is the reason why credit pass in Mathematics is one of the requirements for admission into higher institution in Nigeria. Mathematics is also relevant to decision making process. The Nigerian national policy document on education (Federal Republic of Nigeria, 2013) shows that improvements in the teaching and learning of Science, Technology and Mathematics (STM) is necessary in order to create the basis for technologically sound workforce in line with the nation's developmental needs (Onwuachu & Nwakonobi 2009). However, the student's interest and weakness in Mathematics learning could affect the efforts of various sectors in achieving the Sustainable Development Goals (SDGs) of making Nigeria a fully developed nation by next decade.

Many studies over the years have indicated that many people have negative attitudes to mathematics, sometimes leading to anxiety (Hembree, 1990; Ashcraft, 2009; Maloney and Beilock, 2012). Mathematics anxiety is a feeling of tension that interferes with the manipulation of numbers. Math-anxiety affects all students regardless of their discipline (Fortin, Marcotte, Diallo, Potvin, & Royer, 2013). Higher levels of Math-anxiety have been linked to occupational deficiencies. For example, math-phobia transfer have been found to be transferred from math anxious teachers to students (Beilock, Gunderson, Ramirez, and Levine, 2010; Mcmillan, Jones and Lea 2012). However, the negative effect of math-anxiety on students' achievement in mathematics has interest researchers for several years (Richardson and Suinn 1972; Fennema, 1977; Richardson and Woolfolk 1980; Ashcraft and Ridley 2005; Lyons and Beilock 2011; Maloney et al. 2010 Predeep, 2012; Erin and Beilock 2012; Beilock and Willingham 2014). Further Studies have shown, it can lead to decreased working memory, poor career performance, and avoidance of math pursuits (Miller and Bichsel 2004; Erin and Beilock 2012; Beilock and Willingham 2014). Much of the research on math -anxiety's causes has focused on early exposure to negative math experiences.

Furthermore, studies have linked Math-anxiety to genetic risks underlying poor ability in Mathematics and general anxiety may already predispose children to the development of Mathematics-anxiety (Wang, Hart, Kovas, Lukowski, Soden, Thompson, . . . and Petrill 2014; Maloney, Ramirez, Levine, and Beilock, 2015). However, a positive attitude is important as studies show that there is a relation between students' performance and their attitude to Mathematics (Mohd, Mahmood & Ismail, 2011; Marchis, 2013); students with a positive attitude towards Mathematics have better problem solving skills and like more to solve non-routine problems (Marchis, 2013). With these how can math-anxiety related issues be solved among students.

In light of the evidence that negative thoughts and worries causes students to underperform in mathematics. Mathematics anxiety is regarded as mathematics weakness in students. It deals with the psychological dimension of learning. It is important for educators to identify this factor in enhancing mathematics interest of students. Math-anxiety has been identified to affect students achievement leading to students learning difficulties and show poor performance in mathematics (Predeep, 2012; Erin and Beilock 2012; Beilock and Willingham 2014).

In addition to the above research suggesting that mathematics anxiety may be socially transmitted. Maloney and colleagues (Maloney et al. 2010; Maloney et al. 2011; Maloney et al. 2012) have argued that some people may, in fact, be cognitively predisposed to develop mathematics anxiety. Students who present with deficits in the basic building blocks of mathematics are likely to struggle with mathematics and consequently develop a great deal of anxiety when engaging in mathematics tasks. This opined is based on evidence that high mathematics-anxious adults perform more poorly than their low mathematics-anxious peers on tests of basic numerical and mathematical abilities. Popoola (2008) emphasized that the traditional mathematics teaching methods in Nigeria supports rote learning and memorization which aids maths-anxiety. Popoola (2014) opined that innovative teaching method is best at enhancing student's mathematics achievement and reducing negative attitude towards mathematics.

In Nigeria, efforts have been made at investigating trends of students' achievement in Mathematics as well as factors responsible for the level of such achievement. However, these researchers are not aware of empirical evidences on the Mathematics-anxiety identification and effect on performance in Ekiti State, Nigeria. From fore going, it is against this background that this study identified mathematics anxiety among senior school students, assess its effect on student's math-performance and examine the gender dimension to Mathematics anxiety in Ekiti North Senatorial District, Nigeria.

Research Hypotheses

The following research hypotheses were tested:

HO₁: There is no significant difference in the mathematics performance of students with and without mathematics anxiety.

HO₂: There is no significant difference in the performance of students with Mathematics anxiety based on gender.

