DR AKINOLA

ISSN 1119 - 4723

EKSUJOE

JOURNAL OF EDUCATION

Vol. 8 No. 2, 2018

A Publication of the
FACULTY OF EDUCATION
EKITI STATE UNIVERSITY, ADO-EKITI

CONTENTS

ASSESSING THE IMPACT OF EVALUATION METHODS ON STUDENTS' ATTITUDE AND PERFORMANCE IN MATHEMATICS: IMPLICATIONS FOR SUSTAINABLE EDUCATIONAL DEVELOPMENT IN LAGOS, NIGERIA.

Akanni, O. O.
Department of Educational Foundations, (With Educational Psychology)
University of Lagos, Akoka, Nigeria.

Abstract

The study assessed the impact of evaluation methods on students' attitude and performance in mathematics. The research design was quasi-experimental (Pretest/ Posttest control group method) The population for the study were Senior Secondary School in Lagos Metropolis .Two stage sampling technique as well as proportionate stratified sampling procedure was used to select 540 participants based on their class types across four schools (treatment group)and forty–five(45) from one school for the control group. Four research instruments was used, they are (Diagnostics; Formative; Summative) Mathematics Achievement Tests. (DMAT, FMAT& SMAT) and Mathematics Attitude Scale (MAS) by Obe (2002). Cronbach's reliability coefficient for the three mathematics tests, which were 0.629 (Diagnostics), 0.769 (Formative) and 0.502 (Summative) respectively and the Spearman Brown reliability coefficient for the MAS was 0.555. Three hypotheses were formulated to guide the study and tested at 0.05 level of significance. The empirical research findings revealed that class types and evaluation test types exerts significant impact on students' academic performance across the experimental groups while there is no significant impact exerted on their performance by their attitude to study between the experimental groups and the control group among others. Based on the findings, it was therefore recommended among others, that teachers/educators should create feedback mechanism to students' after any of the three evaluation test types ,such will help reveal to the students' their area of weaknesses ,boost and maintain an increasing trend of scores. Also, the study will help enlightened the Nigeria governments to organize educative programmes for teachers to equip them with require skills and teaching methods that would make the content of their teaching easy and simple for students to understand for sustainable development.

Keywords: Assessment, Evaluation methods, students' attitude, academic performance &class types.

Background to the Study

The need for learners' performance to be assessed is very important in the educational system. This is because assessment of students' learning outcomes is cardinal to the realization of the objectives of education in any economy. Assessment is important because it provides information about learning that can be used to: diagnose learner strengths and needs; provide feedback on teaching and learning; provide a basis for instructional placement; inform and guide instruction; communicate learning expectations; motivate and focus learner attention and effort; provide practice applying knowledge and skills; provide a basis for learner evaluation (e.g. grading) and gauge program effectiveness (McTighe and Ferrara, 2014).Teaching cannot be said to have succeeded until assessment proves so. Durowoju, Onuka and Onabamiro (2010) submits that a good teacher would desire to know whether teaching has really taken place, or whether learners have mastered the lesson taught after the teaching and learning process. Hence, teaching efforts may be completely invalidated if no provision is made for some assessment of progress.

Assessment has been described in several ways by scholars. For example, Baku (2008) describes assessment as a means of determining the extent to which education has achieved its goals and objectives while Rust (2002) describes it as an evaluation or appraisal of students' learning outcome. According to him, assessment involves making judgement about students' performance as well as identifying the strengths and weaknesses of students in a particular subject.

Joshua (2014) asserts that assessment is one of the key processes in the teaching and learning cycle as it provides important decision-making information to the teachers in the classroom. Without assessment, teaching would be pointless. The aims of assessment for students, teachers and schools as stated by the Curriculum Development Council (2002) are:

- For students to understand their strengths and weaknesses in learning, understand what they should try to achieve next, and how best they might do this and improve their learning based on feedback from teachers and other assessors; and
- For teachers and schools to diagnose the strengths and weaknesses in the learning of their students, provide quality feedback and specific advice to students so that they know how to improve their learning, review and improve their learning objectives/ expectations of students, curriculum design and content, strategies and activities so that they are better suited to the needs and abilities of their students to enhance learning and teaching effectiveness.

Assessment is a very important and vital aspect of learning. Joshua (2014) submits that assessment is needed in order to know whether learners understood what has been taught. While Stiggins (2015) asserts that research evidences all over the world show that the consistent or regular application of principles of assessments for learning can give rise to unprecedented gains in students' achievement, especially for low achievers.

Mathematics is one of the core subjects taught in all schools throughout the world due to its relevance to other subject most especially in the development of science and technology. It is an integral part of life because it is needed by everyone for successful living. Mathematics is an indispensable tool in the study of sciences, humanities and technology. Its usefulness to man activities cannot be over emphasized. Man uses it directly or indirectly in everyday life or activities. Agwagah (2005), stated that mathematics involves thinking, modelling, conjecturing and describing all aspects of reasoning about situations. Mathematics is a core subject in both the junior and senior secondary schools in Nigeria. The study of the subject was introduced to schools in order to produce competent persons who are skillful in applying Mathematical knowledge in solving everyday life problem. Mathematics is also relevant for decision making process. The Nigerian National Policy document on education (Federal Republic of Nigeria, 2013) shows that improvement in the teaching and learning of Science, Technology and Mathematics (STM) is necessary in order to create the basis for technologically sound workforce in life with the nation's developmental needs (Onwuachu and Nwakonobi, 2009).

Fajemidagba, Slaman and Ayinla (2012) describe Mathematics as a core science subject and a tool for the development of any science- based discipline. These include technology, astronomy, graphics, industry and analytical reasoning in daily living.Ayinla (2011) also posited that Mathematics is the pillar of all knowledge, showing its relevance to all disciplines. Onwuachu and Nwakonobi (2009) notes that Mathematics is the foundation on which the whole essence of living revolves and the platform for scientific and technological innovation. Mathematics is also viewed as a valuable tool for academic enhancement and career choice of individual regardless of gender and age.

