

Research Article

## Impact of Mathematics Anxiety on the Academic Performance of Junior High School Pupils in the Bongo District of Ghana

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### Abstract

This study aimed to explore the impact of mathematics anxiety on the academic performance of junior high school pupils in the Bongo district of Ghana. In this study, 492 pupils in the Bongo District of the Upper East Region of Ghana were sampled. Using a questionnaire to gather data for the study, Descriptive statistics such as frequency, percentage, mean, and standard deviation and inferential statistics such as the independent samples t-test, one-way between-groups analysis of variance (ANOVA) and Pearson Moment Correlation were used for analysis. Findings from the study identified that mathematics anxiety negatively affects the mathematics performance of pupils and the study also revealed that, gender plays a very key role in influence the mathematics anxiety of pupils. Based on the findings, it was recommended that mathematics teachers should teach Mathematics with the psychology of teaching and learning the subject to prepare pupils for the subject.

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**Keywords:** Anxiety, Mathematics anxiety, Mathematical phobia, Mathematics avoidance

### 1.0 Introduction

Mathematics anxiety has been shown time and again to hinder Mathematics achievement (Preston, 2008). According to research, it is a learned behaviour that often emerges early in one's educational experience, and once established, its negative effects will last throughout the school years. The National Education Assessment (2016) report also review that the general performance of Ghanaian Primary Schools in Mathematics is still well below an acceptable level, where 40% of the pupils in both 3rd and 6th grade fail to achieve minimum competence in Mathematics. Because of the significance of this phenomenon in Ghana, it is worthwhile to investigate it.

Ghana has a distinct educational system and culture. Students are ability-banded by four subjects, including mathematics, as early as kindergarten and in Junior High School Mathematics form part of the compulsory core subject that places students in second cycle schools. As such, people in Ghana place great emphasis on academic performance, especially on Mathematics.

Relevant research began in the 1970s, with Richardson and Suinn (1972) being the first to define it as "tension and anxiety that interfere with the manipulation of numbers and the solution of mathematical problems in a wide variety of everyday life and academic situations." Others have followed suit since then their efforts are motivated by research evidence that not only does Mathematics anxiety impair one's ability to perform mathematically (Preston, 2008), but it is also highly likely to have originated in the classroom (Newstead, 1998).

Fiore (1999), defined Mathematics anxiety as "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" (p 403). Pradeep cited in Mutodi, Ngirande (2014) also defined Mathematics anxiety as a state of a sinking feeling, uncertainty and despair at doing and understanding mathematics. Although the causes of math anxiety are

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still being debated, when math anxiety was reduced, achievement and performance improved (Wilbert, 2006). Vinson (2001) also observed that when anxiety is reduced, mathematics power increases. Hembree, (1990) stated that Mathematics anxiety hinders student achievement and attitude toward mathematics. It may result in poor performance and aversion to mathematics. Many people consider mathematics to be a punishment or a source of stress (Zaslavsky, 1999). There are numerous hypotheses regarding the causes of math anxiety. According to Arem (2003), there are three reasons for high levels of math anxiety and test anxiety: poor test-taking strategies, inadequate test preparation, and psychological stress. Dodd (1999), stated that the greatest challenge for the math-anxious learner is a lack of confidence.

According to Zopp (1999), unrelated life events, trigger events in education, and a lack of support all contribute to math anxiety. Furthermore, parents who suffer from math anxiety pass it on to their children, while teachers who suffer from math anxiety pass it on to their students (Fiore 1999). Male students had higher math anxiety than females, according to Preis and Biggs (2001), while females scored higher than males, according to Karimi and Venkatesan (2009). Lusser cited in Mutodi, Ngirande (2014), on the other hand, failed to find a significant relationship between gender and math anxiety, implying that other factors, such as Mathematics background, must be considered.

