

EFFECT OF FORMATIVE ASSESSMENT PACKAGE ON STUDENTS' ACHIEVEMENT IN MATHEMATICS

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Abstract

The study examined the effects of formative Assessment package (FAPM) on the academic Achievement of Senior Secondary School Students in Mathematics in Umuahia Metropolis, Nigeria, with the objective of improving instruction and Students' learning. Two hypotheses were tested in the study. The instrument used for data collection was FAPM based on the objective of four content areas (quadratic equation, simultaneous equation, circle theorem & trigonometry) and was made up of four forms of ten essays items each in addition to the use of quizzes and class assignments. The instrument was face and content validated and the internal consistencies for the four forms were 0.68, 0.58, 0.52 and 0.65 respectively using Cronbach Alpha. The study adopted a quasi-experimental design of the non-randomized pretest to post test control type and used a sample of 90 students randomly selected from two public schools of intact classes out of 24 schools. ANCOVA was used for testing the hypothesis at 0.05 level of significance. The result indicated a significant difference between the experimental and control groups. The study recommended among others, the use of formative assessment in teaching and learning of mathematics over the conventional type.

Key words: Formative Assessment Package, Students' Achievement and Mathematics.

Mathematics occupies a very significant position in the activities of man. To be an Engineer, Accountant, Economist, Agriculturist, Surveyor, Technologist among other professionals, one requires a good knowledge of

mathematics. This is why mathematics is a core subject at Primary and Secondary School levels. Presently, for one to gain admission into the University or Polytechnics, he or she must have at least a credit in mathematics.

Unfortunately, the West African Examination Council (WAEC) Chief Examiner's Report of 2010, 2011, and 2012 on candidates performance revealed low performance in mathematics. They reported that majority of the candidates were generally weak in their understanding of basic concepts and theories as they apply to topics in trigonometry, quadratic equation, simultaneous equation and circle theorem. In support, Uwadie (as cited in Nworgu, 2015) noted that the national average in mathematics hovers around 32 percent. He reported that, in June/July, 2011 West African Senior School Certificate Examination (WASSCE), out of 1,156,561 who sat for mathematics, only 3,356 representing 0.28% obtained distinction, while 24.86% got credit, 60.27% got ordinary pass, 7.48% failed and 4.27% were involved in Examination Malpractice. By implication, only 25.14% were qualified for admission into Universities and Polytechnics.

In order to improve on the performance, the Examination bodies had organized series of workshops, conferences and seminars for her staff and stakeholders. In addition, the Boards sold their past question papers. In the same way, government and School authorities organised workshops, seminars and conferences on regular bases for their staff on learning strategies that can enhance students' performance in class work, tests and examinations. Even parents and guardians on their part organised coaching and extra mural classes for children and wards. Despite all these efforts, there

seems to be no significant improvement on students' performance in mathematics.

In concern with the students' persistent poor performance and weaknesses in Mathematics, strong (2013) noted that the teaching and learning of mathematics seem to have been characterized by rote memorization of some basic processes and abstract presentation of facts and principles. He further explained that teachers' method of teaching is traditional, content driven and knowledge based. In this context, teachers teach with textbooks without proper preparation of lessons, they wrongly believe that covering the syllabus is the same as effective teaching and that school assessments are basically for record purposes. Teachers therefore concentrate on summative assessment which is giving and recording of continuous assessment scores once a month just for promotion and not corrective in nature.

It implies that students' poor performance, weaknesses and misconceptions can better be addressed using formative assessment. Black and William (1990) explained formative assessment or Assessment for learning (AFL) as one which gathers evidence of students learning. This evidence is then used to adjust teaching practices to better cater for the needs of students. They further explained that formative assessment is an on-going classroom oral questions, quizzes, assignments, discussions and tests that keep students and teachers informed of students' progress towards the lesson's learning objectives. On the other hand, Gronlund

(1990) explained that formative test typically covers some predefined segment of instruction and thus encompasses a rather limited sample of learning tasks. The test items may be easy or difficult depending on the learning tasks in the segment of instruction being tested. According to him, norm referenced survey tests could be used. This is why the present study, the effect of formative Assessment Package (FAPM) on students' mathematics performance will involve teaching and assessing the experimental group using tests, oral questions, quizzes and assignments in the content areas of trigonometry, quadratic equation, simultaneous equation and circle theorem.