Adediran, (2003) also identifies the following goals that Mathematics seeks to achieve, if its concept is well taught in secondary schools. These are:

- Helping the child to explore and understand the world around him by developing competency and understanding the basic skills for dealing with numbers and shapes.

- Helping the child to be able to compare and contrast objects quantitatively thereby develop the habit of effective thinking.
- Helping the child to communicate his thought through symbolic expressions and graph.
- Helping the child to develop the ability to distinguish between relevant and irrelevant data. (Ebeh, 2000).

To realize the objectives of mathematics at any level of the educational system in the society, there is the need to monitor and maintain the quality of the educational processes and products. One major way of monitoring the quality and standards of the teaching and learning of mathematics in schools is through the assessment of the learning outcome of the pupils. The essence of using tests and other evaluation instruments during the instructional process is to guide, direct and monitor students' learning progress towards the attainment of the course objectives (Alonge, 2014; Kolawole, 2010). Hence, it is good for mathematics teachers to monitor and assess their students' progress using proper evaluation techniques.

Oluwatayo and Adebule (2009), see evaluation as such activities that involve gathering of valid information on attainment of educational objectives, analyzing and fashioning information to aid judgment and effectiveness of an educational programme. According to Aduloju (2009), evaluation is the appraisal, judgmental in addition to the decision-making characteristics where the worth of something as to its desirability or non – desirability will be summarily determined. Evaluation helps to determine the efficacy of the instructional materials, the extent to which it has been used and the judgmental value on performance of secondary school students in mathematics that is, it focuses on the worthiness, effectiveness, efficiency such as assessing the worth, value and credibility of the materials; monitoring of students learning achievements in mathematics. In the process of assessment, testing/measurement is frequently done; but a variety of sources of information, both formal and informal may be used. Hence, assessment subsumes testing, measurement and evaluation of the cognitive, psychomotor and affective traits and characteristics (Brown, 1983; Denga, 1987; Joshua, 2014; Nenty, 1997).

According to Gronlund in Joshua (2014), there are four major identifiable purposes for the assessments of individual students' progress in a school. These are:

- Determining pupil performance at the beginning of instruction (Placement Evaluation). This focuses on the student's entry behaviour, and tries to verify whether the child is ready for the lesson/curriculum in terms of pre-requisite knowledge, skills, aptitude, attitude, interest, etc;
- Monitoring lesson progress during instruction (Formative Evaluation) requires giving feedback to the student and the teacher on the students' progress in a unit; and locating possible errors in terms of the structure of the unit so that remedial/alternative instructional techniques can be prescribed;
- Diagnosing learning difficulties during instruction (Diagnostic Evaluation). This is concerned with identifying persistent or recurring learning difficulties that are left unresolved by the standard corrective prescriptions of formative evaluation; and
- Determining students' achievements at the end of instruction (Summative Evaluation). This is designed to determine the extent to which instructional objectives have been achieved; and is used primarily for assigning grade, certifying' mastery of intended learning outcome and promotion graduation.

Much of the classroom assessment is what teachers does, or what they should do, what kind of information they should gather and to what uses they should put the information (Brown & Hirschfield, 2008; Harris and Brown, 2008; Peterson and Irving, 2007). Students' evaluation or learner assessment implies assessment of the three domains of learning. However, a critical review of the current assessment practices in the Nigerian secondary schools make one wonder if the process of learner assessments reflects the position that assessments should take cognizance of, in ensuring that it covers the three domains of learning. The practice of assessment is at variance with the theory and the original concept of it. According to Joshua (2014), learner assessment is hardly formative and

diagnostic in nature in Nigerian secondary schools. Ideally, information gathered in assessments and evaluations should be used to shape strategies for improvement at each level of the education system. Chan, Kennedy, Yu, and Fok, (2006) asserts that, at the classroom level, teachers should gather information on students understanding and adjust teaching to meet identified learning needs. At the school level, school teachers should use the information to identify areas of strength and weakness across the school and to develop strategies for improvement. This means that assessment should be used to support and inform the teaching process by identifying the pupils' areas of weaknesses and strengths so that appropriate remedial intervention could be effected.

However, perceived attitude of students towards success in mathematics affect the idea of mathematics as a subject. Academic problems affecting teaching and learning of mathematics in Nigeria Secondary school include unparalleled hatred, indifference and poor attitude towards mathematics among others (Adebule, 2004). Students' attitude towards mathematics is a major factor that influences students' choice of achievement in the subject. According to Souza and Marces (2010), attitude defines outward and visible postures of human beliefs. Attitude determines what each individual will see, hear, think and do. Classroom assessment is one of the tools teachers can use to inform themselves of their teaching and the learning of their students. Classroom assessment helps to establish what students already know and what they need to learn. Ampiah, Hart, Nkhata and Nyirenda (2013) contended that a teacher needs to know what children are capable to do or not if he/she is to plan effectively. Assessment in the classroom is intended to be a vehicle for change, by getting learners to notice the gap between their current performance and the target performance. The effectiveness of any assessment depends on how well it has succeeded in measuring the knowledge acquisition level of an individual from global and comprehensive perspective of that given individual.

The role of the teacher in the success of any educational system cannot be overemphasized and that is why the National Policy on Education (2013) stipulated that no educational system can rise above the quality of its teacher. Njuguna (2005) was of the opinion that the success of our science programme for sustainable educational development depends greatly on the classroom teacher as he is the one that syntheses, translates and disseminate all our thoughts into action. Students' positive attitude towards mathematics could be enhanced by the following teacher related factors: (i) Teachers grounded knowledge of the subject matter and their making mathematics lessons quite interesting (ii) teachers resourcefulness and helpful behavior (iii) teachers' enthusiasm among others.

Formative and diagnostic evaluation are important evaluation techniques that adds quality to any nation's mathematics education if it meets its requirements of being functional, usable and ensuring instructional effectiveness, This is because teaching and testing are complimentary processes to adopt for organized assessment programmes within the school in order to inject quality in the nation's mathematics education in the country. It is against this backdrop that this study seeks to assess the impact of evaluation methods on students' attitude to and academic performance in mathematics in order to improve their active participation in the learning process, for better understanding and application of the concepts of mathematics for sustainable educational development.

