IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 5, Issue 2 Ver. II (Mar - Apr. 2015), PP 38-47
www.iosrjournals.org

Effects of Formative Assessment on Mathematics Test Anxiety and Performance of Senior Secondary School Students in Jos, Nigeria

ChristianaAmaechi Ugodulunwa[1] and Uzoamaka Priscilla Okolo[2]
[1] *Department of Educational Foundations, Faculty of Education, University of Jos, Nigeria*
[2] *St Louis College, Jos, Nigeria*

Abstract: *The study of mathematics is compulsory in secondary schools in Nigeria because ofthe vital role it plays in the scientific and technological growth and development of the nation. A shortfall in the knowledge of the students in mathematics means that the goal may not be realized, hence the need to improve instructional practices for solving the problem of poor performance in the subject.This study investigated the effects of a formative assessment on mathematics test anxiety and mathematics performance ofsecondary school students in Jos, Nigeria, using a quasi-experimental design. A simple random sample of 110 Senior Secondary two (SS II) students was selected for the study from a population of 2,326 SS II students. Amathematics test anxiety scale and two forms of mathematics achievement test were used for data collection. Data were analyzed using descriptive and inferential statistical techniques. The findings revealed that formative assessment reduced anxiety level and improved mathematics performance of the students. It was recommended that secondary school teachers should be trained and re-trained to update their knowledge in the use of formative assessment for making the teaching and learning of mathematics more interesting and rewarding.*
Keywords*: Formative assessment, mathematics, test anxiety, performance*

I. Introduction

Mathematics is applied in the study of arts, languages, social sciences, vocational studies, natural and physical sciences, through research and departmental documentation. It is used in formal and informal education as well as in our everyday life to subdue our environment and reform our lives through daily domestic activities, construction of infrastructure and a host of others.

The Federal Government of Nigeria, in realization of the importance of Mathematics, embarked on vigorous Mathematics curriculum reforms and the establishment of the National Mathematical Centre (NMC) to enable our educational system to work towards improving our Science and Technology, implementation of initiatives like the Millennium Development Goals (MDG), National Economic Empowerment and Developmental Strategies (NEEDS) as well as Vision 20-2020. The major aim of making Mathematics compulsory in our primary and secondary schools is for skill acquisition and mastery of content taught so as to apply the knowledge of Mathematics in Science and technology, everyday life activities and for the growth and development of our nation. However, the relevance of Mathematics curriculum content notwithstanding, if there exists a defect in pedagogy, its purpose and objectives will not be actualized.

The importance accorded to Mathematics motivated the Plateau State Government to organise workshops from 2005-2007 in the Education Resource Centre and Educational Area Office of Jos North for teachers of Mathematics in Jos metropolis to improve their instructional practices. Despite the efforts made by various tenures of the Plateau State Government, there is still persistent poor performance in Mathematics in the Senior Secondary Certificate Examinations (SSCE) conducted in Nigeria by both the West African Examinations Council (WAEC) and the National Examinations Council (NECO).

The SSCE results revealed students inability to score highly in mathematics in Jos metropolis. There has been mass failure rate in mathematics in both internal and external examinations. For instance, from the year 2005 to 2010, the pass rate at credit level in Plateau State, Nigeria, where Jos is located, ranged from 10.27% to 15.40%, while total percentage of candidates with ordinary pass and failure grades ranged from 84.6% to 89.73% (Education Resource Centre, Jos, Plateau State [1]).There has been reported mass failure of students in public examinations like the West African Senior School Certificate Examinations (WASSCE) organised by the WAEC and the National Examinations Council (NECO) (Obioma, [2]; Obono& Adebayo [3]; WAEC Chief Examiners' Reports [4]). Occasional publications in the dailies also indicate that the levels of performance in the University Matriculation Examination (UME) are still very low (Uwadiae[5]). Consequently many candidates are denied admission because of their poor results in mathematics (Aburime, [6]; Festus [7]).

The WAEC Chief Examiners' Reportsfrom 2008 – 2012 indicate that most of the candidates were generally weak in their understanding of basic concepts and theories regarding topics in geometry, trigonometry,

and algebra. They showed a general weakness in the understanding of basic concepts in algebra and geometry and found it difficult to applycertain concepts appropriately. This demonstrates clearly a lack of knowledge of the topics on the part of the candidates. These observations require that investigation be carried out on how to teach geometry and the algebra for better understanding and performance by students. It is our belief that when students are encouraged to show their workings when answering essay questions in algebra and geometry, many inappropriate reasoning errors, complete lack of understanding and other avoidable behavior, like wrong application of concepts learnt, are displayed.

The Federal Government in realization of the importance of mathematics in 2007, published the current mathematics curriculum through the Nigerian Education Research and Development Council (NERDC). This curriculum is for use at all levels of the educational system in Nigeria. In line with government reform in education, the NERDC was directed by the National Council on Education (NCE) to review and re-align the existing senior secondary school curriculum to meet the targets of the reform in the context of National Economic Empowerment and Developmental Strategies (NEEDS) and the Millennium Development Goals (MDGs).

The success of any reform in the educational system is its ability to improve the attainment of learning outcomes. The reforming of the curriculum for human development and social responsibility is not just to provide access for students but also about developing critical competencies and knowledge for sustainable growth. A quality assessment package, such as Formative Assessment Package, which would serve as a framework for teachers in giving direction to the implementation of educational programmes is therefore required because curriculum contents and objectives that are not attained and assimilated by students can lead to poor performance.

