

**EFFECTS OF QUADRATIC EQUATION FLATS ON SENIOR
SECONDARY SCHOOL STUDENTS' INTEREST IN ALGEBRA IN
ENUGU STATE**

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Abstract

This study investigated effects of Quadratic Equation Flats (QEF) approach on senior secondary school students' interest in algebra. Two research questions and three hypotheses guided the study. The design for the study was quasi-experimental non-equivalent control group design. A sample size of 316 SSI mathematics students drawn through random sampling technique from four single sex schools was used for the study. The instrument for the study was validated by three experts and used for the study. The instrument used was Quadratic Equation Interest Scales (QEIS). Cronbach Alpha was used to establish the reliability of QEIS and the reliability coefficient was 0.70. The research questions were answered using mean and standard deviation scores. The hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA). The results showed that the Quadratic Equation Flats (QEF) improved students' interest in algebra significantly. However, there is no significant difference between male and female students exposed to QEF instructions on interest. The result further revealed that there no interaction effect between method and gender. The study recommended that since QEF was found to be effective instrumental approach, for enhancing students' interest, teachers should adopt it as instructional approach in teaching algebra.

Key words: Quadratic Equation Flats, Mathematics, Algebra, Interest and Gender

Introduction

Mathematics is a compulsory subject in Nigeria education system both in primary and secondary school education levels. It is an indispensable subject for all and sundry. Mathematics is very essential in daily life activities and has much regards in the society due to its relevance in industrialization, entrepreneurship, scientific and technological development of any nation (Nwoke 2017).Nwoke further said that any nation without a plan for improved standard in mathematics also has a plan of non-development in science and technology. Obiako (2017), without mathematics, one could be totally left behind in the movement of science of life and the pattern. This shows that no individual or nation can advance scientifically and technologically without the good foundation in mathematics education. This is why Nnakwo (2022) suggested that students required the ability to use technology effectively and acquire scientific skills for processing information. Despite all this importance attributed to mathematics, it is still disappointing that students' interest in mathematics have not been improved. However, many research reports have showed that the interest of students in mathematics at all level of the education system is poor. The students' low interest in mathematics has been of a great concern to mathematics educators. In order to address this ugly situation, mathematics educators such as Iji(2012), Imoko and Agwagah (2014) Iji, Okonkwo and Anyor (2017) explored different strategies to improve mathematics teaching and learning in schools. Different attempts have been made towards improving students low interest in mathematics in secondary school education without any remarkable success. This could be the use of inappropriate instructional strategies in mathematics learning.

Interest is a strong factor in the teaching and learning of mathematics .It is a factor that determines one's readiness to learn. According to Iji, Okoronkwo and Anyor, without interest

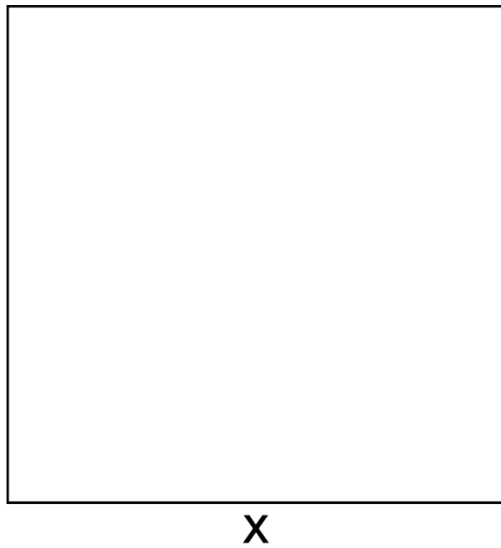
and personal effort in learning of mathematics by the students, they can hardly perform well in the subject. This is one of the major causes of failure in the subject mathematics as rightly observed by Nnakwo (2019) who said that the loss of interest is one of the principal causes of students' failure in mathematics learning and teaching. Okereke (2010), had observed that students lacked interest in algebra and achieved poorly in it. Imoko and Agwugah (2014), lamented that there is a low interest among students in the study of mathematics and mathematics related disciplines at all level of Education in Nigeria. This is confirmed by Anigbo (2016), who stated that the consistent poor achievement in mathematics in primary and post-primary school levels may be attributed to students' lack of interest in the learning of mathematics. Anigbo, further said that interest has to do with preparedness or mastery of a subject matter, background knowledge that can enable the learner to cope with further or next higher level of learning of the subject matter. Boyed and king (2005) opined that there is a great neglect of learner's interest in teaching mathematics. Boyed and King explained that the interest need is not the extraneous interest that passes away and leaves the mind unmoved, but the deep and living interest that goes along with all serious efforts. Gender differences in mathematics has been another source of worry to mathematics educators and researchers. Fabiyi (2017) revealed that female students do better than male students in interest in mathematics while Allahnana, Akande, Martina, Vintseh, Alaku and Monica (2018), stated that there is a disparity in mathematics in the cognitive interest of male and female students with male students' having higher interest mean scores than their female counterpart. Alio and Nnakwo (2022), showed that male and female students showed equal interest in their mean interest score. Could this gender differences be eradicated in teaching and learning of mathematics when taught algebra with Quadratic Equation flats.?