Statement of the Problem

There have been consistent poor performance and high failure rate by Senior Secondary School Students in Mathematics (WAEC Chief Examiners', 2010-2016) These consistent mass failure of most secondary school leavers in May/June Examination conducted by West African Examinations Council(WAEC), the National Examination Council (NECO) and the National Business and Technical Examinations Board (NABTEB) has made the Federal Government to set up panels to investigate mass failure of students in the Senior Secondary Certificate Examinations (SSCE). The import of this on the candidates' future, nation's manpower and sustainable development should be a cause of concern for the country's leaders, stakeholders in the education industry and the nation as a whole. Ogan (2014) opined that the consistent poor performance in mathematics poses a great threat to the much desired scientific and technological advancement of the nation. Aburime (2007) Stated that Mathematics is a very important

subject in Nigeria. Yet, for more than twenty years, Mathematics education in Nigeria has been in a sorry State. Mathematics achievement has been very low and frustrating. So far, every effort made to save Nigerian education from the devastating effect of persistent poor Mathematics achievement has failed. The rate of failure in major public examinations has been alarmingly on the rise. It sounds unbelievable that more than 80 per cent of the candidates who sat for the examination failed to obtain at least a credit in Mathematics. Which is one of the minimum requirements for admission into Universities and other Tertiary institutions, this situation is saddening.

Ajogbeje (2012) cited that one of the key factors which seems to contribute more to the problem of poor students' achievement in Mathematics is the essence/lack of using test and other evaluation instruments during the instructional process which is to guide, direct and monitor students' learning and progress towards attainment of course objectives. Another major problem identified is poor assessment method adopted by many Mathematics teachers in our senior secondary school. It is against this backdrop that, this study assessed the impact of evaluation methods on students' attitude to and performance in Mathematics among senior secondary school students. Hence, the need for the study.

Purpose of the Study

The main objective of the study was to assess the impact of evaluation methods on senior secondary school students' attitude to and performance in mathematics within Lagos State. Specifically, the researcher sought to:

1. determine the impact exerted on students' academic performance across the five experimental groups (i.e. the four treatment groups and the one control group).
2. investigate the impact (a measure of relationship) exerted on students' academic performance by their attitude towards studies between the experimental groups and the control group.
3. determine the impact exerted on students' academic performance across the class types in each of the four treatment groups and the one control group.

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance.

1. There is no significant impact exerted on students' academic performance across the five experimental groups (i.e. the four treatment groups and the one control group).
2. There is no significant impact (a measure of relationship) exerted on students' academic performance by their attitude towards studies between the experimental groups and the control group.
3. There is no significant impact exerted on students' academic performance across the class types in each of the four treatment groups and the one control group.

Methodology

Research Design

Quasi-Experimental research method (pretest-posttest control group design) was adopted in carrying out the study. Quasi-Experimental method, as described by [Ary, Cheser, &Razavieh (1972:26)] is "a scientific investigation in which an investigator (i.e. a researcher) manipulates and controls one or more independent variables and observes the dependent variable or variables for any measurable variation with respect to the manipulation of the independent variables". Ilogu (2005) seesquasi –experimental design as designs that can be used only when one cannot use true experimental designs.

Population of the Study

The target population for this study were Senior Secondary Two (S.S.2) students from government-owned schools within Lagos Mainland zone of Educational District IV. The estimated senior secondary students' population for the entire Education District IV was 32,899 out of which 11,446 are Senior Secondary Two (2) students (Lagos Eko Project, 2012).

Sample and Sampling Technique

Two-Stage sampling technique as well as Proportionate Stratified Sampling technique was employed. Two-Stage sampling technique was used for random selection of five (5) schools in the entire Lagos Mainland zone, followed by the selection of students based on their class type in each of the concerned schools. Proportionate

Sampling technique was also deemed appropriate since there were unique members of the population (each S.S.2 students) existing in the population (i.e. Senior Secondary Students) in form of strata/categories (i.e. existing class types across senior secondary schools), and there was need to randomly pool samples (i.e. sizable number of students) from each stratum (i.e. each class type) to comprise the entire sample, such that equal number of samples are pooled from each stratum/category.

Five (5) schools were randomly selected within the study area. Four of these five schools were observed as treatment groups, while one of them was taken as a control group. From the existing strata (i.e. class types - Sciences, Arts, and Commercials) in each of the four treatment groups fifteen (15) students was randomly pooled, hence, this selection amounted to a total of forty-five (45) senior secondary two (2) students from each of the four treatment groups and from the control group (i.e. the fifth school that was selected), fifteen (15) students were also randomly pooled from the existing strata (i.e. class types - Sciences, Arts, and Commercials), so as to make up a total of forty-five (45) senior secondary two (2) students. Since there were three (3) experimental treatments (i.e. diagnostic, formative and summative test), the process of selection was done thrice on the same type of students, hence implying that on the overall, forty-five (45) students per treatment groups (i.e. each of the four schools) multiplied by the three (3) times each treatment was given on the same set of students. Hence, for each treatment group, a total of one hundred and thirty-five (135) students were used; and then on the overall, five hundred and forty (540) students were per school in the treatment groups for the four schools with only forty-five (45) students in the control group. In conclusion, the total sample size of five hundred and eighty-five (585) students was used.

Research Instruments

Four research instruments was used for this study, these include: the Diagnostic; Formative and Summative Mathematics Achievement Test (DMAT; FMAT and SMAT)which was constructed by the researcher from WAEC past question papers (2014 - 2016) while the fourth instrument is a questionnaire titled Mathematics Attitude Scale (MAS). This is a standardized instrument constructed by Obe (2002) and adopted for the study. Each of the achievement tests contains 20-item multiple choice test items with four answer-options. While the MAS questionnaire contained twenty-four (24) items that measure the students' attitude towards mathematics. Section A of the questionnaire requested the students to supply responses on the name of their school, their gender, age group, and class type, the section B requested to supply responses on the attitude-measuring items. The questionnaire was a Likert-type measuring scale with four (4) response keys and their numeric values for scoring are (i.e. StronglyAgreed (SA) - 1, Agreed (A) -2, Disagreed (D) -3 and Strongly Disagree (SD) -4.

