

## Investigating the Level of Mathematics Anxiety among Junior High School Pupils

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<b>Corresponding author:</b>	<b>Abstract</b>
David Koomson <a href="mailto:nanakoomson1806@gmail.com">nanakoomson1806@gmail.com</a>	Mathematics is a fascinating and perplexing subject that is constantly evolving in a variety of scientific fields. Naturally, it is amazing and beautiful to use mathematics to solve a real-life problem and comprehend it. However, most people fear mathematics. The goal of this research was to explore Ghanaian Junior High School pupils' level of anxiety in mathematics at two different schools.. A Likert-Scale type of questionnaire on mathematics anxiety was given to 120 pupils who were randomly selected from the population to answer voluntarily. Descriptive and inferential analysis were both used to analysis the responses from the pupils. It was revealed that mathematics anxiety was reported to be high among junior high school pupils. It was also found that female pupils had greater levels of mathematics anxiety than male pupils. Practical recommendations are provided based on the findings of the study.
<b>Keywords:</b> Mathematics anxiety; Ghanaian Junior High Schools; Gender difference	

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Koomson, D., Boateng, F.O. & Lotely, E. K. (2024). Investigating the Level of Mathematics Anxiety among Junior High School Pupils. *Mathematics Education Journal*, 8(2), 147-158. DOI: 10.22219/mej.v8i2.33693

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### INTRODUCTION

Mathematics is a fascinating and perplexing subject that is constantly evolving in a variety of scientific fields. Naturally, it looks beautiful. It feels amazing to use mathematics to solve a real-life problem and comprehend it (Ojose, 2011). People all across the world utilize mathematics for a variety of purposes, including natural science, technology, engineering, medicine, finance, and social science (Abd Algani, 2022; Batterman, 2010). Mathematics may be seen in a variety of ways. For instance, mathematics is about measuring things, performing computations, discovering new things, understanding how things are related, and solving space difficulties (Schoenfeld, 2017). People have several interpretations of it. Mathematics has many diverse meanings, and there is no single proper method to describe it. Mathematics is extremely significant in many fields, including science, agriculture, business, and industry. That is why it is known as the “Queen of Science” (Das, 2016). We cannot grasp anything in the universe without Mathematics.

However, most people fear mathematics (Sokolowski & Ansari, 2017). People with stress feelings when faced with mathematics-related situations may be experiencing what is called “mathematics anxiety.” Mathematics anxiety (MA)

occurs when certain people get extremely terrified and confused when faced with a mathematical challenge. (Maloney & Beilock, 2012) Mathematics frequently causes people to feel anxious and tense, and this may happen to different people in many ways (Szczygieł, 2020). Mathematics anxiety is defined as feeling unpleasant when performing mathematics tasks. It is most frequent in elementary school-aged children (Szczygieł & Pieronkiewicz, 2022). Anxiety over mathematics is an emotional problem, not a cognitive problem (Dowker et al., 2016; Grežo & Sarmány-Schuller, 2018; Jiang et al., 2021; Passolunghi et al., 2016). The two basic dimensions of anxiety in mathematics which are referred to as mathematics testing anxiety and mathematics learning anxiety studied in literature can be found in children, adolescents, and adults. These two dimensions of anxiety in mathematics as mentioned earlier have a great negative effect on pupils' (students) performance in mathematics (Caviola et al., 2017).

Although most recent studies have given a keen interest in examining and understanding the various aspects of MA, huge research work has focused mainly on senior high schools and tertiary institutions across both developed and developing countries with little attention being geared toward elementary or junior high schools (Luttenberger et al., 2018; Ramirez, et al., 2013) were much belief MA usually develops (Devine et al., 2012). MA in educational settings according to Hembree (1990) studies is higher in pupils than college students. He established an average correlation of -0.73 between MA and mathematics enjoyment as well as an average correlation of -0.82 between MA and mathematics confidence in pupils against college students with an average correlation of -0.47 between MA and mathematics enjoyment as well as an average correlation of -0.65 between MA and mathematics confidence. Even though the anxiety level in mathematics declined as pupils proceeded to college, Hembree (1990) finds very high anxiety in students at both levels of the education setting. Perina (2002) also believes that the problem of mathematics anxiety occurs in middle school more than at any other level of the educational setting.

