

Academic Interest and Test Anxiety as Predictors of Achievement of Secondary School Mathematics Students in Quadratic Equation in Enugu Education Zone

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Abstract

The overall underachievement of secondary school mathematics students in quadratic equation has raised a worrisome situation among mathematics educators on the inclusion of interest and test anxiety as predictors of academic achievement. Therefore, the study examined the academic interest and test anxiety as predictors of achievement of secondary school mathematics students in quadratic equation in Enugu Education Zone of Enugu State. Three research questions and three null hypotheses formulated and tested at .05 level of significant guided the study. A correlational survey research design was adopted for the study. A simple random sampling procedure was used in selecting three hundred and sixty-seven (367), Senior Secondary II (SS II) Mathematics students from eighteen selected schools in the Zone. Mathematics achievement scores were extracted from their school records, Quadratic Equation Interest Scale (QEIS) and Quadratic Equation Test Anxiety Scale (QETAS) were used for data collection. The QEIS and QETAS were adapted from Wong and Wong (2019) and Spielberger (1983) respectively. The instruments QEIS and QETAS were validated by three experts and tested for reliability using Cronbach's alpha with the reliability indices of 0.91, and 0.85 respectively. Data were analyzed using simple and multiple regression of SPSS version 24. The findings of the study amongst others showed that interest is a positive factor of academic achievement in secondary school mathematics, test anxiety negatively influenced the academic achievement of secondary school mathematics students. Based on these findings, it was recommended that mathematics students should improve their mathematics learning curiosity and strategies that could reduce anxiety amongst students, thereby fostering achievement in mathematics.

Keywords: Mathematics, Achievement, Interest, Test Anxiety and Quadratic Equation.

Introduction

Mathematics is the science of structure, order, and relation that has evolved from counting, measuring, and describing the shapes of objects. Mathematics deals with logical reasoning and quantitative calculation in both science and art. Since the 17th century, mathematics has been an indispensable attachment to the physical sciences, social and management sciences and technology, to the extent that it is considered the underlying language of science. It is for this reason that mathematics is universally called the Queen and Servant of the sciences so it must be taught well (Nekang, 2018). Mathematical concepts like quadratic equation are used to solve many problems in Engineering and science at large.

Quadratic equations are second-degree algebraic expressions and are of the form $ax^2 + bx + c = 0$. The term "quadratic" comes from the Latin word "quadratus" meaning square, which refers to the fact that the variables like x is squared in the equation. In other words, a quadratic equation is an "equation of degree 2." The order of degree 2 shows a parabolic shape (Lopez, Robles & Martinez-Planell, 2016). There are many scenarios where a quadratic equation is used. Quadratic equation uses the notion of parabola when a rocket is launched. Furthermore, a quadratic equation has numerous applications in physics, engineering, astronomy, etc. According to Tendere, and Mutambara (2020), quadratic equations have maximum of two solutions, which can be real or

complex numbers. These two solutions (values of x) are also called the roots of the quadratic equations and are designated as (α, β) . Quadratic equations have always been approached in four known modes. Factorization mode, completing the square mode, formula mode and graphic mode.

Instructional materials are ingredients that make teaching and learning of mathematics pleasant and satisfying. Today's successful teacher of mathematics is able to communicate ideas, build students curiosity through the use of instructional materials. Nsuh (2018), acknowledged the existence of problems in the teaching of mathematics when he observed that some of the main problems in science teaching are in mathematics teaching. Agbor-Etang (2017), added that these problems affect both the future professional mathematicians and are also of great concern to the physicist, statistician, engineer, economist and sociologist. There is a general impression that mathematics is difficult by its very nature. Students believe that mathematics is highly structured and that it is so abstract that its study requires special intellectual talents. Some see the subject as something mysterious that is to be feared and even believe that mathematicians are mad (Amirali, 2019). One of the reasons many students hate mathematics, and why so many fail it, is because of poor teaching approaches. In many cases, teachers teach mathematics in a rather abstract way because of inadequate preparation, poor teaching methods and lack of instructional materials (Nekang, 2018). All these make students lack interest in learning the subject. Therefore, Mathematics teachers should think in terms of tangible and visual representation such as sketches, models to concretize ideas. Such materials can help increase the achievement of secondary school students.