Validity of the Research Instruments

Content Validity is the ability of the research instruments to comprehensively measure the domain.

Content Validity of the four research instruments (i.e. the three mathematics achievement tests and the MAS questionnaire) was ensured. The' MAS' questionnaire was adopted for the study while the three Mathematics Achievement Tests (MAT), were given to experts in the field of measurement and evaluation, University of Lagos. The experts helped to ascertain whether the items in the instruments were well structured to measure the variables of interest in the study, thereby ensuring the content validity of the research instruments.

Reliability of the Research Instrument

The reliability of the research instrument was ensured by a pilot study carried out by the researcher. The pilot study involved 60 senior secondary two (2) students in a school within Apapa zone of Educational District IV. The schools in these zones were appropriate for the pilot study since the main study was to be carried out in Lagos Mainland zone of the Educational District IV to avoid contamination. Twenty (20) students were randomly pooled from each of the class typesThe choice of each sixty (60) students in those schools was based on their class types (i.e. Sciences, Arts, and Commercials). Cronbach's Alpha reliability analysis was employed (with the aid of Statistical Package for Social Sciences-SPSS) to determine the reliability coefficient of the Mathematics Achievement Tests (MATs). The choice of this reliability analysis was because it measures the internal consistency of each of the instruments. The reliability coefficients for the diagnostic,

formative, and summative test were *0.629, 0.769,* and *0.502* respectively, while the Spearman-Brown reliability coefficient for the MAS was *0.555.*

Data Analysis, Results, and Discussion

Hypothesis 1: There is no significant impact exerted on students' academic performance across the five experimental groups (i.e. the four treatment groups and the one control group)

Table 1: One-way Analysis of Variance in Students' Academic Performance across the Experimental Groups

	Sum of Squares	d.f.	Mean Square	F-calculated	Sig. (p) value	Remark
Between Experimental Groups	310.369	4	77.592			
Within Experimental Groups	4704.124	579	8.125			
Total	5014.493	583		9.550*	0.000	H_0 is Rejected

F- Critical = 2.38; F- calculated ≥F- critical

Table 1 reveals that the observed difference in the students' academic performance across the experimental groups was statistically significant. Such difference attracted yielded an F-calculated value of 9.550, which is greater than the F-critical value of 2.38 given 4 and 579 degrees of freedom (between and within the experimental group respectively) at 0.000 level of significance (less than the statistical benchmark of 0.05 significance level). Therefore the null hypothesis was rejected. It implies that there is a significant impact exerted on students' academic performance across the five experimental groups (i.e. the four treatment groups and the one control group)

Table 2: Multiple Comparison Post Hoc Test of Difference in Students' Academic Performance across the Experimental Groups

Experimental Groups	Experimental Groups	Mean Difference	Sig. (p) value
Experi. Group1	Experi. Group 2	-1.496*	0.001
	Experi. Group 3	-1.252*	0.012
	Experi. Group 4	-0.247	0.973
	Control Group	0.733	0.693
Experi. Group2	Experi. Group 1	1.496*	0.001
	Experi. Group 3	0.244	0.974
	Experi. Group 4	1.249*	0.012
	Control Group	2.230*	0.000
Experi. Group3	Experi. Group 1	1.252*	0.012
	Experi. Group 2	-0.244	0.974
	Experi. Group 4	1.005	0.081
	Control Group	1.985*	0.003
Experi. Group4	Experi. Group 1	0.247	0.973
	Experi. Group 2	-1.249*	0.012
	Experi. Group 3	-1.005*	0.081
	Control Group	0.980	0.409
Control Group	Experi. Group 1	-0.733	0.693
	Experi. Group 2	-2.230*	0.000
	Experi. Group 3	-1.985*	0.003
	Control Group	-0.980	0.409

In order to confirm the cause of this observed statistical significance in table 1. Table 2 shows a multiple comparison of the test scores per pairs of experimental groups, The table reveals that the significant difference in students' academic performance was as a result of the impact exerted by the high students' average scores in experimental group 2 and 3 (Grp2-Grp1: mean difference = 1.496, p = 0.001 < 0.05; Grp2-Grp4: mean difference = 1.249, p = 0.012 < 0.05; Grp2-Control Grp: mean difference = 2.230, p = 0.000 < 0.05; Grp3-Grp1: mean difference = 1.252, p = 0.000 < 0.05; Grp3-Control Grp: mean difference = 1.958, p = 0.003 < 0.05).

Hypothesis 2: There is no significant impact exerted on students' academic performance by their attitude towards studies between the experimental groups and the control group.

The Pearson Product Moment Correlation (PPMC) was employed for the analysis

Table 3: An "r" statistical table showing the relationship (a measure of Impact) between the students' academic performance and their attitude towards studies

	Experimental Group		Control Group	
	Academic Performance (Summative) n_1=180	Students' Attitude towards Mathematics n_1=180	Academic Performance (Summative$_1$=45	Students' Attitude towards Mathematics n_1=45
Academic Performance (Summative)	$(10.23)^{average}$ $(2.71)^{std\ dev.}$	$(178)^{d.f.}$	$(10.38)^{average}$ $(1.59)^{std\ dev.}$	$(43)^{d.f.}$
Students' Attitude towards Mathematics	$(-0.027)^{*r\text{-}cal}$ $(0.719)^{p\text{-}value}$	$(64.23)^{average}$ $(5.32)^{std\ dev.}$	$(-0.028)^{r\text{-}cal}$ $(0.854)^{p\text{-}value}$	$(63.58)^{average}$ $(5.99)^{std\ dev.}$

For each class types, the mean values (or averages) per variables are on the diagonals with their respective standard deviation. The calculated r values with respective p-values are below the diagonals, while their respective degrees of freedom are above the diagonals, where n_1= number of students for each class type.