This study aims to explore the prevalence and underlying causes of mathematics anxiety among junior school students in Ghana. By employing a quantitative approach, it seeks to uncover the socio-cultural, pedagogical, and psychological factors contributing to this phenomenon. The ultimate goal is to devise effective strategies and interventions that can alleviate math anxiety, thereby improving the student's academic performance and their overall attitude toward mathematics. Hence, the study was therefore laid down to investigate pupils' level of MA at the junior high school in Ghana and further examine mathematics anxiety in terms of pupils' gender. In a developing country like Ghana, MA studies at pre-senior high school are relatively scarce with few works by researchers such as Essuman et al., (2021) and Nyarko, et al., (2013), and hence beyond the global contribution to literature, there is likewise a local significance to this current studies.

### ***Research Questions***

Two research questions were designed to guard the studies.

- a. What is the level of mathematics anxiety among JHS pupils of Tanoso Anglican and Apatrapa?

- b. Is there any difference in gender regarding pupils' level of anxiety in mathematics?

## **RESEARCH METHOD**

### **Research approach, and Participants**

A quantitative research technique was employed in this study, which was a cross-sectional survey design. The present study's population consists of junior high school students of Tanoso Anglican (A & B) and Apatrapa junior school students. The total number of students in both schools is 171. The research includes 120 pupils drawn from the target group as determined by Yamani's formula with an error margin of 0.05. The sample size was indicative of the overall population of the two schools in the district. Furthermore, because mathematics is a required subject for all learners, obtaining such a sample for the study was simple. The sample drawn from each school was proportionate to the school's population. The pupils were chosen as the study's sample using a basic random selection procedure based on a lottery approach. This was accomplished by enabling students to choose from a pool of folded sheets of paper with yes or no printed on them; students who chose yes were participants chosen for the study.

### **Data Collection and Instruments**

The primary data-gathering instrument used for this current study was a face-to-face survey questionnaire with two main components. Section A includes questions regarding the student's demographics. Section B included questions about the amount of student mathematics anxiety. The questionnaire items were the Likert-Scale style of answers on the students' agreement to the assertions about MA. The constructs in this study were adapted from Carey et al., (2017) and Mitchell and George (2022) which were abbreviated by Hopko et al., 2003 from the original developers (Richardson & Suinn, 1972). A Likert-scale starting from 1 = low to 5 = high which constituted 9 variables was used to rate pupils' level of MA when they engage in mathematics instruction at their schools. The questionnaire was modified to ensure that it is culturally appropriate and relevant to the experiences of Ghanaian junior high school students. For instance, the questionnaire was translated into the local language (for some students who can read and understand Twi a popular Ghanaian language), and certain questions were rephrased to reflect the specific educational and cultural context of Ghana.

### **Reliability and Validity**

The reliability of the survey instrument is the degree to which the instrument used gives similar outcomes with repeated measurement (Lotey et al., 2023). Validity on the other is the ability of the instrument to measure the intended trait (Mitchell & George, 2022). Cronbach's alpha is the commonly adapted test measure for validating the reliability of most research instruments. The alpha score obtained from a valid response from pupils was 0.835 (from the 13 constructs) which falls within the recommendation (0.7-0.9) of Tavakol and Dennick (2011). A study is conducted with a method that depends on the type of research it uses. In the explanation of the research method is preceded by the research approach used. This is related to the aspects inherent in the research approach. If the research

approach uses quantitative studies and uses inferential statistics as a data analysis tool, a population and sample are needed. However, if you use a qualitative approach, the research subject that needs to be disclosed is the method of data collection and analysis used.

### Data Analysis

All data acquired from participants was compiled and analysed using the SPSS version 21. The researchers perform descriptive analysis to examine the students' degree of mathematics anxiety using mean standard deviation. An inferential statistic in the form of a t-test was employed to determine gender differences concerning pupils' mathematics anxiety levels.