Foong (1987) conducted an exploratory study with 206 secondary four express female students from a single Singapore school. She found that while both Mathematics anxiety and test anxiety were negatively related to math achievement, the relationship between mathematics anxiety and test anxiety was positive and moderately strong. Her study, however, was conducted more than two decades ago, and the instruments used were all self-reported Likert-scaled questionnaires that were unable to identify students' sources of anxiety. As a result, there is a pressing need to assess students' mathematics anxiety and its relationship to mathematical performance. Mutodi, Ngirande (2014) discovered that parental home support and expectations influenced students' performance and reasoning by reducing their Mathematics anxiety in a study on home-school mediation analyses.

Mathematical phobias and anxiety may have far-reaching consequences. If math-anxious lecturers are tasked with teaching students math, their anxieties may have an impact on their students' math achievement. Anxiety, according to Makari cited in Bentil (2020), is a broad term for a variety of disorders that cause nervousness, fear, apprehension, and worry. Fear of not being able to do the math, fear of it being too difficult, or fear of failure, all of which stem from a lack of confidence. Students' feelings and behaviours are influenced by mathematics anxiety. It is common to feel anxious inside or outside of a Mathematics class. Severe anxiety may lead to math phobia in some students, while it may lead to improved achievement in others.

Math avoidance leads to less competency, exposure, and practice in Math, leaving students more anxious and mathematically unprepared to succeed (Ashcraft, 2002). Students who have had negative math experiences frequently develop this phobia and, as a result, struggle to learn various concepts because they believe they are unable to do the mathematics. According to several math anxiety researchers, some instructional strategies for teaching mathematics, as well as facilitators' training and beliefs, are some of the underlying causes of math anxiety (Ashcraft, 2002; and Hellum, 2010). Math anxiety is frequently caused by poor teaching and learning experiences in math. Some teachers have a negative attitude toward mathematics, and their lack of confidence in their practices causes students to become anxious. The teacher, on the other hand, can take many steps to reduce math anxiety, such as reviewing basic mathematics skills, ensuring students understand the mathematical language, and providing a support system for their students (Schwartz cited in Bentil, 2020).

According to Russell (2008), Math anxiety is an emotional rather than an intellectual problem. Some researchers, however, argue that math anxiety can impair a person's ability to learn math and thus become an intellectual problem. Failure experiences in mathematics, as well as the fear of future failures, were identified as major contributors to mathematics anxiety and phobia. The academic performance of students in Mathematics has become a source of concern for all education stakeholders in Ghana in recent decades (Bentil, 2020).

According to the Ministry of Education (2017), Ghana has seen an increase in poor student performance in mathematics in recent years. Mathematics achievement of pupils in Junior High Schools in the Bongo District, particularly in the Basic Education Certificate Examinations (BECE), has not been encouraging, as shown in Table 1. The analysis of BECE results in Table 1 revealed that the district's average mathematics

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performance from 2013 to 2018 was 54.2%. In 2013, the district had a pass rate of 40.5% and a failure rate of 59.5%.

**Table 1: Mathematics Performance of Pupils in Basic Education Certificate Examination (2013-2018)**

Year	Pass Rate (%)	Failure Rate (%)
2013	40.5	59.5
2014	44.0	56.0
2015	45.8	54.2
2016	55.7	44.3
2017	50.4	49.6
2018	46.5	53.5

**Source: Bongo District Examination Unit of Ghana Education Service (2013-2018)**

Performance in 2014 increased with 44.0% of the pupils passed and 56.0% failed. There was a slight improvement in performance in 2015 over the previous year with a 45.8% pass and 54.2% failure. The 2016 academic year noticed a further improvement in performance with 55.7% pass and 44.3% failure. In 2017, the academic performance of pupils in the municipality declined with a 50.4% pass and 49.6% failure. In 2018, performance dropped were 46.5% of the pupils passed while 53.5% failed. These results have proven that in recent times, almost half of the pupils in the municipality were unable to pass mathematics which is a major requirement to enter into second cycle institutions.