Table 3 above shows that the students who were exposed to the three experimental treatments possessed an appreciated attitude towards mathematics with an average of 64.23 (which is greater than the expected average value of 48.00), this was more than the attitude of students that make up the control group (whose average attitude towards mathematics was 63.58 (which is greater than the expected average value of 48.00). It was also observed that for those in the experimental groups, students' academic performance significantly did not impact on their attitude towards mathematics (with calculated R-values of 0.-0.027 and a p-value of 0.719 > the statistical benchmark of 0.05; in the same vein, students' academic performance significantly did not influence their attitude towards mathematics (with calculated R-values of 0.-0.028 and a p-value of 0.854> the statistical benchmark of 0.05.In conclusion, there was no significant impact exerted on students' academic performance by their attitude towards studies between the experimental groups and the control group.

Hypothesis 3: There is no significant impact exerted on students' academic performance across the class types in each of the four treatment groups and the one control group.

Table 4: One-way Analysis of Variance in Students' Academic Performance across the Class types in each Experimental Groups TTest Variable: Academic Performance

Experimental Groups	Sum of Squares	Df	Mean Square	F-calculated	Sig. value
Experi. Group1	Between Groups	2	48.467	4.491	.013
	Within Groups	1424.400	132	10.791	
	Total	1521.333	134		
Experi. Group2	Between Groups	8.015	2	4.007	.529	.591
	Within Groups	1000.178	132	7.577		
	Total	1008.193	134			
Experi. Group3	Between Groups	.415	2	.207	.031	.970
	Within Groups	894.800	132	6.779		
	Total	895.215	134			
Experi. Group4	Between Groups	168.188	2	84.094	11.010	.000
	Within Groups	1000.618	131	7.638		
	Total	1168.806	133			
Control Group	Between Groups	24.711	2	12.356	6.043	.005
	Within Groups	85.867	42	2.044		
	Total	110.578	44			

The trend of result (i.e. significant impact being exerted on students' academic performance due to their class types) was only the same in experimental group 1, 4 and control group [Experi. Grp1: F-value=4.491, p-value=0.013<0.05; Experi. Grp4: F-value=11.010, p-value=0.000<0.05; Control Grp: F-value=6.043, p-value=0.005>0.05]. Hence, these numerical evidences imply that only in experimental group 1, 4, and control group, there is a significant impact exerted on students' academic performance across the class types in experimental groups 1 and 4

Table 5: Multiple Comparison Post Hoc Test of Difference in Students' Academic Performance across the Class Types in each Experimental Groups

	Class Types	Class Types	Mean Difference	Sig. (p) value
Experimental Group 1	Sciences	Arts	2.067*	0.013
		Commercials	0.867	0.459
	Arts	Sciences	-2.067*	0.013
		Commercials	-1.200	0.227
	Commercials	Sciences	-0.867	0.459
		Arts	1.200	0.227
Experimental Group 2	Sciences	Arts	-0.556	0.633
		Commercials	-0.467	0.724
	Arts	Sciences	0.556	0.633
		Commercials	0.089	0.988

	Commercials	Sciences	0.467	0.724
		Arts	-0.089	0.988
Experimental Group 3	Sciences	Arts	-0.089	0.987
		Commercials	-0.133	0.971
	Arts	Sciences	0.089	0.987
		Commercials	-0.044	0.997
	Commercials	Sciences	0.133	0.971
		Arts	0.044	0.997
Experimental Group 4	Sciences	Arts	2.689*	0.000
		Commercials	1.776*	0.012
	Arts	Sciences	-2.689*	0.000
		Commercials	-0.913	0.301
	Commercials	Sciences	-1.776*	0.012
		Arts	0.913	0.301
Control Group	Sciences	Arts	-0.400	0.747
		Commercials	-1.733*	0.007
	Arts	Sciences	0.400	0.747
		Commercials	-1.333*	0.048
	Commercials	Sciences	1.733*	0.007
		Arts	1.333*	0.048

In order to confirm the cause of this observed statistical significance in table 4, table 5 is a multiple comparison of the test scores per pairs of class types in each experimental groups, reveals that the significant difference in students' academic performance was as a result of the influence exerted by the high students' average scores in Sciences only for experimental groups 1 and 4 [Experi. Grp 1: (Sciences-Arts: mean difference = 2.067, $p = 0.013 < 0.05$); Experi. Grp 4: (Science-Arts: mean difference = 2.698, $p = 0.000 < 0.05$); Science-Commercials: mean difference = 1.776, $p = 0.012 < 0.05$)]. As for the control group, the significant impact that was observed across the class type within the control group was due to the high scores of the commercial students Control Grp: Commercials-Sciences: mean difference = 1.733, $p = 0.007 < 0.05$); Commercials-Arts: mean difference = 1.333, $p = 0.048 < 0.05$).

Discussion

Finding 1 showed that there is a significant impact exerted on students' academic performance across the five experimental groups (i.e. the four treatment groups and the one control group) generated by the high students' average scores in experimental group 2 and 3. This implies that the impact of the experimental treatments was much felt on the students who are in the four treatment groups (i.e. students who were given experimental treatments in the four selected schools). This present finding was supported by Adodo (2013) in his investigation of two-tier multiple choice diagnostic assessment items on students' learning outcome in BST (Basic Science and Technology), when he showed that there was an increase in the performance of the students among the groups after the given experimental treatment. In the same vein, Ojugo, Ugboh, Onochie, Eboka, Yerokun&Iyawa (2013) who in their experimental survey affirmed that the overall tendencies of the experimental groups indicated that all experimental groups exposed to formative testing relatively performed better than no-formative tested experimental group in the GSQEAI (Graphical Solution of Quadratic Equation Ability Instrument), implying that the close book formative test (as the experimental treatment) significantly facilitates achievement in mathematics. Moreso, Ajogbeje (2012) noted that there was a significant difference in the level of achievement of members of the four treatment groups in their posttest scores after correcting for initial group differences.