### RESULTS AND DISCUSSION

Out of a total of 120 students, 57 (47.5%) were boys, while the remaining 63 (52.5%) were girls. This suggests that the majority of the students chosen as research participants were females. 39 of the pupils range in age from 10 to 13 years. This accounts for 32.5% of the 120 pupils. The remaining 67.5% of students are older than 13 years old. The majority of the pupils who participated in this survey were over 13 years of age. Table 1 depicts the summary of the demographics of pupils in the two schools used for the study.

Table 1: Demographic Profile of JHS pupils

Demography	Category	Frequency	Percentage
Gender	Male	57	47.5
	Female	63	52.5
Age Range	10 – 13	39	32.5
	Above 13	81	67.5
Total		120	100

**Research Question 1:** What is the level (low, moderate, and high) of mathematics anxiety among JHS pupils of Tanoso Anglican and Apatrapa?

The first research question for the current study was investigated by computing the MA scores for individual respondents by finding the summation of the MA responses. A minimum (10) and maximum (50) scores were then utilised to develop the ranges relating to pupils MA levels. A range from 10 to 23 represents low anxiety, 24 to 37 represents moderate anxiety, and 38 to 50 represents high anxiety. Figure 1 depicts the level of MA among JHS pupils of Tanoso Anglican and Apatrapa in line with the three domains of MA developed.

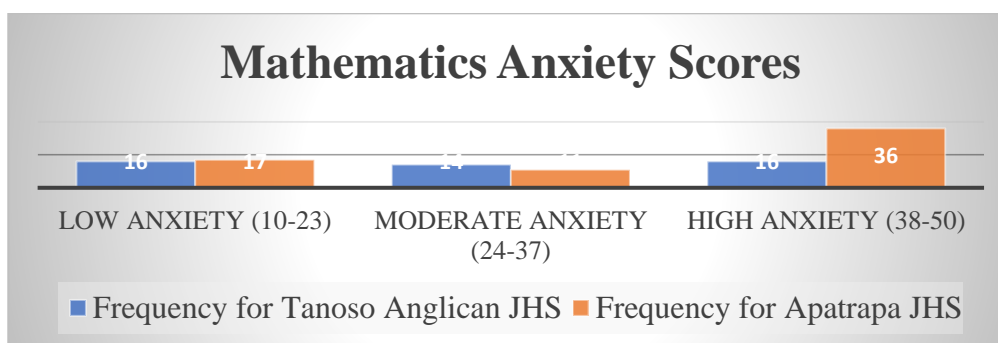


Figure 11. The level of mathematics anxiety scores for Tanoso Anglican and Apatrapa pupils.

From Figure 1, it was established that 16 representing 13.3% of respondents from Tanoso Anglican JHS reported low mathematics anxiety while 17 representing 14.2% reported low mathematics anxiety at Apatrapa JHS, 14 and 11 (20.0% and 9.2%) reported moderate mathematics anxiety level for Tanoso Anglican JHS and Apatrapa JHS respectively. 16 (13.3%) reported a high level of mathematics anxiety at Tanoso Anglican JHS and 36 (30.0%) reported high mathematics anxiety at Apatrapa JHS. However, the results from Apatrapa JHS (30.0%) show that the majority of the pupils are experiencing higher MA than pupils from Tanoso Anglican.

**Research Question 2:** Is there any difference in gender regarding pupils' level of anxiety in mathematics?

The next goal was to determine the difference in mathematics anxiety between male and female pupils. To examine this goal, an independent t-test analysis was performed to verify whether there exists any statistically significant difference in the mathematics anxiety of boys' and girls' students. Because the t-test is a parametric analysis, the underlying assumption was followed. Thus, normality analysis and variance equality testing. Table 3 displays the results of the assumption tests.