Academic achievement defined as a metric for output, and learning that shows the modifications in people's behaviors, knowledge, abilities, and attitudes as a result of their experiences in the educational system. Achievement is the primary output in education that demonstrates the learnability of the students. It is quite alarming that students' achievement in mathematics has been so poor over the years. As a result of this, it leads to the poor academic achievement of students in WASSCE Examination. Academic achievement refers to a student's current academic status as demonstrated by their grades, achievement on an educational achievement examination, and cumulative indicators like degrees

and certificates. Academic achievement was further defined by Umakalu (2025) as the overall achievement results that show how well a student has achieved particular objectives that were the focus of activities in instructional contexts, specifically in schools, colleges, and universities. In the context of this research, academic achievement is taken as the student's overall achievement in the external WASSCE and/or NECO examinations (Umakalu, 2025). In addition, during the May/June 2025 SSCE. A total of 1,969,313 candidates took mathematics in the said examination, of this figure 754,545 (38.32%) passed between Alpha and Credit, and 61.68% made F9 grade. National examination reports indicate a growing decline in students' achievement which engendered poor interest and anxiety in mathematics.

Interest, in the educational context, refers to students' intrinsic motivation, curiosity, and psychological investment in a subject. The awareness propensity to learn about the world and gain knowledge of culture and science is called interest. Students who are passionate about a subject; mathematics may focus more on it, paying close attention, learning it well, devoting time to it and applying their critical thinking skills. Students can only become more enthusiastic about learning mathematics, improve their conceptual understanding and procedures, and develop a scientific spirit and attitude if we can pique their interest in the subject. Students who are interested in a topic like quadratic equation in mathematics are probably more driven to take charge of their education and acquire the necessary abilities to become proficient mathematics learners (Onah & Anamezie 2022). Interest in mathematics is therefore important while thinking about how to create efficient mathematics learning methods. An inspiring mathematics teacher recognizes difficulties encountered in teaching and learning of mathematics but strives to make his teaching vigorous, planned, purposeful, friendly and interesting (Ezekute & Ihezue, 2016). He uses a variety of teaching materials and methods in enhancing his students' interest in their study of mathematics. The following instructional strategies (anti-aversions) have also been developed and examined in order to improve secondary school students' interest in mathematics. interest is essential in any teaching-learning process, but it could be adversely affected by academic test anxiety.

Test anxiety is defined as excessive worry, nervousness, or fear of failure during evaluative

situations. Test anxiety is another critical factor influencing students' achievement and interest. According to Okorie, Nwafor, and Chukwu (2018), high levels of test anxiety can impair cognitive functioning, reduce working memory capacity, and hinder students' ability to perform effectively in practical assessments, such as those in quadratic equation, where precision and problem-solving are essential. In the context of secondary school mathematics, where external examinations often carry significant weight, test anxiety may disproportionately affect students' ability to demonstrate their understanding, thus negatively impacting their achievement and interest in the subject. Test anxiety has been shown to negatively affect students' academic achievement across various subjects, including mathematics. It can manifest as physical symptoms (e.g., increased heart rate, sweating), cognitive difficulties (e.g., difficulty concentrating, negative thinking), and emotional distress (e.g., fear of failure, low self-esteem) (Okafor, Olanrewaju, & Ebisi, 2020). When students experience test anxiety, their ability to perform well in mathematics examinations can be significantly compromised, leading to poor academic outcomes. Research has consistently found a strong negative correlation between test anxiety and academic achievement. For mathematics students, test anxiety can lead to difficulties in recalling essential equations and calculation flow processes, understanding complex concepts, and accurately interpreting questions during exams (Eze & Uzochukwu, 2019). As a result, addressing test anxiety is critical for improving students' achievement in mathematics. To this end, here is an urgent need to improve mathematics learning through proper engagement in secondary school.

Statement of the Problem

Secondary school students' academic achievement in mathematics has plucked the stakeholders into worrisome situation in recent time. The reality of persistent trend of low achievement of secondary school mathematics students presents a troubling situation to mathematics educators and researchers. Mathematics educators and researchers have noted that quadratics equation demands higher precision, spatial visualization and accurate mathematical calculation which has continued to pose great threat to students' achievement in the topic.

In the Enugu Education Zone, interest and test anxiety have been cited as a major contributor to students' low achievement in quadratic equation, despite efforts by mathematics educators to improve teaching methods and provide adequate resources. The students have continued to show low achievement and enrolment in mathematics prone courses in the institution of higher learning. Therefore, understanding the extent to which test anxiety affects students' achievement in quadratic equation is crucial for developing strategies to support students in managing their anxiety and improving their academic achievement. The problem of this study therefore is to empirically determine the extent to which interest and test anxiety predict secondary school students' academic achievement in quadratic equation in Enugu Education Zone".