In spite of the spelt out objectives of teaching mathematics in our secondary schools, the teaching and learning of mathematics have not changed in most schools from conventional methods to a student-centred discovery and deductive approach of teaching which would encourage concept development. Conventional methods that are mostly used by teachers are traditional methods of teaching mathematics that are based on direct instruction, where students are shown standard method of performing a task, which is taught in isolation rather than as only a part of a more complex project. They are characterized by rote learning of some basic processes in mathematical operations and abstract presentation of facts, which is teacher-dominated lesson, without understanding and applying the memorized facts into other aspects of our everyday life. The Mathematics performance of senior secondary school students in Plateau State have been reported to be poor. Students' failure in Mathematics examinations affects their academic career progression in Mathematics and Science-related courses at tertiary institutions, which has a negative effect on the growth and development of Science, technology and commerce in Jos and Nigeria at large.

Factors that lead to students' poor performance in mathematics have been identified. A study carried out in Plateau State by the Japan International Corporative Agency (JICA) in 2006 revealed that teachers' method of teaching contributed to students' high anxiety level. Teachers teach using conventional teaching methods as well as teaching without adequate preparationof lessons. Many students go to school without textbooks or writing materials. The results are lack of interest, fear and mathematics test anxiety leading to students' poor academic performance. Other factors responsible for poor performance in mathematics include poor method of teaching that is not supportive for effective and efficient learning (Adegoke [8]), general apathy by students due to perception of mathematics as very difficult (Eniayeju [9]; Ivowi [10]), negative attitude (Nurudeen [11]), anxiety (Freedman [12]; Harman [13]), and gender (Maliki, Ngbam&Ibu [14]; Atoyigba,Vershima, O'kwu&Ijenkeli[15]).

Mathematics test anxiety originates from fear and negative emotional reactions. Anxiety is associated with panic, nervousness, restlessness, helplessness, trembling and confusion that arise in students when mathematics or mathematics tests are mentioned. This is mostly observed when students do not possess the knowledge of the content to be assessed.Measurement of mathematics test anxiety is important for understanding of the nature of this construct and the degree of its presence in a student for intervention planning and instructional delivery (Bai, Wang, Pan and Frey [16]). Mathematics test anxiety has been shown to be a significant factor of learning success (Cates and Rhymer [17]; Ryan and Ryan [18]). Students with high mathematics anxiety tend to perform poorly when presented with mathematics test. Nonetheless, it can be inferred that mathematics test anxiety greatly impacts mathematics education and students' career choice.

It has also been found that test anxiety can be reduced to a moderate level in such a way that it will not lead to poor academic performance (Taylor[19]). The techniques to be applied in reducing test anxiety as identified in literature are formative assessment, frequent testing, relaxation techniques, adequate preparation for tests, mental and physical preparation, change of attitude, and effective study habits (Ausubel [20]; Morakinyo, [21]; Freedman; Harman; Poppe [22]; Nurudeen). Specifically, the use of formative assessment has been advocated for reducing students' mathematics test anxiety and improving their performance in the subject (Black & William [23]; Alonge[24]; Falaye [25]; Svihla [26]).

Formative Assessment encompasses lesson plans with on-going classroom oral questioning, discussions, quizzes, evaluation, assignments and tests, that keep students and teachers informed of students' progress towards meeting learningobjectives.It also includes weekly tests, immediate feedback and remediation and re-teachingof concepts that were not learnt. The utilization of formative assessment in the teaching-learning process involves breaking up the subject content into smaller hierarchical units for instruction, specifying objectives for each unit, designing and administering formative tests, offering group based remediation in areas where students are deficient, and finally administering a summative test on completion of all the units. This is based on the assumption that regular assessment of students' progress assists greatly in monitoring their progress and improving their learning and performance.

1.1 Theoretical framework and research question

The theoretical foundation upon which this study is build are the theories of learning hierarchy by R.M. Gagne and the theory of learning by discovery by J. S. Bruner. These theories have had a profound impact on curriculum development and the methodology of teaching mathematics and science at both the primary and secondary school levels. Gagne [27] postulated that learning is best achieved when teaching is organized from simple to complex. He suggests that concepts acquisition takes place in an orderly, sequential, integrative and hierarchical manner. The present study employed Gagne's theory in the arrangement of the learning tasks within the Formative Assessment Package. As a result, the tasks in the learning package are sequentially and hierarchically structured moving from simple task to complex ones and from known to unknown. Efforts are also made by teachersbefore teaching any concept to ascertain what prior knowledge students had and to use that as prerequisite for new learning. Bruner's [28] theory of learning by discovery promotes the acquisition of knowledge through discovery. This becomes necessary where the instructional strategy is learner-centered. Learners have to respond to the teachers' questions to enable them discover new ideas, theories and concepts in algebra and geometry. The lessons within the formative assessment package is learner-centred and designed in such a way that teachers will teach to foster deductive learning and also help to reduce anxiety level in students and improve performance in mathematics.