Table 3: Tests of Normality and Test for Equality of Variances

Tests of Normality.						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic.	df	Sig.	Statistic.	df	Sig.
Anxiety	.261	120	.051	1.914	120	.054
Levene's Test for Equality of Variances.						
	F		Sig.			
Male-Female	5.616		0.219			

The two tests of normality, thus the Kolmogorov-Smirnov and Shapiro-Wilk, revealed that the calculated anxiety from the participants' replies was normally distributed, as the p-value was less than 0.05 in Table 13. Levene's evaluation for Equality of Variances was deployed to evaluate the equality of means for anxiety in males and females, and it yielded an F ratio of 5.616 and a p-value of

0.219. Because the p-value is greater than 0.05, equality of variance between males and girls was assumed. Table 4 depicts the outcome of the t-test analysis.

Table 4: The independent t-test of Mathematics Anxiety of Male and Female Pupils

Gender	N	Mean	Std.d	t-stat.	d.f.	Sig.
Male	57	2.462	0.451	-0.3483	116.171	0.001
Female	63	2.786	0.566			
Total	120					

In studying the differences in mathematics anxiety between males and females, Table 4 indicated that female students' anxiety is higher (0.324) than male students. The difference is statistically significant ( $t=-0.03483, p=0.0001 < 0.05$ ), indicating that female JHS students at Tanoso Anglican and Apatrapa are more anxious about mathematics than their male counterparts. However, the effect size was relatively small.

### Pupils' level of mathematics anxiety

This study examined the level of MA among a sample of JHS pupils from Tanoso Anglican and Apatrapa a public basic school in Ghana. The finding showed that 16 (13.3%) reported a high level of mathematics anxiety at Tanoso Anglican JHS and 36 (30.0%) reported high mathematics anxiety at Apatrapa JHS. The rate of MA was high among pupils from Apatrapa JHS as compared to pupils from Tanoso Anglican JHS. However, the prevalence of MA was generally high (43.3%) among sampled JHS pupils from both schools which was similar to the previous finding by Essuman et al., (2021) and Bruce (2016) in the same country but different regions. A similar result was confirmed by Mitchell and George (2022) in Jamaica with grade 4 and grade 6 students from a sample of 62 students (grade 4 =25 and grade 6 = 37). In contradiction, the results from this study deviate from the findings from Nag et al., (2019). Nag et al., 2019 discovered low anxiety 198 (49.4%) and moderate anxiety 173 (43.3%) from a sample of 400 pupils of Class IX-XII of Teliamura Municipality in Tripura and further argued that the level of anxiety established from their results can be attributed to factors such as socio-demographic characteristics and stress student encountered within the past 6 months

People who feel very anxious about mathematics performed worse on a memory test that involved solving mathematics problems (Ashcraft & Kirk, 2001). They posited again that, when people had to do mental addition while also remembering things, those with less working memory had slower reaction times and made more errors. Some students might feel very anxious about mathematics, which could make it harder for them to remember things and take longer to answer questions. This can also lead to more mistakes with math problems. The lack of integration of local socio-cultural norms and values in the teaching of mathematics could create a disconnect for students, making the subject seem foreign and intimidating and the restricted use of ICT in mathematics learning at certain educational levels (pre-SHS) could limit students' engagement and understanding

of the subject, potentially leading to increased anxiety. Additionally, the teaching methods employed could also play a role. If they do not align with students' learning styles or fail to make the subject matter relatable and understandable, this could contribute to mathematics anxiety. This could possibly contribute to the high level of MA established from the findings of this study. These proposed causes of high MA in this study provide a starting point for further research into mathematics anxiety in the specific context of junior schools in Ghana. It's important to note that these are just proposed causes of MA by the researchers and there would be a need to test such causes through rigorous research methods. Understanding the specific causes of mathematics anxiety in this context could inform the development of targeted interventions to alleviate this issue and improve mathematics education in Ghana.