Research has suggested that formative assessment could improve both learning and examination results and also reduce test anxiety (Svilha, 2006). He opined that students who are systematically taught using formative assessment perform better than those who are taught using traditional method. Supporting this assertion, Junjie and Beng (as cited in, Chua, Kansok & Lee, 2014, p.40) reported that teachers noticed improvements in their students learning and motivation since they started to consciously use formative assessment strategies in the classroom. According to them, teachers commented that their students (i) Were more engaged during lessons and participated actively in class. (ii) Were better able to support one another and took responsibility for their own learning; and (iii) were able to act on feedback from teachers and peers to improve on their assignments. Moss and

Brookhart (as cited in William, 2012) also stressed that highly effective assessment for learning practices can boost students' achievement and as they develop into more competent and confident learners, their intrinsic motivation as students become enthusiastic about their learning. For effective formative assessment in the classroom, feedback is needed to close the gap between performance and goal (William, 2012). Feedback provides an opportunity for the teacher to modify instructional method and materials to facilitate learning. According to Ministry of Education, Singapore (2009) an effective feedback system which can be employed in teaching mathematics involves:

- Identifying students profile and learning outcomes
- Selecting and designing suitable teaching strategies and assessment tasks
- Involving students through effective teaching strategies
- Gathering information about students' progress using various assessment tasks
- Interpreting the result and giving immediate feedback that move students forward
- Reflecting and improving teaching and learning and the loop takes the teacher back to the instructional objectives to identify possible explanations and for a new lesson to begin.

On the procedures that can be adopted for formative assessment in the classroom, Falaye (as cited in Okolo, 2005, P.30), suggested the following steps which could

be used for the purpose of facilitating effective teaching using formative assessment.

i) The teacher should break the topics into units that can be covered conveniently within specified weeks

ii) The units must be arranged sequentially, especially where the content is hierarchical. This is very essential because a unit cannot be mastered easily if the preceding one had not been learnt

iii) The teacher should present the content to the students using a variety of participatory methods like questioning, quizzes and demonstrative activities in Mathematics

iv) The teacher should also progressively assess whether the stated instructional objectives have been achieved

v) After completing a unit, the teacher gives a test or asks questions. From the responses; he will be able to identify students' areas of weaknesses.

vi) The teacher then teaches the identified area of weaknesses and

vii) If after a reteach, many students still perform poorly, the teacher should assess his teaching process.

Apart from procedures or steps that can be adopted to implement formative assessment in the classroom, some of the formative assessment strategies that can be used in the classroom according to Okolo (2005), Madu (2012) Chua, Kansok and Lee Soo (2014) include:

i) The use of oral questions; questions should be posed to students during instruction. This helps the students to be attentive while in class since

questions can be directed to any of the students

ii) The use of Assessment Probes: Assessment Probes are Multiple Choice questions with the options purposefully crafted to include distracters which are research identified misconceptions held by the students.

iii) Quick Quizzes: These are short five minute quizzes aimed to assess how much students have understood the previous lessons and

iv) the use of pre-test and Post-test after a unit of instruction to measure strengths and weaknesses, as well as whether the instruction is moving towards achieving it objectives.

Similarly, formative assessment packages in this present study will encompass the use of quiz, assignments, weekly test and immediate feedback. Studies have been carried out by other researchers (Black & William, 1998a, Black & William, 1998b, Svihla, 2006 & Uche, 2012) on formative assessment but did not involve the use of a formative package as teaching strategy especially in mathematics to improve performance against the background that this research work focused on the effect of the use of formative assessment package (FAPM) on Senior Secondary School Students in Mathematics.

Research Question

1. What is the achievement mean score of students in mathematics when assessed using the formative assessment package and the conventional approach of short type test.

Hypothesis

The null hypothesis was tested at 0.05 level of significance

2. There is no statistically significant difference in the achievement mean scores of students in mathematics when assessed using the formative assessment package and the conventional approach.

Methodology

Research Design

The study adopted quasi-experimental research design of pre-test, post-test control group. This was with the aim of examining the effect of the use of formative assessment on students' achievement in Mathematics against the conventional approach of on shot-type of test. The design was specific with non-randomized control group and non-equivalent groups. This was because the students were taken as intact groups composed of mixed low and high achievers. In this study, a pretest was administered to both the experimental and control groups before the exposure of the groups to different conditions

Population and Sample for the Study

The population for this study consisted of Senior Secondary II students in Umuahia North Local Government Area of Abia state. Purposive sampling technique was adopted and used to select schools for the study. Out of the 26 public schools, two of them were randomly selected using the table of random numbers. The subjects were intact group from the selected schools. Chosen schools were randomly assigned to experimental

and control groups. There were 90 students in the intact classes. The choice of a sample of 90 students considered adequate because it is an experimental study.

Instrumentation

The instrument used for data collection was formative Assessment Package in Mathematics (FAPM) based on the objectives of four content areas. The four content areas covered by the instrument included the following: Quadratic equation test (FAPQE), simultaneous equation test (FAPSE), Circle theorem test (FAPCT) and trigonometry test (FAPTM). The number of items in each test or form were 10 short essay items based on the objectives of various content areas.