B. Literature Review

1. *Influence of Mathematics Anxiety on Students' Academic Performance*

The study conducted by Sherman and Wither (2003), on students from the age of 6 to the age of 10 revealed that the students level of mathematics anxiety in is strongly related to student achievement. These findings were corroborated by Elenchothy (2007), which showed an inverse relationship between mathematics anxiety and student achievement. This inverse relationship implies that students with high level of mathematics anxiety will realize low mathematics achievement. The results conform to the findings of Khatoon and Mahmood (2010); Kusaeri and Cahyan (2016), Yuksel-Sahin (2008) and Satake and Amato (1995). Students will often get worried, frustrated, tired and afraid or feel that mathematics is not important and will refuse to learn mathematics, even though it is a compulsory and important subject for engineering, science and technology. Arem (2009), noted that students with higher level of mathematics anxiety engage in negative thinking about their self-ability. These students will exhibit less confidence in working with numbers and mathematical concepts through a problem-solving process.

Zakaria (1997) also explained that students that perform well in mathematics often have a positive attitude toward mathematics. This is in line with several researchers who reported that teachers' interest and self-confidence play an important role in student success. A student with developed interest can be encouraged to work and train without being asked by the teacher. Interest and confidence in this aspect are very important in learning to reduce anxiety in mathematics and eventually being able to obtain good performance in examinations.

Mitchell (1987) described mathematics anxiety as a combination of factors. The author stated that mathematics anxiety is a 20 combination of physical, cognitive and psycho-behavioral components. Physical aspects of mathematics anxiety are biological, entailing hormonal, chemical and muscular changes in the body which resulting in inability to think (Mitchell, 1987). Dossel (1993), identified several factors leading to the Creation of mathematics anxiety: These are outlined as follows:

- a. Personality factors (the belief that success cannot be traced to effort-feelings associated with lack of control);
- b. Pressure of perceived authority figures (guardians, parents, teachers);
- c. Time pressure (to answer quickly and verbally);
- d. Effect of public failure (asking to perform in front of a class); and
- e. Right - wrong dichotomy (the teacher's attention should be directed towards effort rather than achievement)

Stodolsky (1985); Williams (1988) noted that the anxiety development can often be traced to negative classroom experiences and teaching of mathematics. It is considered of importance to evaluate classroom practice and establish whether the cause of mathematics anxiety may be in instructional delivery methods and in the quality of mathematics teaching in elementary school (Newstead, 1998).

Finally, the effect of providing answers in front of teachers or peers has been found to lead anxiety. There were some students, who expressed the fact that this was the only cause of anxiety for them, and that performing mathematical calculations and working with numbers was not a source of anxiety (Newstead, 1998). Kogelman (1982) found that learners who have been punished or humiliated at the blackboard usually have a damaging self-worth. Newstead (1998) concludes that learners often learn to perform mathematical tasks before they are able to explain problems and communicate about mathematics. Expecting students to provide answers to mathematical questions could lead to anxiety at the critical stage between the development of skills for doing mathematics and the development of skills for explaining it (Newstead, 1998).

The psychological factors and their effects on academic achievements are becoming issues of growing concerns among educational researchers and practitioners. Many learners experience Mathematics anxiety in schools today. It has been reported that the consequences of being anxious toward mathematics include the avoidance of the subject or related issues, the decline in mathematics achievement and conceptual processes. This kind of 'anxiety' was first detected in the late 1950s. Dreger and Aiken (1957) noticed undergraduate college students reacting

emotionally to arithmetic and Mathematics. Although this reaction shared some similarity with other test anxiety in general; they found that Mathematics anxiety has an entity of its own. The researchers called it 'number anxiety'. It is often acclaimed that high level of anxiety affects performance. However, a moderate amount of anxiety may enhance performance.

Shemp, (1986) noted that beyond a certain degree, anxiety hinders performance particularly in the case of higher mental activities and conceptual process. Many students who suffer from Mathematics anxiety have little confidence in their mathematical ability and tend to take the minimum numbers of required mathematics courses, greatly limiting their career choice options in the future (Garry, 2005). While researchers tend to agree that household quality is an important determining factor in influencing student academic outcomes, there is little consensus about the relationship between specific parents socio economic background (for example, age, income and education) on student academic achievements (Green, 1990; Ingersoll, 2001).