Algebra is a very important topic in mathematics which is applied in different fields of life. National Council of Teachers of Mathematics (NCTM, 2015), reported that algebra concepts need to be presented in a context that is meaningful to students. According to Iji, Okoronkwo and Anyor (2017), Algebra is not usually presented in a meaningful or interesting way, causing students not to enjoy learning the subject. Iyoke (2015) stated that students dislike certain topics in algebra because they feel the topics are difficult and cannot be understood easily. Some teachers experience difficulties in achieving effective teaching in teaching and learning of some topics in algebra in school system. One of such topics in algebra that teachers and students have problems with is in the area of quadratic equations and expressions. It is an important equation that is used in many areas of science and engineering and a good ground on the topic becomes compelling as part of preparing students for useful life after schooling (Bourn, 2007). Hence, quadratic equations and expressions deal with an unknown quantity, there is need to use an active participation approach which will enhance students' interest to learn the topic. No wonder, Iji, Okoronkwo and Anyor continued to state that any effort to tackle the problems of poor achievement in mathematics will prove abortive if students' interest is not taken into consideration.

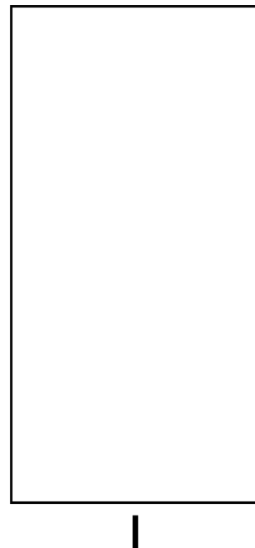
Therefore, to improve students' interest in algebra, there is need to put more effort in developing appropriate instructional strategies like QEF and other approaches in teaching algebra in order to improve students' interest in mathematics. Quadratic Equation flats are instructional approaches that enable an individual or a group to lay out ideas on quadratic equations and expressions in a rectangular shape. It was designed and constructed by Bruner (1965) for teaching quadratic equations and expressions. The flats are made up of x , x -squares and unit-square flats. This instructional strategy is assumed to have the capacity of improving

students' interest in algebra. Hence, this study determined the effect of quadratic equation flats on improving students interest in quadratic equations and expressions. The procedures for teaching quadratic equations and expressions were summarised below.

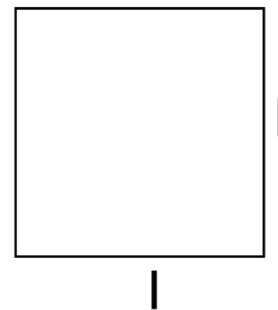
x-square flat



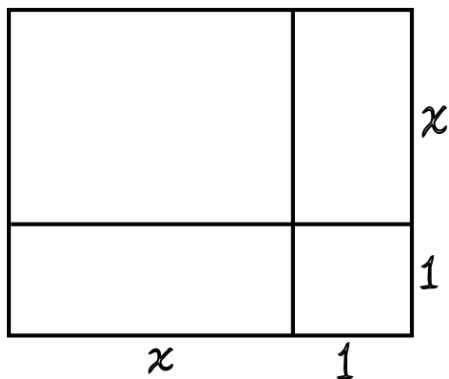
x-flat



unit-square flat



Quadratic Equation Flats



That is $(x + 1)$ square

Teacher asks them to describe what they did. Their reply might be ‘*we have one square x , with two x ’s and a 1*’. The students will be asked to keep a record of what they have done. The notational (symbolic) system for describing this is $x^2 + 2x + 1$, where x^2 represents the square x , a ‘+’ for ‘and’. Also, the figure above can be denoted by describing each side which has an ‘ x ’ and a ‘1’. Thus each side can be denoted as ‘ $x + 1$ ’ and the square is $(x + 1)(x + 1)$ after some work with parenthesis. This means that there are two basic methods of describing the same square. Hence, $x^2 + 2x + 1 = (x + 1)(x + 1)$. This description oversimplifies the procedure used. The students will be asked to continue forming squares and thus deduce the notation for each as shown above.