Finding 2 showed that there is no significant impact (a measure of relationship) exerted on students' academic performance by their attitude towards studies between the experimental groups and the control group. Even though students' attitude towards the learning of mathematics in the treatment group appreciated above the attitude of these students in the control group, yet in spite of this, the average summative test score of those given experimental treatments is less than the average formative test scores of those in the control group. So, that means that the scores on the diagnostic and summative tests were not effective to propel high scores in the summative test (for the treatment groups). This was opposite to Palmen, Vorstenbosch, Tanck, Kooloos (2015) in their survey on a medical course (i.e. anatomy), through correlational analysis who submitted that students' participation in formative quizzes influences the scores on the final summative examination. Afemikhe, (1985) had earlier found formative assessment to be very efficacious in improving learning particularly when based on process of learning. How is the learning going on? What have been done to facilitate it? Are students having difficulties and what can be done to assist them?

Finding 3 showed that there is a significant impact exerted on students' academic performance across the class types in experimental groups 1 and 4. In opposition to this present finding, Alonge (2014) revealed in his descriptive survey that Art-oriented students outperformed others with an average score of 14.64; this was followed by Commercial students (12.30), while Science-oriented students' scores the least (11.66). Although, Alonge, (2014) did not make further effort to know whether such difference is statistically significant or not. However, Okafor (2017) with respect to the mathematics achievement test, declared that science-oriented students (15.87) outperformed the other category of students, while the commercial students (14.23) performed better than the Arts-oriented students (13.16).

Conclusion

Based on the research findings, it could be inferred that as far as Lagos Mainland of Education District IV of Lagos State is concerned, on a general note, class types and evaluation methods exerted a significant influence on students' academic performance, the students' test scores in the summative test did not significantly influence their attitude or affection towards mathematics (for both the treatment and control groups). Clearly speaking, the diagnostic and formative evaluation test type were not efficacious in raising students' summative evaluation test scores above the scores of their colleagues who were not given any of the diagnostic and formative test treatment.

Recommendations

Based on the findings and conclusion in this study, it would be appropriate to recommend that:

- Assessment should be adequately used in schools in order to improve students' learning achievement.
- Teachers should ensure that they use various tools such as assignments, discussion, projects, oral questions and even observation to assess students in order to improve learning.
- School teachers/well-meaning educators should conscientiously create a feedback mechanism system to students after any of these evaluation methods test types (diagnostic, formative, and summative); such system will reveal to the students the areas of their past errors and mistake while solving each questions, these can help them master quick ways of solving questions; hence, this will help to boost and maintain an increasing trend of scores in the diagnostic, formative, and summative evaluation method test and as well help motivate their attitude towards the learning of mathematics.
- School Teachers should ensure that the mode or the form in which diagnostic and formative evaluation are constructed are up-to-date and relevant so as to enhance academic performance at the end of each academic term. (This is because the average diagnostic test score was the highest, and the average summative test score was the least).
- Students should cultivate the habit of noting the corrections made from the feedback mechanism system. This is because it will help build on such form of knowledge needed to construct their final examination for each academic term.

- The Nigerian Government/Ministry of Education should organize educative programme for teachers that will equip them with panacea teaching method that would make the content of their teaching easy-to-understand for students after being given diagnostic test
- Parents should make efforts to give their children good parental care and training which would go a long way in enhancing their concentration to studies and better academic performance

Implications for Sustainable Development

Sustainable Development is economic development that is conducted without depletion of natural resources. It is the organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem. It is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is the process of change, in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony.

The Sustainable Development Goals (SDGs) otherwise known as the global goals are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The SDGs work in the spirit of partnership and pragmatism to make the right choices now to improve life in sustainable way, for future generations. The SDGs came into effect in January 2016, and they will continue to guide UNDPs policy and funding for the next 15 years till year 2030. As the lead United Nations Development Agency. The Strategies plan focuses on key areas including poverty alleviation, democratic governance and peace building, climate change and disaster risk and economic inequality.

Evaluation processes will play a key role in National and global review systems for the Sustainable Development Goals. The 2030 Agenda for sustainable Development adopted by the United Nations in 2015 puts follow-up review process as the heart of global and national efforts to achieve the 17 Sustainable Development Goals (SDGs). It says follow-up and review processes will be informed by country led evaluations and data which is high-quality, accessible, timely and reliable. They argue that effective evaluation goes beyond measurement and provides a way to explain data trends and investigate whether progress is equitable, relevant and sustainable.

With all that has been said and done in this research, it is noteworthy to establish that:

- Teachers need to develop guidance to simplify, choosing the right methods and approaches for different purposes, and to make their use more effective in promoting sustainability.
- Our policy makers should be adequately enlightened on the role of evaluation in policy implementation especially its education and allied policies that have bearing on sustainable development. This calls for the involvement evaluators and associations of evaluators in enlightenment campaigns, sensitization and advocacy on evaluation. Policy makers should also be discouraged from the usual unplanned and uncoordinated announcement and execution of policies and programmes.
- Without a feedback mechanism, every diagnostic and formative evaluation test cannot be able to enhance better performance in the summative evaluation test. Hence, Evaluation should be a mandatory of all mathematics teachers for sustainable development.
- Teachers should ensure that after giving students diagnostic and formative test, their teaching styles/methodology must be down-to-earth in nature and student centred so that the students will be able to observe and correct their previous errors (in the initial test) and make adjustment so that there will be no recurrence of such errors in the subsequent tests.
- Evaluation methods of mathematics teachers in our schools needs to be monitored in other to achieve excellent in the subject for technology and sustainable educational development ,this is because mathematics is the bedrock of the sciences and without mathematics as a core subject there is little a nation can achieved.

- There is the need for Nigerian students to develop positive attitude toward mathematics as a subject because every – one no matter the profession needs rudimentary knowledge of mathematics in day to day activities for sustainable and educational development.

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THE INFLUENCE OF MATHEMATICAL LANGUAGE AND SYMBOLS ON THE UNDERSTANDING OF MATHEMATICAL CONCEPTS BY SECONDARY SCHOOL STUDENTS

Popoola, A. A., Binuyo, J. O., Daramola, K. R., Fabiyi T.R., Oyerinde O. O., Abioye, I. & Isaac, A. M.

Ekiti State University, Ado – Ekiti, Ekiti State, Nigeria.