2. *Influence of Gender on Students' Mathematics Anxiety*

Many studies have been conducted to examine mathematical anxiety levels among male and female students. Some researchers have argued that females have higher levels of mathematics anxiety when compared with their males counterpart (Salwani and Salleh, 2001; Woodard, 2004; Yuksel-Sahin, 2008; Karimi and Venkatesan, 2009; Khatoon and Mahmood, 2010). Khatoon and Mahmood, (2010) noted further that, female students are often labeled as timid, with tendency to express fear and this characteristic can harm their ability to learn. Male students were found to be more active in a wider range of social activities than female students. Yuksel-Sahin (2008) study on secondary school students in Turkey reported that the stereotypical view of this issue has a powerful influence. Female students believed boys were gifted with the advantage of higher mathematical ability while the boys felt they were better in performing mathematical task when compared with their female counterparts. Such beliefs influence the mathematical ability of the female students negatively and their initial assumptions about mathematics achievement can have a long-term effect on their mathematics achievement (Yuksel-Sahin 2008).

However, other studies do not support this school of thought. Some researchers have argued that there is no statistical difference in mathematics anxiety levels between males and females (Marsh and Tapia, 2002; Elenchothy, 2007; Mohamed and Tarmizi, 2010).

C. Methodology

1. *Study Area and Research Design.*

The study was carried out in Ekiti State, South-West Nigeria. The State has sixteen Local Government Areas with coordinates $7^{\circ} 40'N, 5^{\circ}15'E / 7.667^{\circ}N, 5.250^{\circ} E$. The total land area is 6353Km^2 and a population of 2,237,186 people, with Agriculture providing income and employment for more than 75% of the population (NPC, 2007). The study is a descriptive research of the survey type carried out in Ekiti State Nigeria.

2. *Population and Instruments*

The population for the study would consist of 15,250 senior secondary school II (SS II) students in all 172 public secondary schools in the sixteen local government areas of Ekiti state. (Ekiti State Ministry of Education). The choice of SS II students was due to the fact that, they are not preparing for any external examination which may hinder their availability for the study. Also, they have been exposed to different concepts in Mathematics in their SSS I which will serve as basic prerequisite knowledge of the subject. The sample consisted of 238 SSS2 students and 25 math-teachers that were randomly and purposively selected respectively. Information were obtained from respondents using a designed pro forma for mathematics teacher complemented with structured questionnaire for students. The student's questionnaire was a researcher's adapted questionnaire from the Fennema-Sherman Mathematics Attitudes Scale (FSMAS), which was translated by Zakaria and Nordin (2008).

3. *Technique of Data Analysis*

Data collected was analyzed using Statistical Package for the Social Sciences (SPSS) (Ver. 20; SPSS Inc., Chicago, IL). Mean, frequency, charts and t-tests were used for analyses.

D. Findings and Discussion

1. Research Question 1 "Is mathematics anxiety present among senior school students?"

The study revealed that mathematics anxiety is present among senior school students. The pro forma given to teachers of mathematics revealed the presence of mathematics anxiety in all the selected school because teachers were able to understand the concept and its characteristics. Also, teachers were able to identify math-anxious students in their class based on math-anxious characteristics. Furthermore, in the selected schools for the study, the mathematics teachers were able to identify mathematics anxiety as a problem to mathematics learning in their schools. They were also able to provide list of math-anxious students in their class. They opined that mathematics anxiety is expressed as seen in table 1. The study showed the expression of mathematics anxiety by students is characterized by feverish feelings in math class, difficulty in understanding math problem, failure to ask or answer/contribute in math class, truancy in math class, student's refusal to do their math assignment and students showing no interest in math class. Some of these findings are in agreement with Smith (1997) and Wilson (2012) who had earlier found out that mathematics anxiety in students is characterized in a number of ways ranging from uneasiness when asked to perform mathematical task, to avoidance, feeling of physical illness, and panic in math class.

Table 1: Expression of Mathematics anxiety

S/N	Expression of mathematics anxiety	Number of Respondents
1	Feverish feelings in math class	3
2	Difficulty in understanding math problem	4
3	Students do not concentrate in math class	2
4	Students showing no interest in math class	3
5	Students' failure to ask or answer/contribute in math class	4
6	Truancy in math class	5
7	Students mood switch when asked to perform mathematical task	2
8	Students who were not showing concern for math classes	2
9	Students refusal to do their math assignment	3

2. Research Question 2 "What are the differences between the students with and without mathematics anxiety?"

The differences in performance of student with and without mathematics anxiety using t-test. The mean average score of the math-anxious student and non-math anxious students was found to be 31.84 and 61.31 respectively. The study implies that there is a statistical difference between the performance of students with and without mathematics anxiety among the respondents at 0.05 alpha levels. This is probably due to the fear and believe system that math is difficult. These conforms to the studies of (Mohamed and Tarmizi, 2010; Arem, 2003) that stated mathematics performance of student is influenced by psychological factors such mathematics anxiety. These studies stated further that many students with poor mathematic skills get disturbed while attempting to use math skills to solve problems. Tapia (2002) noted that students with low level of math anxiety or non-math-anxious feel more eager, confident and demonstrate interest to learn mathematics when compared with math anxious students. Also, according to the study Sherman and Wither (2003) mathematics anxiety is strongly related to student's mathematics achievement. This is supported by Arem (2009) conceded that students with high mathematics anxiety levels engage in negative thinking about their self-ability in mathematics. Finally, the findings further conform to Zakaria et. al., (2012) that conceded that there is a statistical difference in the mean achievement score of based on the level of mathematics anxiety.