Purpose of the Study

The main purpose of this study was to investigate the effect of quadratic equation flats approach on secondary school students’ interest in algebra in Enugu State. Specifically, the study was designed to determine the

1. Students’ interest in quadratic expressions and equations
2. male and female students interest in quadratic expressions and equations

Research Question

1. What are the mean interest scores with standard deviation of students taught quadratic equations and expressions using quadratic equation x-flats approach (experimental group) and those taught with expository method (control group) as measured by QEIS?
2. What are the mean interest scores with standard deviations of male and female students in experiment (QEF) and control (EM) groups in both pre-test and post-test as measured by QEIS?

Hypotheses

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

1. There is no significance difference between the mean interest scores of students taught quadratic equations and expressions using quadratic equation flats approach (experimental group) and those taught with expository approach (control group) as measured by QEIS.
2. There is no significant difference between the mean interest scores of male and female students taught quadratic equations and expressions using quadratic equation flats (experimental group) and those taught with expository method (control group) as measured by QEIS. There is no significant interaction effect between method and gender on students' interest in algebra.
3. There is no significant interaction effect between method and gender on students' interest in algebra.

Method

The design adopted for this study is a quasi-experimental design. This research was carried out in Enugu Education zone has thirty-one public secondary schools. The population of the study consisted of all the 5, 386 senior secondary one (SS1) students in the thirty-one government schools under Enugu Education zone. The sample of this study was 316 students from four randomly sampled intact classes of SSI students drawn from two boy's secondary schools and two girl's secondary school purposively sampled in Enugu Education zone. The sample comprises 80 males and 82 female students in the experimental group and 70 males and 84 female students in the control group. The experimental group was exposed to learning of quadratic equations and expression using quadratic equation flats while control group was

exposed to expository teaching method in the learning of quadratic equations and expressions. Quadratic Equation interest scale (QEIS) was used for data collection. The QEIS consists of 20 items framed on a four-points SA = 4, A = 3, D = 2 SD = 1 developed by the researcher. The QEIS was used to assess students interest in the quadratic equation interest scale (QEIS) was subjected to face validation only by experts. Inclusion or exclusion of an item in the test was based on its acceptance by at least two out of the three validators. The QEIS was administered to the students by the research assistants at the beginning of the experiment while the post-QEIS was administered to the students at the end of the experiment by the research assistants. Data obtained from QEIS instrument was analyzed using descriptive statistics of mean and standard deviation to answer the research questions while ANCOVA was used for testing the research hypotheses at 0.05 level of significant.

Research Question 1

What are the mean interest scores with standard deviations of students taught quadratic equations and expression using quadratic equation flats approach (experimental group) and those taught with expository method (control group) as measured by QEIS?

Table1 below shows the results for the research question

Table 1: mean interest scores with standard deviations of experimental and control group.

Group	N	Pre-test Mean SD	Post-test Mean SD	Min score point	More score points
Experimental	162	10.26 3.89	56.83 10.21	20	40
Control	154	13.98 6.08	21.71 11.58	20	80

Where n = sample size for group

From the table above, the pre-interest scores for the experimental and control group were 10.26 and 13.98 respectively with corresponding standard deviation of 3.89 and 6.08. the post-interest scores of experimental and control groups were 56.83 and 21.71 respectively with corresponding standard deviation of 10.21 and 11.58. The experimental group obtained higher mean interest scores in the post-interest scale than their control counter parts.

Research Question 2

What are the mean interest scores and standard deviations of male and female students in experiment (QEF) and control (EM) groups in both pre-test and post-test as measured by QEIS?

Table 2 indicates the findings of research question 1.

Table 2: Mean Interest Scores and Standard Deviations of Experimental and Control Groups due to Gender.