Abstract

This study has probed into the influence of mathematical language and symbols on the understanding of mathematical concepts by secondary school students in Ekiti state. Convenience sampling (for Ekiti North senatorial district), simple random sampling with proportional allocation were used. The sample included five schools. Fifty senior secondary school II students and five Mathematics teachers of those students. The students completed the questionnaires and were interviewed as a group at each of the five (5) selected schools while the teachers were individually interviewed. It was found that most students fail to understand or interpret the meaning of Mathematical terms and symbols due to the way they were taught to read, pronounce and use them. The misuse (and also abuse) of symbols may considerably hinder formation, understanding and communication of concepts and might affect achievement; the final outcome desired. Teachers are thereby sensitized on appropriate and workable strategies to take to overcome students' challenges on the understanding and interpretation of terms and the use of symbols. The strategies include informed choice of the main classroom textbook to use, integration of Mathematics with other subjects and a firmer grasp of the subject matter and its pedagogy.

Keywords: Symbols, Language, Terms, Notations, Misuse, Abuse, Influence, Mathematics Concepts.

Introduction

Mathematics education begins in language, it advances and stumbles because of language and its outcomes are often assessed in language (Kolawole and Popoola 2011). Language is critical for cognitive development as it provides the concepts for thinking and therefore a means of expressing ideas and asking questions (Omobola, 2010).

Clement (2009) established that words are used to construct our interpretation of experience; our experiences shape our language and in the culture of schools, a concept does not exist until it has been named and its meaning shared with others. Therefore, the enhancement of the learner's thought processes should be the main objective of the school. The roles of the teacher as an agent of the school should include: encouraging the learners to be aware of their own thought processes and to engage actively in appropriate thinking by using precise terminologies through posing critical questions, clarifying ideas and processes as well as withholding value judgment (Fennema and Peterson, 2005). Language enables learners to interact with more capable peers and adults and later with written materials which give them a chance to share their accumulated knowledge (National Research Council, 2002).

In order to achieve in-depth mathematical understanding Popoola, (2013) suggested that effective communication of mathematical ideas is the key because language forms an integral part of this communication. Language and mathematics are intrinsically related. Attention to language is an important component in developing students' conceptual understanding of mathematics. Kolawole (2010) therefore

emphasize the need for the mathematics teachers to be mandated to assess students' ability to communicate their reasoning and their use of mathematical language and symbols since thinking of Mathematics as a language can affect how the subject is taught.

Popoola (2015) opines that mastering mathematics is considered to be a two-step process; firstly, learners have to understand the mathematical concepts, secondly, they have to be able to communicate their understanding of these concepts in written format. Chinime (2012) thereby explain the two verbal languages through which mathematical concepts can be explained; a commonly spoken, every day language and a subject-specific mathematical language. It is therefore essential for learners to be proficient in both these languages which poses the role that educators need to develop effective ways of teaching both the language of mathematics and the language of teaching and learning.

Meanwhile, in this modern technological world, Mathematics plays a greater role than ordinary language in trying to find solutions to everyday problems. Coding and decoding information, shortening sentences and representing and analyzing data are all processes where mathematical symbols are used (Brown, 2004) and as supported by Esty (2011) that mathematics itself is a language with an internationally recognized syntax and vocabulary. Therefore, how mathematics exploits the spatial features of its symbolisms and develops manipulations of symbolic expression is a special property that is not shared with ordinary languages. From experience as mathematics instructors, it is discovered that most students failed to grasp mathematical skills and concepts. The reason for that failure could have been that the symbols which they encountered were unfamiliar, confusing and sometimes contradictory. The researchers then became interested in finding out the truth about this conjecture, focusing on the topics on sets at senior secondary schools.

Statement of the Problem

The unsatisfactory display of mathematical understanding by the Senior Secondary School students in both internal and external assessment tasks has created a great concern to the teachers, government, examining bodies, parents and educators. This situation demands an urgent investigation and attention. A close examination of mathematics questions at Ordinary Level showed that a higher percentage of each examination comprises mathematical language which demands high

Purpose of the Study

The purpose of the study was to investigate the influence of mathematical language and symbols on the understanding of mathematical concepts by secondary school students. The study also examined the gender difference in students' achievement using mathematical language and symbols. The study also examined the difference between the performances of students having teachers with teaching qualifications and those without teaching qualifications in mathematics assessment using mathematical language and symbols.

Research Hypotheses

1. There is no significant difference in students' performance in Mathematics using Mathematical language and Mathematical symbols.
2. There is no significant influence of students' gender on their performance using Mathematical language and symbols.
3. There is no significant difference between the performance of students having teachers with teaching qualifications and those without teaching qualifications in Mathematics assessment using Mathematics symbols and language.

Population and Sampling Procedure

The target population for this study consisted of all SS II students in Ekiti State public Secondary Schools 2015/2016 academic session. There were 187 public secondary schools across the 16 Local Government Areas of the state. The sample consisted of 50 SS II students and 5 mathematics teachers selected using multistage sampling technique. The first stage was the purposive selection of a of Ikole Local Government Area. The second stage is the selection of 5 schools using simple random sampling technique. The last stage involves the

random selection of 10(5 male and 5 female students from each school to make a total of 50 students with their respective 5 SS II teachers from each selected school.

Research Design

The study employs an evaluative design which involves the administration of the instrument for assessment of the on set theory.

Research Instruments

Two research instruments were used to generate data for the study. They are:

1. The interview for the selected Mathematics teachers which contains bio-data of the respondent's school, local government area, gender, area of subject specialization, teaching experience and qualification. They were also interviewed to find out the areas of difficulties while teaching the students mathematics and perspective areas of misconceptions in Mathematics.