Given the Ministry of Education's (2017) assertion that one of Ghana's educational system's major challenges is pupil performance in mathematics, studies to investigate the determinants of pupil mathematics performance are relevant. Meanwhile, research evidence exists to validate the fact that examination anxiety affects the academic performance of students (Bentil, 2020). Consistently, this study hypothesizes that the poor pupils' mathematics performance could be attributed to the mathematics anxiety they experience during examinations.

The researcher is inclined to believe that the presence of mathematics anxiety among students in the district is likely to affect their academic performance, though no evidence to support this claim is available. The researcher is inclined to believe that the presence of mathematics anxiety among students in the district is likely to affect their academic performance, though no evidence to support this claim is available. As a result, the purpose of this study is to collect empirical evidence to shed more light on the impact of mathematics anxiety on the academic performance of junior high school pupils in the Bongo District of Ghana

The study was guided by the following research questions:

1. What is the level of mathematics anxiety among Junior High Pupils in the Bongo District in Ghana?
2. What is the relationship between Mathematics anxiety and pupils' academic performance among Junior High Pupils in the Bongo District in Ghana?

### Hypotheses

H<sub>01</sub>: There is no statistically significant difference between Mathematics anxiety and students' gender.

It is hoped that the findings of the study will not only help to broaden the borders and boundaries of knowledge in the field of Mathematics anxiety and its impact on students' academic performance but will also assist school Mathematics teachers in becoming aware of the level of mathematics anxiety among students and help pupils by developing appropriate strategies and methods in improving students' mathematics performance. Furthermore, through this study, students will be made aware of the extent to which Mathematics anxiety affects their performance, which will motivate them to implement measures and strategies to manage their anxiety levels for improved Mathematics performance.

### 1.2 Theoretical framework

The theory which underpins this study is the Transactional model of test-related emotions by Smith and Ellsworth (1987). Many researchers Liebert and Morris, Zeidner cited in Bentil (2020) that test anxiety is prompted by two main factors; namely, worry and emotionality. To these researchers, the worry factor entails the cognitive components of test anxiety which results in the student having gloomy expectations,

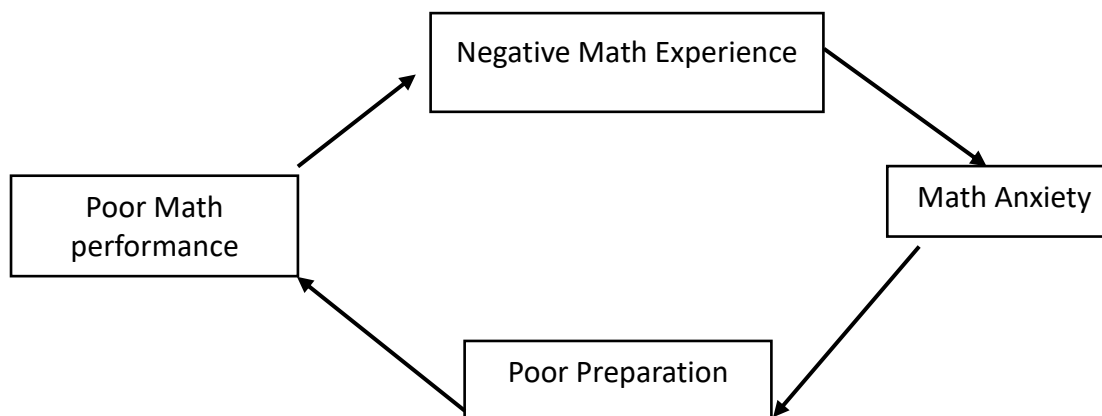
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being absent-minded, self-criticism, and irrational outcomes which have been discovered to negatively correlate with academic performance.