Group	N	Pre-interest				Post- interest				Min. score	Max. score
		Male		Female		Male		Female			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Experimental	162	9.66	9.61	10.86	10.99	55.79	9.88	57.87	10.72	20	80
Control	154	14.28	7.01	13.68	5.22	22.16	12.00	21.26	10.81	20	80

Where n =Sample Size per group

Table 2 . Shows that the pre-interest scores for male and female students in both experimental and control groups ranged from 9.66 to 14.28. The post-interest scores for male and female students in both experimental and control groups ranged from 21.26 to 57.87. These scores were obtained out of a maximum score of 80.

Hypotheses

1. There is no significant difference between the mean interest scores of students taught quadratic equations and expressions using quadratic equation flats approach (experimental group) and those taught with expository approach (control group) as measured by QEIS.
2. There is no significant difference between the mean interest scores of male and female students taught quadratic equations and expressions using quadratic equation flats (experimental group) and those taught with expository method (control group) as measured by QEIS.
3. There is no significant interaction effect between method and gender on students' interest in algebra.

Table 3 shows the result for the above hypotheses 1, 2 and 3 on interest

Source	Type III sum of square	DF	Mean square	F	Sig.	Dec
Corrected model	0.695	3	0.228	5.761	0.001	
Intercept	23.446	1	23.446	571.854	0.000	
Method	1.374	1	1.374	23.122	0.000	S
gender	0.118	1	0.118	2.950	0.073	Ns
Method & gender	0.019	1	0.019	0.467	0.495	Ns
Error	12.710	310	0.041			
Total	72.325	314				
Corrected total	12.269	315				

From the table 3 the f-calculated value of 33.122 for method was significant at 0.000 significant levels which are less than the 0.05 level of significance set for this study. Hence the researcher rejects the null hypothesis of no significant difference. This means that there is significant difference between the mean interest scores of experimental and control groups as

measured by QEIS. For gender, the f-calculated value of 2.95 was found significant at 0.073 computer level of significance which is higher than 0.05 level of significance set for this research. Consequently, there is no significant difference between the mean scores of male and female students when taught with QEF and Expository method. For interaction (Method and Gender), the f-calculated value of 0.467 was significant at 0.45 computer level which is higher than 0.05 level indicated for this study. Hence, the null hypothesis is not rejected, that is, there is no significant interaction effect between method and gender on students' interest in algebra.

Discussion of the Findings

The findings on the effect of QEF on student's interest showed that experimental group obtained higher mean interest scores than the control group in the post-QEIS. ANCOVA analysis of Covariance showed that there is a significant difference between the mean interest scores of students' taught algebra using Quadratic Equation X-flats (experimental group) and those taught algebra with expository method (control group). The fact that QEF increase students' interest, may be because of treatment administered to experimental group. This result lends credence to the work of Egbe (2017) and Anigbo (2016), who found out in their individual studies that instructional strategy enhances the interest of students. The result on the effect of gender on students' interest showed that female students had slightly higher mean interest scores than their male counterparts. ANCOVA analysis revealed that difference was not significant. This means that gender does not affect students' interest on algebra. This could be due to the activity-based nature of quadratic equation flats in solving quadratic equations and expressions. This result contradicts the findings of Fabiyi (2017) and Egbe (2017), who found out in their individual studies that there is a significant difference in the students' mean interest with respect to gender.

But the findings is in agreement with the study of Okafor (2015), Alio and Nnakwo (2022) who found out in their separate studies that there is no significant difference in mean interest scores of male and female students. The results further revealed that there is no interaction effect between method and gender on students mean interest scores in algebra. This indicated that method and gender did not produce a combined effect on the mean interest scores of students. This result is in agreement with the work of Nekang (2011) and Nnakwo (2022) who found out in their separate studies that there was no significant difference between method and gender. But the result contradicts the works of Kyeleve and kurumeh (2018) and Ozumadu (2020) who found out in their separate studies that there is significant difference between method and gender.

Recommendation

Based on the findings of the study, the researcher recommended the following:

1. The curriculum planners should incorporate and emphasize the use of Quadratic Equation Flats in teaching and learning of mathematics in senior secondary schools .
2. In view of the learning effectiveness of model and the fact that the serving mathematics teachers may not be familiar with its use, seminars and workshops should be organized by the relevant professional bodies such as Mathematics Association of Nigeria (MAN), National Teachers Institute (NTI) and Science Teachers Association of Nigeria (STAN) to educate and sensitize the teachers on the use of QEB in mathematics education.
3. Government and relevant professional associations should sponsor further research on the effectiveness of the instructional strategy (QEB) in enhancing achievement, interest and retention in other aspects of mathematics.

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