Purpose of the Study

The primary purpose of this study is to examine the academic interest and test anxiety as predictors of academic achievement of secondary school students in quadratic equation in Enugu Education Zone of Enugu State. Specifically, the study sought to determine the:

1. Amount of variation in mathematics students' achievement in quadratic equation accounted for interest.
2. Amount of variation in mathematics students' achievement in quadratic equation accounted for test anxiety.
3. Amount of variation in mathematics students' achievement in quadratic equation accounted for both interest and test anxiety.

Research Questions

1. What is the amount of variation in mathematics students' achievement in quadratic equation accounted for interest?
2. What is the amount of variation in mathematics students' achievement in quadratic equation accounted for test anxiety?
3. What is the amount of variation in mathematics students' achievement in quadratic equation accounted for both interest and test anxiety?

Research Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

HO₁: The amount of variation in mathematics students' achievement in quadratic equation accounted for interest is not significant.

HO₂: The amount of variation in mathematics students' achievement in quadratic equation accounted for test anxiety is not significant.

HO₃: The amount of variation in mathematics students' achievement in quadratic equation accounted for both interest and test anxiety is not significant.

Method

The study employed a correlational survey research design. Nworgu (2018) noted that correlational survey is the relationship study between two or more variables without manipulation of the variables. It allows the researchers to examine associations among naturally occurring variables through structured data collection methods. The design was appropriate for this study as it enabled the researchers to investigate into how variables such as the physical environment, psychosocial environment, and simulation and games relate to students' achievement in mathematics in secondary schools. The study was carried out in Enugu Education Zone, located East of Enugu State, Nigeria. Enugu Education Zone consists of three local government areas; namely: Enugu North, Enugu East and Isi-Uzo local government area. The area is predominantly urban, semi-urban and rural in nature with basic amenities such as good roads, hospitals, electricity, schools and markets. The researcher chose Enugu Education Zone because most of the secondary schools have qualified mathematics teachers, laboratories and instructional materials and yet students experience difficulties in answering questions in mathematics especially quadratic equation in their external examinations which was evident in their final achievement scores and grades in WAEC results hence the need for the study in the area. The population for the study was 4,689 Senior

Secondary year two (SS2) Mathematics students from 32 public secondary schools in the zone. Three hundred and sixty-seven (367) SS2 mathematics students (235 males, & 132 females) were sampled using Taro Yamane formula. The sample was done in three stages through multistage sampling procedure. The three local government areas were purposively sampled to capture the area under study. Purposive sampling was used to select eighteen secondary schools in the zone with six schools from each of the local government areas based on the existence of well-equipped mathematics resources, laboratories and experienced mathematics teachers with teaching qualification in the school. Simple random sampling technique (precisely balloting) was next used to select 367 students. The instruments used for data collection were three, the mathematics achievement scores that were extracted from the students records of 2024/2025 academic session, Quadratic Equation Interest Scale (QEIS) adapted from Wong and Wong (2019) and Quadratic Equation Test Anxiety Scale (QETAS) adapted from Spielberger (1983) and modified for educational use, was used to measure the level of test anxiety among the students. QEIS and QETAS consisted of 20 items each on a 4-point Likert scale, ranging from 1 (Strongly Disagree) 2 (Disagree), 3 (Agree) and 4 (Strongly Agree). The instrument assessed the personal interest, situational interest and academic interest; physiological, cognitive, and emotional aspects of interest and test anxiety respectively. The researcher modified the instrument to be Quadratic Equation based using likert type of strongly agree through strongly disagree of 4 points. structured questionnaire titled "Quadratic Equation Interest and Test Anxiety Questionnaire" (QESTAQ). QESTAQ were face validated by three experts and tested for reliability using Cronbach alpha which yielded a coefficient of 0.91, and 0.85 indices respectively. The instrument was distributed to the respondents upon selection through the help of the research assistants who doubled to be their mathematics teachers in their respective schools. The data was analyzed using simple and multiple regression with SPSS version 24.

Result

Research Question One: What is the amount of variation in mathematics students' achievement in quadratic equation accounted for interest?

Table 1: Simple regression analysis of mathematics students' achievement in quadratic equation

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate
1	.600 ^a	.360	.357	1.350

a. Predictors: (Constant), Interest

Table 1 shows that the independent variable (Interest) as seen in model 1, has significant influence on the mathematics students' achievement in quadratic equation with the value of $R^2 = .360$ and adjusted $R^2 = .357$, it implies that the independent variable; interest contributed approximately 36%

variation on academic achievement of mathematics students' achievement in quadratic equation. On the other hand, 64% variation in academic achievement of mathematics students was accounted to other variables other than interest.