2. Questionnaires for the selected SS II students. This comprises 3 sections. Section A comprises the students' bio data which include school, sex, class, age, the type and their weekly schedule to study Mathematics. Section B Questionnaires were given to the selected students from SS II to complete within 40 minutes. There were 20 objective questions comprising two sections. Part I comprises 10 test items with pure Mathematical symbols and Part II, 10 test items on Mathematical language on set theory. The reason for focusing on sets was that almost all Mathematical structures can be fundamentally explained in set-theoretical terms and many students had been confronted with difficulties in grasping and using set symbols. The content validity of the instrument was established by giving the items to two experts in Mathematics education and two Mathematics teachers for their comments on whether the test item measured what it was expected to measure relative to the objectives. Their comments assisted the researcher to determine the appropriateness and adequacy of the items in terms of content coverage, lucidity of rubrics and language level.

Validity of the Instruments

The face and content validities of the instruments were established by giving them to experts in Test, Measurement and Evaluation and also to two mathematics teachers for scrutiny. Their corrections and comments assisted the researchers to determine the appropriateness and adequacy of the items in terms of content coverage, lucidity of rubrics and language level.

Reliability of the Instruments

The internal consistency of reliability was used to determine the reliability of the instruments in a school not within the sampled schools and students. The reliability coefficient obtained was 0.68 which was considered moderately high enough to be used for the study.

Data Analysis

The data collected were subjected to a t-test statistical analysis in order to test the hypotheses.

Results and Discussion

Results of the Interview with Teachers

Table 1: Teachers' Qualifications

Qualifications	Number	Percentage
NCE	0	0%
ND	0	0%
HND	2	40%
B.Sc	1	20%
B. Sc. Ed.	2	40%
B. A.	0	0%
B. A. Ed	0	0%
M. Ed.	0	0%
Masters	0	0%
PhD	0	0%
Others	0	0%

Table 1 shows the teacher's qualifications. Out of 5 teachers interviewed, 3 (60%) have Higher National Diploma (HND), while 2 (40%) have B.Sc (Ed) in Mathematics. Other qualifications were not found. Only the teachers with educational qualifications in Mathematics were considered the qualified teachers teaching Mathematics.

The teachers who have educational qualification in Mathematics have adequate understanding of Mathematical language and while the teachers who are HND and B.Sc holders have less understanding of elucidating the Mathematical language, terms and symbols to the students.

Hypothesis I: There is no significant difference in the students' performance in Mathematics using Mathematical language and Mathematical symbols.

Table 2: Performance of students using mathematical language and symbols

	N	$\bar{X}$	S.D	df	t-cal	t-tab	Remark
Mathematical Symbols	50	2.68	1.43	98	6.434	2.6269	Significant
Mathematical Language	50	3.74	0.99				

Table 2 shows that the t-cal (6.434) > t-tab (2.6269) at 0.05 level of significance. Hence, the null hypothesis is rejected.

Therefore, there is significant difference between the performance of students in Mathematics using Mathematical language and Mathematical symbols. From the table, the performance of students was better in Mathematical language assessment than the pure Mathematical symbols.

Hypothesis 2: There is no significant difference between the students' sex and their performance using Mathematical language and symbols.

Table 3: Students' sex and their performance using mathematical language and symbols.

	N	$\bar{X}$	S.D	df	t-cal	t-tab	Remark
Male Students	25	5.36	2.26	48	0.781	2.682	Not Significant
Female Students	25	6.12	1.67		5	2	

Table 3 shows that the t-calculated which is 0.7815 is less than t-table which is 2.6822 at 0.05 level of significant. Hence the null hypothesis is not rejected. Therefore, male students did not perform better than female students in Mathematics test comprising both Mathematical language and pure Mathematics symbols in secondary schools.

Hypothesis 3: There is no significant difference between the performance of students having qualified teachers and those having unqualified teachers teaching Mathematics in Mathematics assessment using Mathematics symbols and language.

Table 4: Performance of students having qualified teachers and those having unqualified teachers teaching Mathematics in Mathematics assessment using Mathematics symbols and language.

	N	$\bar{X}$	S.D	df	t-cal	t-tab	Remark
Students with qualified teachers	20	7.15	2.242	48	2.546	1.677	Significant
Students with non-qualified teachers	30	6.03	0.608			2	

Table 4 shows that the t-calculated which is 2.546 is greater than the t-table which is 1.6772 at the 0.05 level of significance. Hence, the null hypothesis is rejected. Therefore, the students being taught by the qualified teachers had better performance than the students taught by the unqualified teachers in the Mathematics assessment comprising both Mathematical language and Mathematical symbols.

The findings of this study revealed a significant difference in the performance of students when assessed with mathematical language than when symbols are used. This was due to too many symbols to which students are not familiar but rather with the language expression. The findings also revealed no gender disparity in the performance of students, an indication of equal level of male and female students in mathematics. The study also showed a difference in the performance of students in favour of those taught by the teachers with qualifications in mathematics. This shows a reflection from interview with the teachers, dynamism in teaching strategies, knowledge of the concepts and even teachers' attitude in the class as the determinant factors to effective classroom teaching.

Conclusion and Recommendations

This study has investigated how the use of set theory, symbols and others influence

understanding of concepts by secondary school students. It has also sensitized teachers on appropriate strategies to take to overcome students' difficulties on the use of symbols. From the findings of the study there is evidence that most students fail to interpret or understand the meaning of Mathematical symbols due to the way by which they were taught to read, pronounce and use them. The misuse (and abuse) of language and symbols considerably hinder formation, understanding and communication of concepts to a great deal and might affect the final achievement.

This study has also concluded that students fail to grasp Mathematical concepts because they take the symbols themselves as the objects of Mathematics rather than the ideas and processes which they represent. According to the results, from the questionnaires, the blame lies on the textbooks and the teachers. Teachers seldom explain the meanings and proper uses of the symbols while textbooks change the symbols too often and don't bother to give historical background information about these symbols. Students fail because teachers introduce new words from the subject language and symbols when the given situation can be handled in terms of words and symbols already known.

Based on the finding of these results, it was therefore recommended that mathematics symbols should well simplified to enhance the learners' understanding during the teaching of mathematics. Also, teachers should try as much as possible to be equipped with adequate understanding of mathematical terms, symbols and language so as to be able to discuss mathematical concepts expositorily for the learners. Moerso, acquiring teaching qualifications aid pedagogical skills, therefore, all the mathematics teachers should endeavour to have teaching qualifications.

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