Research has suggested that formative assessment could improve both learning and examination results and also reduces test anxiety (Svihla; Ajogbeje and Alonge [29]). They reported that students who are systematically taught using formative assessment perform better than those who are taught using conventional methods. Other studies on the effects of formative assessment in improving instruction and students' learning include Black and William; Adewuyi[30]; Svihla; and Oduwole[31]. Although the studies investigated the effects of formative assessment on students' learning, they did not use a Formative Assessment Package as teaching strategy. Furthermore, the researchers are not aware of any current effort to develop and use a formative assessment package for reducing students' anxiety and improving performance in mathematics in Jos, Nigeria. This study is necessary because it focuses on reduction of mathematics test anxiety and improvement of students' performance through formative assessment. Generally, algebra and geometry are regarded as difficult to teach and learn as reported in the WAEC Chief Examiners' Reports.

The guiding research question was, "To what extent can the use of a formative assessment package in teaching reduce senior secondarytwo students' Mathematics test anxiety and improve their performance in geometry and algebra? Evidence of efficacy of formative assessment in reduction of students' anxiety and improvement of performance in mathematics would suggest that mathematics teachers use similar formative assessment packages in teaching mathematics topics in secondary schools in Nigeria. Weak evidence of efficacy of the package would suggest further exploration of its application in reducing mathematics test anxiety and improving performance of the students. Thus, the present study was designed to investigate the effects of a Formative Assessment Package on mathematics test anxiety and performance among senior secondary school students in Jos, Nigeria.In order to achieve this purpose, the following hypotheses were tested at .05 level of significance:

1. There is no significant difference between the posttest Mathematics performance mean scores of students in the experimental and control groups when the moderating effect of pretest is controlled.
2. There is no significant difference in the Mathematics test anxiety posttest mean scores of students in the experimental and control groups.
3. There is no significant difference in the pretest and posttest of Mathematics test anxiety mean scores of SSII students in the experimental group.
4. There is no significant difference between the pretest and posttest Mathematics performance mean scores of students in the control group.
5. There is no significant difference between the pretest and posttest Mathematics performance mean scores of students in the experimental group.

II. Method

2.1 Design

This study adopted a quasi-experimental design, specifically the non-randomized pretest posttest control group design. The choice of this design and its relevance to this study were based on the fact that it is an experimental study using intact classes. It also provides major control against factors that could constitute a potential threat to the internal validity of the experiment. These factors are differential selection of students, maturation processes, testing procedures, instrumentation, statistical regression and experimental mortality. The selection was based on students in the same class of SS II suitable to study the algebra and geometry embedded within their curriculum. The testing procedures were the same within the two schools and students that were not administered the pretest were not used for the experimental study. Consequently, the provision of major controls was introduced through the use of the equivalent schools such as a public day senior secondary school and classes such as SS II. Therefore, the sample which comprised intact classes was used in the schools of study to avoid disrupting the normal school programme. In other words, the characteristics of the students obtainable in the experimental group were the same with those of the students in the control group.

2.2 Population and Sample

The population for the study consisted of all public senior secondary school class two (SSII) students in Jos, Nigeria. The sample for the study was randomly selected from a population of 2,326 SSII students distributed among 28 public senior secondary schools in Jos. The choice of SS II students was informed by the fact that they are not in their final examination class. Moreover, the topics that the chief examiners reported to be students' weak areas are within the SS II mathematics curriculum. In addition, these students at this level were assumed to have acquired some basic concepts, knowledge and skills in mathematics to enable them answer the pretest items. SS III students were facing their Senior Secondary Certificate Examination (S.S.C.E) and so were too busy to participate in the study.

A sample of 110 students was in intact classes from two schools within Jos. The selection was done by a flip of a coin. Each of the classes that chose head became the experimental group while those that chose tail became the control group. This study used 53 students in the intact class as the experimental group from the two schools and 57 students as the control group. There were 25 male and 28 female students in the experimental group and 32 male students and 25 female students in the control. Altogether, 57 male students and 53 female students from the two schoolsparticipated in the study. The experimental and control groups were in the same schools.

2.3 Instrument

Mathematics Test Anxiety Scale (MTAS) and Mathematics Achievement Tests (MAT) were the instruments for data collection. Mathematics Test Anxiety Scale (MTAS) was adapted from the Anxiety Test Inventory of Sokan [32]. The inventory is made of two scales: General Anxiety Scale and Examination Anxiety Scale. The items using the term "examination anxiety" were modified to read "mathematics test anxiety". For instance item 9 was changed from "During examination I find myself thinking of things unrelated to the examination" to "During mathematics test I find myself thinking of things unrelated to the mathematics test". The Mathematics Test Anxiety Scale consists of 14 items on a four point scale, optimally capturing the two dimensions of Mathematics test anxiety. The main objective of developing the anxiety scale was to provide a tool for measuring test anxiety in an individual and to provide opportunity for the level to be reduced when test anxiety level is diagnosed to be high. The items of the scale are concerned with students' feeling towards mathematics tests.

The Mathematics Achievement Tests (MAT) are two structured alternate forms of50-item multiple choice test adopted by the researchers from WAEC and NECO questions from 2001- 2011. The tests were used for the pre-test and post-test. The MAT covers quadratic equation, simultaneous equation, chord properties, circle theorems and trigonometry. In addition, four essay items were constructed each week as a teacher-made test. There were a total of 32 essay questions that were administered within the 8 weeks of teaching. These essay questions were used for assessing students' understanding of subject-matter content and their ability to reason with their knowledge of the subject. The items were reviewed by SS II mathematics teachers and two Tests and Measurement experts for content validity.