The emotionality factor relates to physiological attributes such as heart rate, feeling of sickness, sweating, tense muscles, etc. (Liebert & Morris, 1967; Zeidner, 1998). Some scholars have offered other models in explaining test anxiety such as Skills-Deficit Model and the Cognitive-Attentional Model. Therefore, the outcome of research based on this theory could be used in making inferences on other examination anxiety theories. The study also adopted the cycle of math avoidance model by Pries and Biggs' (2001) to explain why students experience math anxiety. According to this model, in the first phase, the person experiences negative reactions to math situations. These may derive from past negative experiences with math, and lead to a second phase in which a person avoids math situations.

This evasion leads to phase three, which is inadequate mathematics preparation, which leads to phase four, which is inadequate math performance. This leads to further unpleasant math experiences, bringing us back to the first phase. This cycle can repeat itself so many times that the math-phobic believes they can't perform arithmetic, and the cycle is rarely interrupted. In essence, pupils go through this cycle over and over, seldom rebounding, and as a result, they believe they are incapable of doing Mathematics.

Biological investigations on mathematics anxiety discovered that math-anxious people have a faulty inhibitory system, causing task-inappropriate distracters to deplete working memory resources (Jones, 2006). Students who perform poorly on exams and examinations remark that they feel confused are unable to focus on the work at hand, or constantly worrying about how bad they are at mathematics, according to Jones (2006). Mathematics worry affects working memory's ongoing, task-relevant activity, reducing performance and lowering accuracy.



**Adopted:** Pries and Biggs' (2001).

**Methodology**

This study adopted the cross-sectional descriptive survey design with a quantitative approach. This design gathers information about the occurrence, distribution, and interrelations of variables within a population where data are usually gathered through self-reporting (Polit & Beck, 2014) which is well-positioned by way of the purpose of the study.

In this study, the population comprised all Junior High School pupils in basic schools in the Bongo district totalling 7,176 and was made up of 3,847 females and 3329 males. Through simple random sampling, 492 pupils were sampled for this study. The male population was 58% and the remaining 42% was for the females. The main principle of the proportionate stratified sampling is that each member of the population has an equal chance of being selected to be in the sample and that the sample replicates the population (Cohen, Manion & Morrison, 2011).

The instruments used for data collection included a structured questionnaire and a checklist. The study adopted a structured questionnaire from Cassady and Johnson (2002) labelled Cognitive Test Anxiety Scale (CTAS). The CTAS contained twenty-seven (27) items measured on a 4-point Likert scale questionnaire such that 1= Not at all typical of me, 2= only somewhat typical of me, 3= Quite typical of me, and 4= Very typical of me which required the pupils to rate every option to describe their anxiety level. The checklist was

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used to collect end of term Mathematics examination scores for the 2020/2021 academic year. These subjects were considered because they are core subjects that all pupils study and are crucial in determining pupils’ grades at the BECE. The examination was conducted by the Bongo District Education Directorate which was considered to be standardized. Hence, the comparison could be made based on the results of the examination within the district.

In this study, the reliability of the questionnaire was determined through internal consistency of items where Cronbach's alpha coefficients were computed and results revealed a coefficient of 0.89 for the Cognitive Test Anxiety Scale (CTAS) which is deemed reliable based on the suggestion of Bryman and Bell (2012) that Cronbach alpha coefficients of at least 0.70 are indicative of reliability. Validation of the instruments was checked as the researcher sought the views of some faculty members and a professor where typographical mistakes, ambiguities, grammatical errors, as well as expert advice were all incorporated in putting the instrument to shape before the actual data collection

Before data analysis, the data was cleaned and poorly answered questionnaires were eliminated. The data were entered into the Statistical Product for Service Solutions (SPSS) version 26 and explored to identify missing data and outliers. To ensure that there was uniformity regarding the scale of measurement in the data for both the independent (Mathematics anxiety) and dependent (academic performance) variables for inferential analysis, the pupil’s test scores hitherto measured in percentages, were converted into a 4-point Likert scale to correspond with the questionnaire value. For instance, 80% in the examination was converted, thus:  $80/100 \times 4 = 3.2 = 3$ .