Validity of Research Instrument

The face and content validity of FAPM items were judged adequate by a Measurement and Evaluation expert and three experienced mathematics teachers. Their constructive criticisms and recommendations were effected.

Reliability of Research Instrument

The internal consistencies of FAPM were established using Cronbach's Alpha Method. This is because it provides a reliability estimate for instrument composed of items which are scored dichotomously and essay test having items of varying point values (Ugodulunwa, 2008). The internal consistencies for the four forms were 0.68 (FAPQE), 0.58

(FAPSE), 0.52 (FAPCT) and 0.65 (FAPTM)

Procedure for Data Collection

Permission was sought from the principals, Dean of Studies and Mathematics teachers in the two schools used for the study. The teaching of the four content areas to the experimental group involved the use of lesson plan as teaching manual which consisted of 24 lessons taught in six weeks with assignments, oral questions, the use of quizzes involving feedbacks and corrections of errors and misconceptions. On the other hand, the control group was taught for six weeks without giving the above treatment. One experienced mathematics teacher was used for the experimental and control groups in the two schools based on the agreement reached in the schools used for the study. At the end of every 10 days, each test or form was administered to the experimental and control groups.

Data Analysis

The data collected were analysed using mean, standard deviation and ANCOVA

Results and discussions

Research Question 1 What is the achievement mean score of students in mathematics when taught using the formative assessment package and the conventional approach of short type test.

Table 1: Pre-test and posttest achievement mean score and standard deviations scores of students in mathematics when taught using the using the formative assessment package and the conventional approach of short type test.

Teaching Method	Number of Students	Types of Test				Achievement Gains
		Pre-test		Post test		
		\bar{X}	S.D	\bar{X}	S.D	
Experimental	45	54.96	11.11	70.82	20.53	16.06
Control	45	52.84	6.96	60.04	12.91	7.20

The data presented in Table 1 indicated that the students taught using the formative assessment package method had a mean achievement score of 54.96 and a standard deviation of 11.11 in the pre-test and a mean score of 70.82 and a standard deviation of 20.53 in the post test, making a pre-test posttest gain to be 16.06. The data also showed that the students taught using the conventional approach method had a mean achievement mean score of 52.84 and a standard deviation of 6.96 in the pre-test and a mean score of 60.04 and a standard deviation of 12.91 in the post-test with a pre-test post-test gain of 7.20

Hypothesis 1: There is no statistically significant difference in the achievement mean scores of students in mathematics when taught using the formative assessment package and the conventional approach.

Table 3: Analysis of covariance for achievement mean scores of students in using formative and conventional approach of teaching.

Sources of variation	Type II sum square	Df	Mean square	F	Significance
Corrected model	2635.927 ^a	2	1317.964	4.430	0.15
Intercept	9891.243	1	9891.243	33.529	0.000
Pre-test	22.316	1	22.316	0.75	0.785
Teaching method	2524.851	1	2524.851	8.499	0.005
Error	25846.173	87	297.082		
Total	41381.900	90			
Corrected total	28482.100	89			

a R square = .093(adjusted R squared = 0.072)

The data in Table 2 shows that the assessment method is a significant factor

in the mean achievement scores of the students in Mathematics; this is because the p-value of 0.005 is less than 0.05. This indicates the rejection of the null hypothesis which states that there is no significant difference between the mean achievement scores of students in mathematics when taught using the formative assessment package and the conventional approach.

Discussion of Results

The findings as shown in the Table indicate a significant difference between the experimental and control groups, that is, between the students taught using formative assessment package made up of quizzes, weekly tests, assignments and correction of errors and misconceptions and those taught without involving formative assessment. This finding agrees with Svilha (2006), Seehom and Monet (2012) who opined that students who are systematically taught using formative assessment perform better than those who are taught using traditional method. They went further to suggest that formative assessment could improve both learning and examination results and also reduces anxiety. In agreement with the present finding also Moss and Brookhart (2009) stressed that highly effective assessment for learning practices can boost students' achievement and as they develop into more competent and confident learners, their intrinsic motivation as students become more enthusiastic about their learning.

Recommendations

Based on the finding of this study, the following recommendations are made;

1. The use of formative assessment should be adopted by mathematics teachers to teach concepts in mathematics
2. The use of formative assessment can be adopted in teaching other subjects especially the use of quizzes, assignments and frequent use of tests
3. Remediation activities can be successfully carried out through the use of formative assessment

Conclusion

The use of formative assessment while teaching especially the use of quizzes, assignments, frequent use of tests and correcting errors and misconceptions promote students' achievement in mathematics more than adoption of traditional method of teaching.

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