2.4 Validity and reliability of instrument

Construct validity was sought for the Mathematics Text Anxiety Scale during the pilot study by adopting the following procedure: administering the instrument to the sample of students, computing correlations of each item with every other item in the test, applying orthogonal varimax rotation model, assessing the factor loading from the varimax rotated factor matrix, adapting the criteria of 0.4 recommended by Plake and Parker [33] for accepting an item in terms of its factor loading, dropping items that fail to attain the

factor loading criteria, those that are factorially complex, and factors that have less than four items loading significantly on them. Three factors accounted for 65.75% of variances in the students' responses to the MTAS. The internal consistency of the scale, established with Cronbach alpha method, was 0.95, which was considered to be high.

Content validity was established for the Mathematics achievement tests. This was determined through the judgment of eight experts, who are proficient and knowledgeable in the skills being measured. The appropriateness and comprehensiveness of the items were checked by two Ph. D holders in tests and measurement, a Ph. D holder in mathematics education, three experienced mathematics teachers teaching SSII students and two experienced team leaders in the marking ofSenior Secondary School Certificate mathematics examinations conducted by WAEC and NECO in Nigeria. These experts were given a copy each of the test instruments, table of specifications and instrument evaluation guide. These helped in guiding the researchers in making necessary revisions of the items in the instruments and in determining the validity of the instruments. Items that did not measure what they ought to measure were deleted or modified, while good items were retained. Content validity was also established for the weekly formative achievement tests. The experts verified if the items were in line with the content and objectives stated in the curriculum and the lesson plans.

The Kuder-Richardson method was used to estimate the internal consistency of all the tests that were used for the study. The alternate FormsI and II of the tests were administered within two weeks interval to establish their equivalent form reliability. The equivalent form reliability obtained was 0.85, while the reliability coefficient of internal consistency for form I and form II were 0.89 and 0.91, respectively. The reliability results of MAT were compared with the guidelines for interpreting alpha coefficients suggested by George and Mallery [34]) that "$\alpha \geq 0.9$ excellent, ≥ 0.8 good, ≥ 0.7 acceptable, ≥ 0.6 questionable, ≥ 0.5 poor, ≤ 0.5unacceptable". The result of the equivalent form reliability enabled the researcher to use the two instruments for both pretest and posttest, since the correlation was considered high.

2.5 Procedure for Data Collection

Four research assistants were trained by the researchers to assist in administering the instruments and teaching the topics selected for the study. Each of the research assistants was a senior mathematics teacher in a senior secondary school with B.Sc.(Ed) or B.Ed. degree in mathematics with at least three years post qualification experience, as well as two years' experience in marking of WAEC or NECO examinations in mathematics. These qualities were necessary to ensure that these teachers had good knowledge of the subject matter and also possessed the professional qualification required for the successful conduct of the study. A five-day training programme was held with the research assistants. The training programme was to acquaint the research assistants with how to use the components of the formative assessment package from lesson plan to remediation with the experimental groups and how to use a traditional method of teaching with the control groups. The following features were addressed during the training: the objectives of the package, topics, contents, duration, teachers' and students' activities, methods and how to use formative assessment techniques, test administration, scoring and remediation for experimental group only. Administration and scoring of tests papers were discussed and research assistants were given the opportunity to demonstrate the use of the package in teaching before the commencement of the experiment. The training ensured that the teaching was comparable, applying the same teaching skills with little or no variation in their teaching effectiveness.

The MTAS was administered within 10 minutes followed by the MAT Form I which lasted for one hour fifteen minutes. During the period of testing, the researchers and research assistants ensured that the students were not cheating. The MAT Form I was given to the students as a pretest for the purpose of ascertaining the prior knowledge of the students in geometry and algebra before the treatment was given to the experimental group. Students were required to write the correct option out of four alternatives provided for each question on the answer sheet. After the time allocated for the test, the scripts were collected marked and scored using a marking scheme.

The Formative Assessment Package was developed by the researchers, using the SS II curriculum. The scheme of work was split into weeks and days. The components of the package are objectives; topics and contents taught on quadratic equation, simultaneous equations, cord property, circle theorem and trigonometry; thirty-two lessons taught within eight weeks; weekly formative assessments; feedback and the remediation procedure, which focuses on correction of misconceptions and process error analyses. The daily topic was developed into a lesson plan. The objectives were tested using formative assessment during the lessons. Assessments were conducted at the beginning of each lesson, duringlesson delivery to monitor students'strengths and weaknesses, and at the end of the lesson. Assignments were given at the end of each lesson, weekly,feedback and remediation of process errors encountered during instruction were given to facilitate teaching and learning. The package was subjected to evaluation by five secondary school mathematics teachers and three Ph.D. lecturers of University of Jos. The experts scrutinised the package and commented on

the clarity of objectives, suitability of topics and contents, adequacy of teaching materials, appropriateness of assessment procedure, feedback, and remediation.