### **Gender differences regarding mathematics anxiety**

The level of MA among gender was also another peculiar area of interest in this research work. The male score (Mean = 2.462 and S.D = 0.451) was relatively lower than the female (Mean = 2.786 and S.D = 0.566) scores in both schools. However, there was a statistically significant gender difference in relation to MA among Tanoso Anglican and Apatrapa JHS pupils. While this result concurs with the findings of Carey et al., (2017) and Szczygieł (2020); it deviated from the findings of Bruce (2016) and Van Mier et al., (2019). Girls' high level of mathematics anxiety may be regarded as one of the reasons for girls "escaping" from STEM education (Choe et al., 2019). Per the obtained results, MA begins at an early age in educational settings and is higher among women than men. It appears therefore that being a woman is a high-risk factor for MA development; however, more research work is required in this sector. Test anxiety (TA) and mathematics performance (MA) have a negative correlation and a positive correlation, respectively, for both boys and girls (Devine et al., 2012; Hill et al., 2016). According to Devine et al. (2012) and Rahafar et al. (2016), there is a larger negative correlation observed between mathematics achievement and TA for girls compared to boys. The negative relationship between MA and performance persisted for girls only when TA was taken into account. According to the regression analysis, MA significantly predicted performance for females but not for males (Devine et al., 2012).

A larger study is needed to determine what factors are likely to be responsible for the elevated mathematics anxiety among females in both schools. As a result, it is anticipated that girls would score worse in mathematics examinations compared to males; consequently, test analysis must be performed to see whether this is accurate. However, guys are also predisposed to poor mathematics performance due to a significant amount of mathematics anxiety. This study's finding is also in contraction with some studies in the past (Adal & Yavuz, 2017; Tuncer & Yılmaz, 2020). Given these findings, interventions should be tailored to address the specific needs of each gender. Such interventions may include (1) Making mathematics meaningful: the teacher must find ways to make mathematics meaningful to learners' lives and interests (2) Engaging students: Ensure students have an active role, e.g., in problem-solving and collaborative learning (3) Creating space for social learning: Create space for social and

collaborative learning, based on dialogue between learners, and between learners and teachers and (4) Providing female role models: This can help redefine where vulnerable groups belong by providing external attribution for difficulties.

## **CONCLUSION**

One of the strongest impediments to mathematics achievement is mathematics anxiety. The study was conducted to understand the level of mathematics anxiety among two different JHSs in Ghana and to examine if there exists a significant difference in gender concerning mathematics anxiety. Globally and locally, the study is important as it focuses on a Junior high school sample where additional insight is required concerning MA.

Based on the conversation about the findings, it has been discovered that junior high school pupils' have a high level of mathematics anxiety. Mathematics anxiety is higher in girls as compared to boys. To reduce the differences in how boys and girls feel anxious about mathematics, teachers can stop comparing them based on gender. Instead, they should focus on helping all students with their individual questions and concerns. According to how much someone likes mathematics, it might not be possible to have different levels of mathematics anxiety. For this reason, mathematics teachers are advised to establish an inclusive education in mathematics instruction and to give more room for equality in the classroom. To address the differences in how students feel about mathematics anxiety, mathematics teachers can do things to make sure students are happy. For instance, teachers can focus on using materials in math class, teach by demonstrating concepts, have a friendly and patient attitude toward students, and communicate well with them. If students enjoy mathematics, they will like their mathematics classes more, do better in mathematics, and feel less worried about it. The way we teach can help students learn mathematics.

Moreover, mathematics teachers can use effective teaching methods that focus on students' needs and interests, making math lessons more fun and engaging. Instructional technology can also be adopted as a means of enhancing pupils' visualisation skills, and conceptual understanding of mathematics concept which may be perceived as complex to students in junior high schools (Bandoh et al., 2024). We can change how we teach mathematics to make people less scared of it. For instance, if students have more influence in mathematics classes, they will likely feel better about mathematics if the teaching style focuses on the students, encourages them when they struggle, and celebrates their small victories. This approach can help students feel inclusive and less nervous when they have to do mathematics. The research found that being scared of mathematics is something you are born with and not something you learn. The way mathematics is taught can make this fear of mathematics worse (Kaja, 2002).

As the sample size was small, generalisation prospects can be discarded. Future studies can examine student anxiety levels based on mathematics performance. For more insight into mathematics anxiety, further studies can investigate factors such as techniques and materials used by facilitators in teaching mathematics concepts, especially geometric topics. Additional work can be undertaken with larger participants together with a qualitative research design..



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