Descriptive statistics such as frequency, percentage, mean, and standard deviation and inferential statistics such as the independent samples t-test, one-way between-groups analysis of variance (ANOVA) and Pearson Moment Correlation were used for analysis after the assumptions underlying the use of inferential statistics have been checked and satisfied. After meeting the ethical requirements of anonymity, confidentiality, and informed consent as criteria of conducting research, the researcher self-administered the instruments to the participants.

**Analysis Of Discussion And Results**

**Demographics of Respondents**

The results are shown in Table 2 below indicates the demographic characteristics of the students used for the study.

**Table 2: Demographics of Respondents**

<b>Variables</b>		<b>Frequency</b>	<b>Percentage (%)</b>
Sex	Male	284	57.7
	Female	208	42.3
	<b>Total</b>	<b>492</b>	<b>100</b>
Age	Less than 16 years	42	8.5
	17-20	312	63.4
	20 and Above	138	28.1
	<b>Total</b>	<b>492</b>	<b>100</b>
Level of Education	JHS 1	234	47.6
	JHS 2	142	28.9
	JHS 3	116	23.5
	<b>Total</b>	<b>492</b>	<b>100</b>
Type of School	Public	364	74.0
	Private	128	26.0
	<b>Total</b>	<b>492</b>	<b>100</b>

**Source: Fieldwork, 2021**

Results from Table 2 indicates that more males (n=284, 57.7%) than females (n=208, 42.3) were involved in the study. The results from the Table further indicated that most of the respondents were between the ages of 17 and 20 years (n=312,63.4%) and as compared to those who were 20 years and above (n=138, 28.1%) and the last group of students were less than 16 years (n=42, 8.5%). Concerning the level of education of students, the table indicated that a greater proportion of the students were in JHS1 (n=234, 47.6%), whiles

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JHS 2 students were the second-highest group (n=142, 28.9%) were more than the students in JHS 3 (n=116, 23.5%).

Table 2 also indicated that the distribution of the respondents by type of school in which they attended revealed that a lot of the respondents attends a public school (n=364, 74.0%) and (n=128,26.0) attended a private school. The demographic compositions of the respondents were vital to the study in two folds. Firstly, they confirmed that data were collected from a sample with different age groups and backgrounds which suggested that the data were rich and representative of the population.

### Research Question 1: What is the level of Mathematics anxiety among Junior High Pupils in the Bongo District in Ghana?

The purpose of this research question was to determine the level of Mathematics anxiety among JHS students in the Bongo District. In this research question, the instrument used in determining the level of examination anxiety was adopted from Cassady and Johnson (2002) which contained twenty-seven (27) items which were required to rate every option to describe their anxiety level and have proposed a mean range in determining the level of anxiety. In this study, the level of examination anxiety was determined based on the suggestion of Cassady and Johnson (2002) as shown in Table 3 below.

**Table 3: Interpretation of Levels of Examination Anxiety**

Scale	Range of Mean Scores	Interpretation
1	27-61	Low Anxiety
2	62-71	Moderate Anxiety
3	72	High Anxiety

**Source: Cassady and Johnson (2002)**

The results on the level of Mathematics anxiety experienced by the Junior High School students in the Bongo district are presented in Table 4.

**Table 4: Levels of Mathematics Anxiety**

	Mean	Std. deviation
Mathematics Anxiety	86.02	6.18

**Source: Fieldwork,2021**

Comparing the results in Table 4 to the measures set by Cassady and Johnson (2002) as contained in Table 3, it could be observed that generally, the level of Mathematics anxiety (M=86.02, SD=6.18), among Junior High School pupils in the Bongo district is high. The findings of this study are consistent with the studies of (Ferdous, 2012) in which his findings discovered that high Mathematics anxiety amongst students during the teaching and learning activates the anxiety level of the learners in all areas. Also, the results of the study reaffirm the findings of Bentil (2020) who also stated that the higher the anxiety of students in examination the lower their academic performance. However, the result of this study contradicts that of Cherry (2012) which reported moderate levels of examination anxiety.