The experimental groups were taught using the Formative Assessment Package.Students in the experimental groups were exposed to the instructional units using the lesson plans for eight weeks. There was formative assessment during instruction aimed at monitoring students' learning progress, to detect their strengths and weaknesses and the feedback and remediation methods were employed. The assessment also inquired if the students had achieved the set of instructional objectives or not. At the end of each week, a four-item weekly test was administered. After each assessment, students were given feedback on their performance in the test. The feedback was followed by discussions, problem solving and correction of the test as a remediation. Discussions involved closer interaction among the students and between the teacher and the students to identify, discuss, reinforce, and try to reduce tension as they solved problems and made correct responses to the test items. In addition, students' answer scripts were distributed to them and they were allowed to check their mistakes oneach question. Students who performed poorly, that is, those who scored less than 9 out of 20 after remediation, were selected for re-teaching. The teacher repeated the process until most or all of the students were able to attain a high score. The researchers frequently visited the classes during each treatment session to ensure that the research assistants complied with the instructions given in the package.

On the other hand, students in the control group were exposed to a conventional method of teaching. This is the lecture method of teaching, where the teacher talks and writes on the board while the students take notes. The formative assessment package was not used with these groups of students. Although they were taught all the topics using lesson plans and were given a monthly test, there were no feedback and remediation. All the topics were covered during the period of the experiment.

At the end of the eight weeks of teaching the posttest on MTAS and MAT Form II were administered to both the experimental and control groups. The posttest lasted for one and half hours, fifteen minutes for the MTAS and one hour, fifteen minutes for the MAT form II. The pretest and posttest results on the MTAS and MAT were compared to obtain the gain scores of the experimental and control groups. The gain scores revealed the knowledge acquired by each group as well as the extent to which the anxiety level of the control and experimental groups were reduced. During the administration of the posttest, the researchers and the research assistants ensured that students were not interacting with one another and that they adhered to instructions. The scripts were collected after the posttest and given to the researchers who scored them personally using the marking scheme.

The students' scores in the Mathematics Achievement Test form I and form II were categorized according to level of performance into high, average and low as follows: 70%-100% High, 50%-69% Average, and 0-49% Low. The weekly tests were scored usingWAEC essay marking procedure, which assigns marks for method (M), bonus (B) and accuracy (A). Each weekly test has a minimum score of zero and maximum score of 20 marks.The response categories for the Mathematics Test Anxiety Scale (MTAS) are strongly agree, agree, disagree and strongly disagree. The scoring 4, 3, 2,1 was used for positive statements,while the reverse 1,2,3,4 was used for negative statements. Scoreswere calculated in percentages and categorized as 0-42% Low, 43-59% Average, 60-100% High. The data collected were analysed using percentages, means, standard deviation, t-test, and analysis of covariance (ANCOVA) techniques. The results are presented in tables.

III. Results

3.1 Efficacy of formative assessment in reducing mathematics test anxiety and enhancing performance

Before the experiment, 67.9% of the students recorded high anxiety level of 60-100% while 28.3% obtained medium level of anxiety and 3.8%obtained low levels of anxiety score, which is 0-43%. After the treatment, the students whose scores fell in the high anxiety level reduced from 67.9% to 1.9% while the percentage of those with moderate anxiety increased to 71.7%. This suggests that the Package had a positive effect on students' anxiety levels since most of their anxiety levels changed from high on the pretest to medium on the posttest as shown on Table 1.

Table 1:Percentage distribution of students by mathematics test anxiety level

Group	MTAS	Anxiety level							
		Low (0-42%)		Average (43-59%)		High (60-100%)		Total	
		N	%	N	%	N	%	N	%
Experimental	Pretest	23.8	1528.3	3667.9	53	100			
	Posttest	14	26.4	38	71.7	1	1.9	53	100
Control	Pretest	0	0	18	31.6	39	68.4	57	100
	Posttest	0	0	14	24.6	43	75.4	57	100

Analysis of the results of pretest and posttest anxiety levels of students in the control group indicates that most of the students' scores fell within the high anxiety levels while about a third fell within the medium level and none of the students obtained a low level of anxiety. Specifically, 68.4% of the students' scores fell in the high anxiety level on the pretest and 75.4% on the posttest. It can be deduced from Table 1 that use of formative assessment in teaching mathematics reduced students' mathematics test anxiety to moderate level while the conventional lecture method did not.

Table 2 shows that the performance of students in mathematics before the treatment was very poor. The Table reveals that 100% of students in the experimental group scored from 0-49% in the MAT pretest. After the treatment there was a remarkable improvement as 54.7% scored 70-100% and 45.3% scored from 50-69%, which is considered average performance level. This indicates that 100% of the students obtained average to high levels of performance. The mathematics performance of the SSII students in the control group was very poor in the pretest and posttest because 96.5% of the students scored 0-49%, while 75.4% of the them scored 0-49% in the posttest. This indicates that the levels of pretest and posttest mathematics performance of students in the control group were generally low as shown in Table 2.The findings reveal that formative assessment enhanced the performance of the students while the conventional method did not.