3. Research Question 3 "Is there gender difference in the number of students who exhibit mathematics anxiety?"

The results revealed that there is no statistical significant difference in the influence of mathematics anxiety by gender at 0.05 apha levels from the t-test result. This implies that gender either male or female does not influence the fear of mathematics by students. This may be due to similarities in students' academic background and their basic knowledge of mathematics, learning environment and exposure as it relates to mathematics. These study

conforms to other studies such as (Zettle and Raines, 2000; Marsh and Tapia, 2002; Mohamed and Tarmizi 2010 and Zakaria et al 2012) that argued that there is no statistical difference in mathematics anxiety between male and female students. However, these findings contradicts the findings of Woodard (2004); Yuksel-Sahin (2008) and Karimi and Venktatesan (2009) all of which noted statistical difference in mathematics anxiety according to gender, with female having higher mathematics anxiety when compared with their male counterpart.

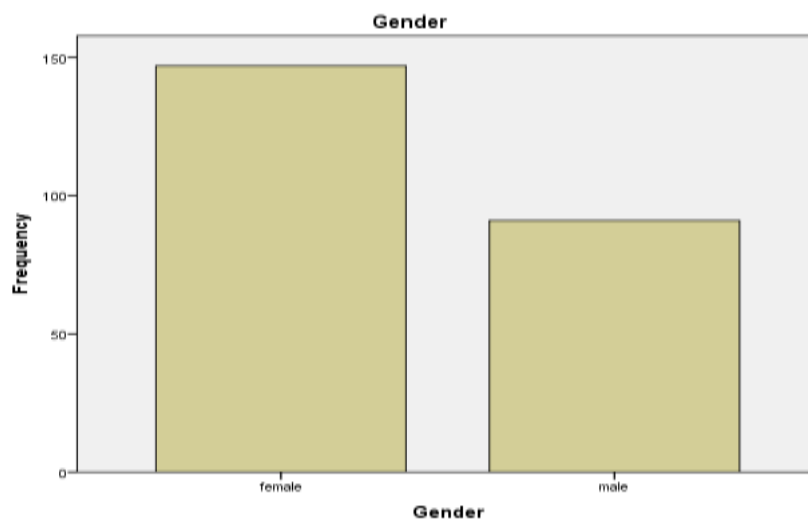


Figure 1: The chart showing the distribution of respondents by gender.

The study as shown in figure 1 revealed that 147 (61.8 percent) of the respondents were female while 91 (38.2 percent) were male. This showed the respondents were female dominated. Suggested way out of math-anxiety includes stimulating student's interest in math, students re-orientation about math, constant retraining of math teachers, extension of allocated time to math on the time table, provision of instructional facilities, adapting suitable teaching methodology for math-teaching, societal recognition for teaching profession etc

E. Conclusion

Findings from the study showed that mathematics anxiety exists among senior school students in the Ekiti State. The study showed that student's math-performance is affected by math-anxiety. There is a need for an urgent attention at solving math-anxiety challenge among school students. This is crucial considering the importance of mathematics to national development.

From the findings of this research the following recommendations are considered relevant to various stakeholders:

1. Teachers should understand individuality of learners based on their math-anxious status and devised appropriate strategies such as biblio-therapy, group studying as appropriate to help Mathematics learners.
2. Students that have been identified to be math-anxious should be helped by parents and friends as deemed fit by the teacher to overcome the challenge.
3. Students' re-orientation on mathematics is recommended through organised Mathematics counselling for students.
4. Concerned stakeholders should implement policies at secondary school level to extend time of math class on time-table as well as conducive environment for the teaching of mathematics.
5. Seminars on mathematics anxiety for mathematics teachers to help educate teachers on the concept and proffering solutions to the problem
6. Constant re-training of math-teachers by concerned stakeholders is recommended to help improve math-teaching and learning using the appropriate methodology.
7. School management should be mandated to employ only teachers with specialty in mathematics to teach the subject.

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