Hypothesis one

H_{01} : The amount of variation in mathematics students' achievement in quadratic equation accounted for interest is not significant.

Table 2: Relative Contribution of interest to the prediction of the achievement of mathematics students in quadratic equation

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error			
1	(Constant)	10.178	1.222		8.327	.000
	Selfefficacy	.382	.038	.600	9.954	.000

a. Dependent Variable: achievement

Table 2 shows the unstandardized coefficients with t- and p-values of the predictor variable. The table showed that the independent variable made a significant contribution to the prediction of mathematics students' achievement in quadratic equation. Considering the extent of contribution, interest with the un-standardized coefficient ($B = .382$) and standardized coefficient or slope ($\beta = .600$)

was significantly different from 0.000 ($t = 9.854$; $P < 0.05$). This indicates a 0.382-unit increase in achievement for every one-unit increase in interest. Therefore, null hypothesis was thus rejected. There was statistically significant predictive influence of interest on the academic achievement of secondary school mathematics students in quadratic equation.

Table 3: Analysis of Variance on the simple Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	180.667	1	180.667	99.073	.000 ^b
	Residual	320.951	366	1.824		
	Total	501.618	367			

a. Dependent Variable: achievement

b. Predictors: (Constant), Interest

Table 6 showed the output of ANOVA on the moderated simple regression. It shows in model 1, $F(1, 366) = 99.073$; $P < 0.05$. This added weight for the rejection of the null hypothesis. Hence, the

independent variable (interest) has statistically significant variation in students' achievement of secondary school mathematics students in quadratic equation. Therefore, interest is a positive factor of

academic achievement of secondary school mathematics students in quadratic equation.

Research Question Two: What is the amount of variation in mathematics students' achievement in quadratic equation accounted for test anxiety?

Table 4: Simple regression analysis of mathematics students' achievement in quadratic equation

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate
1	.609 ^a	.371	.367	1.339

a. Predictors: (Constant), Anxiety

Table 4 shows that the independent variable (test anxiety) as seen in model 1, has significant influence on the academic achievement of secondary school mathematics students with the value of $R^2 = .371$ and adjusted $R^2 = .367$, it implies that the independent variable; test anxiety contributed

approximately 37% variation on academic achievement of secondary school mathematics students. On the other hand, 63% variation in academic achievement of secondary school mathematics students was accounted to other variables other than test anxiety.

Hypothesis Two

Ho₂: The amount of variation in mathematics students' achievement in quadratic equation accounted for test anxiety is not significant.

Table 5: Relative Contribution of test anxiety to the prediction of the academic achievement of secondary school mathematics students in quadratic equation

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	Std. Error	Beta	T	
1	(Constant)	26.837	.457		58.777	.000
	Anxiety	-.286	.028	-.609	-10.179	.000

a. Dependent Variable: achievement

Table 5 shows the unstandardized coefficients with t- and p-values of the predictor variable. The table showed that the independent variable made a significant contribution to the prediction of secondary school mathematics students in quadratic equation. Considering the extent of contribution, test anxiety with the un-standardized coefficient ($B = -.286$) and standardized coefficient or slope ($\beta = -.609$) was

significantly different from 0.000 ($t = -10.179$; $P < 0.05$). This indicates a 0.286-unit increase in achievement for every one-unit decrease in test anxiety. Therefore, null hypothesis was thus rejected. There was statistically significant predictive influence of test anxiety on the academic achievement of secondary school mathematics students in quadratic equation.

Table 6: Analysis of Variance on the simple Regression

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	185.873	1	185.873	103.608	.000 ^b
	Residual	315.745	366	1.794		
	Total	501.618	367			

a. Dependent Variable: achievement

b. Predictors: (Constant), Anxiety

Table 3 showed the output of ANOVA on the moderated simple regression. It shows in model 1, $F(1, 366) = 103.608$; $P < 0.05$. This added weight for

the rejection of the null hypothesis. Hence, the independent variable (test anxiety) has statistically significant variation in students' achievement of

secondary school mathematics students in quadratic equation. Therefore, test anxiety is a negative factor of

academic achievement of secondary school mathematics students in quadratic equation.

Research Question Three: What is the amount of variation in mathematics students' achievement in quadratic equation accounted for both interest and test anxiety?