Table 2: Percentage distribution of students by mathematics performance level

Group	MAT	Performance level							
		Low (0-49%)		Average (50-69%)		High (70-100%)		Total	
		N	%	N	%	N	%	N	%
Experimental	Pretest	53	100	0	0	0	0	53	100
	Posttest	0	0	24	45.3	29	54.7	53	100
Control	Pretest	55	96.5	2	3.5	0	0	57	100
	Posttest	43	75.4	14	24.6	0	0	57	100

3.2 Comparison of students' mathematics test anxiety and performance mean scores

Table 3: ANCOVA results of difference in posttest mathematics performance mean scores of students in the experimental and control groups when pretest scores were controlled

Source	Type III Sum of Squares	df	Mean square	F	P value
Corrected Model	44304.53	2	22152.27	398.15	.00
Intercept	620.99	1	620.99	11.16	.001
Pre math score	6462.22	1	6462.22	116.15	.00
Group	41308.84	1	41308.84	742.45	.00
Error	5953.29	107	55.64		
Total	344586.00	110			
Corrected	50257.82	109			

Table 3 shows that there was a significant difference in the mathematics performance posttest mean scores of the experimental and control groups after controlling for the effect of the pre-test on mathematics scores ($F_{1,107}$=742, p< .05.) The Levene's test of equality of error variances was used to test the difference between subjects' effects. ANCOVA was used to control the effect of the pretest since the groups were intact classes. The Sidak post hoc test confirms that the corrected difference between the experimental and control groups was significant, (I - J) =39.11. Hence, we can say that the formative assessment improved performance in mathematics.

Table 4:Result of t-test analysis of posttest anxiety scores of students in the experimental and control groups

Group	Number	Mean	SD	dft	P-value
Experimental		48.5	7.48	108 -12	0.00
Control	57	65.5	7.62		

P< 0.05

The results of the t-test in Table 4 shows that there is a significant difference between the mathematics test anxiety mean scores of the groups that were exposed to the Formative Assessment Package (M = 48.5; SD = 7.48) and the groups that were not exposed to the package (M= 65.5; SD = 7.62). The negative t value reveals that the posttest mathematics test anxiety mean score of students in the experimental group was significantly

less than that of students in the control group. The result shows that there is enough evidence to reject the null hypothesis that there is no significant difference in the mathematics test anxiety mean scores of students exposed to formative assessment and those who were not.

Table 5: Result of the t-test analysis of pretest and posttest anxiety scores of students in the experimental group

Group	Number	Mean	SD	df t	P-value
Pretest	53	66.21	12.7	52 9.6	0.00
Posttest	53	48.47	7.48		

$P < 0.05$

The paired-sample t-test shown in Table 5 reveals that there is a significant difference between the pretest mathematics test anxiety mean score of the experimental group (M = 66.21; SD = 12.7) and their posttest mean score (M = 48.47; SD = 7.48). The null hypothesis is, therefore, rejected as the test anxiety mean score of the experimental group on the pretest was significantly higher than their mean score on the posttest. This shows that formative assessment effective for reducing the students' test anxiety scores from high anxiety on the pretest to moderate anxiety on the posttest.

Table 6 shows the paired–sample t-test comparison of the mean pretest and posttest mathematics test anxiety mean scores of SS II students in the control group. The analysis shown in Table 6 reveals that there is no significant mean difference between the pretest and posttest mathematics test anxiety mean scores of students in the control group. The pretest mean score (M = 65.61; SD = 7.81) is almost the same as the posttest mean score (M = 65.49; SD = 7.62). This result is enough evidence to retain the null hypothesis. This means that there was no reduction in the anxiety level of students in the control group after the period of exposure to conventional method of teaching mathematics.

Table 6: Pretest and posttest comparison of mathematics test anxiety mean scores of students in the control group

Tests	N	$\bar{M}$	SD	Df	t	p-value
Pre-test scores	57	65.61	7.81	56	0.19	0.85
Post-test scores	57	65.49	7.62			

$P > 0.05$

Table 7 shows the result of the paired–sample t-test statistic for comparison of pretest and posttest mathematics performance mean scores of the students in the experimental group. The Table reveals a significant mean difference between the pretest (M = 26.6; SD = 4.53) and posttest (M = 70.96; SD = 9.08) mathematics performance scores of students in the experimental group. Thus, one may conclude that the formative assessment that was used in teaching the experimental group improved the mathematics performance of students.

Table 7: Pretest and posttest comparison of mathematics performance mean scores of students in the experimental group

Test	N	Mean	SD	t	df	P-value
Pre-test score	53	26.60	4.53	-46.3	52	0.00
Post-test score	53	70.96	9.08			

$P < 0.05$ (reject)

IV. Discussion

The finding that the level at which the formative assessment is most effective is the medium level of mathematics test anxiety is consistent with earlier findings (Ausubel, [20]; Morakinyo, [21]; Taylor, [19]; Freedman,[12]; Morris [35]; Svihla,[26]; Nurudeen, [11]; Laurenco,[36]) that a certain level of anxiety is desired for problem solving and test taking. The study has shown that formative assessment, weekly tests feedback and remediation reduce high anxiety to a moderate level that can enhance learning and improve performance. The implication of the foregoing to educational practice is that the teacher of mathematics can use formative assessment package to teach and test students in the area of algebra and geometry.

The findings also reveal that the levels of pretest and posttest Mathematics performance of students in the control group were generally low. This is in line with the Chief Examiner's report that the candidates exhibited significant weakness in algebra and geometry. They were generally weak in their understanding of basic concepts and theories as they apply to algebra and geometry. The ineffectiveness of conventional method used in teaching students in the control group agrees with the view of Adegoke [8]; Ivowi [10];Ajogbeje, Ojo

and Ojo [37]; that the method is not supportive of effective and efficient mathematics learning.The implication of this finding is that the teachers should not use conventional method of teaching as this does not improve performance in Mathematics.