### Research Question 2: What is the relationship between Mathematics anxiety and pupils' Mathematical performance among Junior High Pupils in the Bongo District in Ghana?

This research question sought to explore the relationship between Mathematics anxiety and pupils' Mathematical performance. To answers this research question, the Pearson Moment

The correlation was used where the coefficients for the variables were computed, and the results are presented in Table 5. The interpretation of the strength of the relationship was based on the recommendation by Kothari's (2004) which indicated that if the correlation coefficient is less than 0.3, then the relationship is weak; the relationship is moderate if the correlation coefficient is greater than 0.3 but less than 0.5, and the relationship is strong if the correlation coefficient is 0.5 or greater.

In comparing the results in Table 5 to the recommendation of Kothari (2004), it was observed that generally, there was a strong and statistically significant inverse relationship between examination anxiety and pupils overall academic performance ( $r= 0.561$ ,  $p<0.05$ , 2- tailed). This finding implied that the higher the level of examination anxiety, the lower the academic performance, and the lower the examination anxiety, the higher the academic performance.

**Table 5: Correlation between Mathematical anxiety and pupils' performance**

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Correlation Coefficient (r)	Sig.	No.
0.561*	0.312	492

\*Correlation is significant at  $p < 0.05$  (2-tailed)

**Source: Field Data, 2021**

The study has produced empirical evidence to conclude that there was a strong and statistically inverse relationship between examination anxiety and pupils’ academic performance. The findings of this study resonate with previous studies (Barrows et al., 2013; Steinmayr, et al., 2016; & Duty, et al., 2016) which discovered that test anxiety negatively affects students’ academic performance. This finding departs from those of Afolayan et al., (2013) and Cheraghian (2008) findings which revealed that there was no significant relationship between test anxiety and students’ academic performance.

**Hypothesis One**

**H01:** There is no statistically significant difference between the gender of Junior High School pupils and their level of exam anxiety.

To provide answers to this hypothesis, the independent samples t-test was used where the mean and standard deviation of male and female pupils on their examination anxiety were investigated to see if statistically significant differences exist, and the results are presented in Table 6.

**Table 6: T-test Results for Pupils Gender and Level of Examination Anxiety**

	Sex	Mean	Std. Deviation	t	df	Sig.(2-tailed)
Examination Anxiety	Male	74.24	6.01	-1.912	819	0.057
	Female	86.12	7.20			

**Source: Field survey (2021)**

Table 6 indicated that female pupils experienced higher anxiety in Mathematics (M=74.24, SD=6.01) than their male counterparts (M=86.12, SD=7.20). However, the t-test results have shown that there was a statistically significant difference in the mathematics anxiety between male and female pupils [t (818) = -1.912, p=0.057, 2-tailed] at 0.05 alpha level. Therefore, the null hypothesis was rejected whilst the alternative hypothesis that there is a statistically significant difference between male and female Junior High School pupils and their level of Mathematics anxiety was supported.

Based on these findings, there is enough evidence to conclude that gender is a critical factor that influenced the Mathematics anxiety of pupils in Junior High Schools in Bongo District. This finding goes in line with the findings of Putwain (2007) and Zaheri (2012) where it was revealed that females typically reported higher levels of Mathematics anxiety than males. However, the outcome of this study contradicts with other studies (Fiore, 2003) where it was discovered that there was no difference in Mathematics anxiety due to sex.

Based on the findings, it was recommended that mathematics teachers should teach Mathematics with the psychology of teaching and learning the subject to prepare pupils’ for the subject. Also, teachers teacher should teach from the concrete stage before getting to the abstract stage.

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