Table 7: Multiple linear regression of joint influence of interest and anxiety on the achievement of secondary school mathematics students in quadratic equation

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate
1	.403 ^a	.163	.158	1.545

a. Predictors: (Constant), Joint

Table 7 shows that the independent variable (interest and test anxiety) as seen in model 1, has significant influence on the academic achievement of secondary school mathematics physics students with the value of $R^2 = .163$ and adjusted $R^2 = .158$, it implies that the independent variable; interest and test

anxiety jointly contributed approximately 16% variation on academic achievement of secondary school mathematics students. On the other hand, 84% variation in academic achievement of secondary school mathematics students was accounted to other variables other than interest and test anxiety.

Hypothesis three

Ho₃: The amount of variation in mathematics students' achievement in quadratic equation accounted for both interest and test anxiety is not significant.

Table 8: Relative joint Contribution of interest and test anxiety to the prediction of the achievement of secondary school mathematics students in quadratic equation

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	25.581	.572		44.712	.000
	Joint	-.007	.001	-.403	-5.850	.000

a. Dependent Variable: Achievement

Table 8 shows the unstandardized coefficients with t- and p-values of the predictor variable. The table showed that the independent variable made a significant contribution to the prediction of secondary school mathematics students in quadratic equation. Considering the extent of joint contribution, interest and test anxiety with the un-standardized coefficient (B = -.007) and standardized coefficient or slope ($\beta = -.403$) was significantly different from 0.000 (t = -

5.850; $P < 0.05$). This indicates that for every one-point increase in interest and test anxiety, the students' academic achievement of secondary school mathematics students in quadratic equation decreased by 0.7/100. Therefore, null hypothesis was thus rejected. There was statistically significant joint predictive influence of interest and test anxiety on the achievement of secondary school mathematics students in quadratic equation.

Table 9: Analysis of Variance on the simple Regression

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	81.668	1	81.668	34.227	.000 ^b
	Residual	419.950	366	2.386		
	Total	501.618	367			

a. Dependent Variable: Achievement

b. Predictors: (Constant), Joint

Table 9 showed the output of **ANOVA** on the moderated simple regression. It shows in model 1, $F(1, 366) = 34.227$; $P < 0.05$. This added weight for the rejection of the null hypothesis. Hence, the independent variable (interest and test anxiety) has statistically significant variation in students' achievement of secondary school mathematics students in quadratic equation. Therefore, interest and test anxiety are reduced negative factors of academic achievement of secondary school mathematics students in quadratic equation.

Discussions

The finding of the study revealed that interest contributed an appreciable amount 36% to the prediction of secondary school mathematics students' achievement. This finding was supported by Onah and Anamezie, (2022), and Ezekute and Ihezue (2016) who in their respective studies reported that school's academic interest is a positive determinant of academic achievement in science related subjects. The findings suggests that mathematics students interest is appositive factor of achievement in the classroom.

Secondly, the study found that test anxiety showed negative prediction of the academic achievement of secondary school mathematics students. The finding showed significant 29% reduction of academic achievement when test anxiety sets in during the course of mathematics study. This is consistent with Okafor, Olanrewaju, and Ebisi, (2020); Okorie, Nwafor, and Chukwu (2018) who noted that student's academic achievement in science related subjects have negative relationship with the test anxiety. This posited that test anxiety negatively contribution to secondary school mathematics students' achievement.

Again, the finding was observed that combined effects of interest and test anxiety reduced the impact of test anxiety to the barest minimum. The finding is in consonance with the findings of Okafor, Olanrewaju, and Ebisi, (2020); Okorie, Nwafor, and Chukwu (2018) who observed that a positive construct reduces the effect of negative construct in the model.

Conclusion and Recommendations

The study concludes that academic interest is a positive predictor of academic achievement of secondary school mathematics students in quadratic equations. The study also concludes that test anxiety is a negative predictor of academic achievement of secondary school mathematics students in quadratic

equation. There is significant contribution of interest and test anxiety on the academic achievement of secondary school mathematics students in Enugu Education Zone. Based on the finding the following recommendation were made: it was recommended that mathematics students should be given formative assessment by the teachers regularly with low-stakes quizzes to reduce test anxiety more and improve more academic achievement. The researcher also recommended that parent-teacher conference and workshop be organized to encourage open communication on academic concern about interest and test anxiety of their children and wards in school. The researcher also recommended the establishment of counseling services and mental health resources especially or science subjects in schools to boost students interest and reduce their anxiety.

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