The findings that the results of pretest and posttest anxiety levels of students in the control group are high agree with opinion of Adegoke [8], who noted that the conventional method of teaching Mathematics has always been criticized as not being supportive of effective and efficient Mathematics learning but generates anxiety as students are not equipped with the necessary knowledge, skills, beliefs and motivation to approach problem in Mathematics and learning tasks in an efficient and successful way as found in other works (Oluwaniyi [38]; Adikwu [39]; Ajegbeje, Ojo&Ojo, 2013).The implication of the foregoing to educational practice is that the teachers will realize that the use of conventional method of teaching can generate anxiety in students and that anxiety when of high level contributes to students' poor performance in mathematics both in internal and external examinations. In other words, teachers should use methods and strategies that could reduce anxiety and improve students' understanding of concepts taught for a better result in WAEC and other external examinations.

The result of this study also shows that the use of formative assessment improved students' understanding of the concepts taught and the strategies employed improved their performance. With formative assessment, teachers are able to assess students often and to know how to apply remedial teaching, error correction or re-teaching of concepts students find difficult to learn in algebra and geometry. It agrees with the earlier findings of Ajogbeje and Alonge (2012) that students who are systematically taught using formative assessment, perform better than those taught using the conventional method.

One of the findingsfrom the test of the hypotheses reveals a significant effect of the formative assessment on the mathematics performance of students in the experimental group after controlling for the effect of the pretest on mathematics scores. Another finding shows that there is a significant difference between the mathematics test anxiety posttest mean scores of the two groups. The mean score of students in the experimental group on the mathematics anxiety posttest was significantly less than that of students in the control group. The results show that mean score of students in the control group on the test of anxiety was high while those of the experimental group were within the moderate range. It was also found that there is a significant difference betweenthe mathematics test anxietymean scores of the experimental group in the pretest and posttest. This shows that formative assessment had a positive effect on the students as their high anxiety scores were reduced after the pretest to moderate anxiety after treatment as indicated by the posttest result. There is no significant difference between the pretest and posttest anxiety mean scores of students in the control group. The pretest mathematics test anxiety mean score of students in the control group is as high as theirmean score in the posttest. The implication is that if students have high mathematics test anxiety score, the tendency is that they will not have the confidence to learn mathematics in an efficient and successful way. Since high anxiety is an indication that a student is nervous, restless, lacking in understanding of concepts taught, she/he is possessed by other conditional fear reaction like heart pounding, trembling and mental disorganization that arise among students with high anxiety when they are required to solve a mathematical problem.The finding that a significant difference exists between the mathematics performance pretest mean score and the posttest mean score of students in the experimental group indicates that the use of formative assessment improved the mathematics performance of the students. Generally, the findings of this study corroborated earlier findings and demonstrated the efficacy of the Formative Assessment Package developed and validated in this study. This has implication for further studies on adaptation of the package for teaching other difficult topics in mathematics and other related secondary school subjects in Nigeria.

V. Conclusion

The focus of this study was to establish the efficacy of formative assessment as a strategy for reducing secondary school students' mathematics test anxiety and improving performance in the subject. The ultimate goal was to solve the problem of poor performance in mathematics, particularly in algebra and geometry. The findings of the study has shown that formative assessment can be used to reduce mathematics test anxiety to a moderate level in order to improve performance of senior secondary school students in algebra and geometry in particular and mathematics in general.One limitation of the research is that opinions of the students were sought on their anxiety level without triangulation with other data sources to validate their responses. In future research, the use of mixed methods approach as well as the use of information and communication technology driven formative assessment technique could yield interesting comparisons. Nonetheless the findings have implications for teacher education in mathematics. Mathematics teachers should be trained and re-trained on the development and use of formative assessment techniques in teaching for effective implementation of SSII curriculum in algebra,geometry and other content areas in mathematics. This will go a long way in meeting the learning needs of students in mathematics and solving the problem of mass failure in mathematics at the secondary level of education in Nigeria.

References

[1]. Educational Resource Centre, Jos, Plateau State, Nigeria. WAEC and NECO SSCE results(Jos:ERC, 2011).
[2]. G.O. Obioma, Popularizing mathematical science for technological development. In S.O Ale & L.O.Adetula (Eds.), Reflective and intellective position papers on mathematics education issue(Abuja: National Mathematical Centre, 2005), 126.
[3]. Obono& Adebayo, Teacher and learning of mathematics in Nigeria senior secondary schools. (Heinemann Educational Books (Nig.) Plc, 2005).
[4]. West African Examination Council, Senior School Certificate Examination. Chief Examiners' Report.(WAEC.(2005 – 2010, May/June).
[5]. I. J. Uwadiae, Release of May/June WASSCE results. This day Newspaper of 20/08/2010. Retrieved May 6, 2011 from allafrica.com. Nigeria, Nig, 2010
[6]. F. E. Aburime, Challenges of Universal Basic Education: a quasi-experimental study of the role of manipulative. Journal of the Mathematical Association of Nigeria,33(1), 2007, 135- 140..
[7]. O. I. Festus, Intention, implementation, realization: The Impact of Mathematics Curriculum Reforms in Nigeria. Abacus MAN, 2007
[8]. A. B. Adegoke, Teacher influence as a determinant of department-Pronestudents'learning outcomes inseniors secondary school geometry. Unpublished M. Ed Thesis, University of Ibadan, Nigeria, 2002
[9]. P. Eniayeju,. Where is the STEM? Reflections on the missing context in science, technology, engineering and mathematics instruction. Memorial Lecture (51st Annual Conference).Proceedings of Science teachers Association of Nigeria Ibadan: HEBN Publisher, 2010
[10]. U. M.O. Ivowi, Perspectives on education and science teaching(Lagos: CIBN Press, 2011).
[11]. T. S. Nurrudeen, Secondary school students' misconceptions solving Mathematical problem.Journal of the Mathematical Association of Nigeria. 3 (2),2007, 34-40.
[12]. E. Freedman, Do you have mathematics anxiety: A Self-test, 2003 Retrieved October 18, 2010 fromhttp://www.file://A:/Test 3HTM
[13]. C. A. Harman, Reducing test anxiety Cambridge. National Extension College, 2004, Retrieved October 18, 2010 from http://www.Trust Ltd. Internet file.htm
[14]. A.E. Maliki, A. N. Ngbam and J. E. Ibu, Analysis of students performance in JuniorSecondaryschool mathematics examination in Bayelsa State of Nigeria, 2009, Retrieved August 8, 2012, from http://www.Krepublishers.com/02
[15]. A. V. Atovigba, O. M. Vershima, O. O. O'kwu, and U. A. Ijenkeli, Gendertrends in Nigerian secondary school students' performance in algebra.Research Journal of Mathematics and Statistics, 4 (2),2 012, 42-44.
[16]. H. W. Bai, P. L. Wang Pan, and M. Frey, Measuring mathematics anxiety:psychometric analysis of a bi-dimensional affective scale. Journal of Instructional Psychology, 36 (3), 2009, 185-19.
[17]. G. L. Cates, K. N. Rhymer, Examining the relationship between Mathematics anxiety and Mathematicsperformance: An instructional Hierarchy perspective.Journal of Behavioural Education. 2 (1), 2003, 23-26.
[18]. K. E. Ryan, and A. M. Ryan, Psychological processes underlying stereotype threat and standardized mathematics test performance. EducationalPsychologist. 40(1), 2005, 53-63.
[19]. F. Taylor, A critical race analysis of the achievement gap in the United States: Politics, reality, and hope, Leadership & Policy in Schools 5(1), 2006, 6-13.
[20]. D. P. Ausubel, Educational psychology: A cognitive view (New York: Holt Rinehart and Winston, 1968).
[21]. A. Morakinyo, Improving academic performance via anxietyreduction. Nigerian Journal of Educational Psychology. 3 (2), 1986, 53 – 58.
[22]. B. Poppe, Overcoming test anxiety (Grainesville: University of Florida Counselling Centre, 2007). Retrieved August 8, 2011 from http://www.file://A:/test/htm.
[23]. P. Black and D. William, Assessment and classroom learning. Assessment in Education.5 (1), 1998, 67-74.
[24]. M. F. Alonge, Measurement and evaluation in education and psychology (Ado – Ekiti: Adebayo Press, 2004).
[25]. F. V. Falaye, Evaluation as a tool for effective teaching and learning in evaluation in theory and practice, 2005, Retrieved August 8, 2011 from http://www.vtaid.com/png/ERIC/formative- Assessment.htm.
[26]. V. Svihla, Formative Assessment, reducing math phobia and related text anxiety in a geology class for non-science Majors. Proceedings of the 7th international conference on learning sciences,2006.
[27]. R. M. Gagne, The conditions of learning (New York: Holt Rinehart and Winston, 1979).
[28]. J. S. Bruner, A theory of instruction(New York: Norton Inc, 1968).
[29]. O. J. Ajogbeje, and M. F. Alonge, Effect of feedback and remediation on students' achievement in Junior secondary school mathematics.International education studies.5 (1). 2012, 56-59.
[30]. J. O. Adewuyi, Effects of feedback and remediation on student are learning outcomes in secondary school economics, Unpublished DoctoralDissertation, University of Ibadan, Nigeria, 2002.
[31]. H. K. Oduwole,An application of absorbed markov chain model in formative and summative assessment of student learning process. The Journal of the Mathematical Association of Nigeria. 3(1), 2007, 51-65.
[32]. B. O. Sokan, Anxiety Test Inventory (Ibadan: Stirling – Horden Publishers, 2000).
[33]. B. S. Plake and C. S. Parker, The development and validation of a revised version of theMathematics anxiety rating scale.Educational and PsychologicaBookl Measurement.41(1), 1982, 551-557.
[34]. D. George and P. Mallery, SPSS for windows step by step: A simple guide and reference (4thed). (Boston: Allyn& Bacon, 2003). Retrieved from http://www.file://A:/test/htm.
[35]. Morris, Anxiety disorders in children and adolescent (Second Edition, Amazon.com, 2004)
[36]. S. F. Laurenco, American Psychology Association, 13 (3), 2011, 13-20.
[37]. O. J. Ajogbeje, A. A. Ojoand O. A. Ojo, Effect of formative testing with feedback on students' achievement in junior secondary school mathematics in OndoState. International Education Research, 1(2), 2013, 120-126.
[38]. S. D. Oluwaniyi, Modern teaching methods of mathematics (Abuja: National Mathematical Centre, 2004).
[39]. M. U. Adikwu,Curriculum development in science technology and mathematics(STM) Education, Proceedings of Science Teachers Association of Nigeria Ibadan: HEBN Publisher, 2008, 3-4.