

**THE EFFECT OF FORMATIVE ASSESSMENT ON
STUDENTS' ACHIEVEMENT IN SECONDARY SCHOOL
MATHEMATICS**

By

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ABSTRACT

The study investigated the effect of formative Assessment on students' achievement in secondary school Mathematics. Three hypotheses guided the study. The experimental research design was employed.. One hundred and twenty (120) Mathematics students in secondary II Art classes in two public schools in Iseyin Local Government of Oyo State, Nigeria selected through purposive technique made up the study sample.. Formative Test I, II and III and Mathematics Achievement Test (MAT) were used for data collection. Data were analysed using paired sample t-test and independent sample t-test statistical tools. Findings from analysis revealed that formative assessment has a strong significant difference in the mean achievement score of Mathematics students that are exposed to it ($t = 36.54$, $p = 0.000$) while there is no significant difference in the mean achievement scores of student who are not expose to formative assessment ($t=2.053$, $p = 0.045$). Also, there is no gender difference in the achievement scores of Mathematics students that are exposed to formative assessment ($t=0.112$, $p = 0.053$). The study recommended that all School Administrators should emphasis the use of formative assessment by all teachers and they should allow, encourage and provide incentives for them to attend seminars, workshops, conference and in-services training to enhance their performance and to acquire necessary skills to constructing formative tests.

Introduction

The consistent mass failure of most secondary school leavers in May/June Examination conducted by the West African Examinations Council (WAEC), the National Examination Council (NECO) and the National Business and Technical Examination Board (NABTEB) has been prompted the Federal Government to set up panels to investigate mass failure of students in the Senior Secondary Certificate Examinations (SSCE) of all the candidates who sat for only June SSCE, above 80% failed Mathematics subject (Information on Nigeria Education, 2014).The import of this on the candidates' future and the nation's manpower development should be a cause of concern for the country's leaders, stakeholders in the education industry and the nation as a whole. Ajogbeje, (2013) has identified different factors responsible for the consistent poor performance of students in Mathematics. These among others, include lack of proper digestion and utilization of research findings by Mathematics teachers, sex-stereotyping, transfer of poor attitudes of older students to the younger ones, and poor self-concept towards Mathematics, while Bernard, (2013) identified problem solving skills and instructional strategy, Sara,(2012) highlighted instructional/classroom characteristics, societal factors and school factors; and (Onocha and Okpala, (1995) stated teachers' characteristics as the problem. 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 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. Johnson (2009) defined assessment as the use of a variety of procedures to collect information about learning and instruction. There are two types of assessments (summative and formative). While formative assessment is commonly referred to as assessment for learning, in which the focus is on monitoring student response to, and progress with instruction. Formative assessment provides immediate feedback to both the teacher and the student regarding the learning process. Christiana et al, (2015) were of the opinion that the key requirements for successful formative assessment include the use of quality assessment tools and the subsequent use of the information derived from these assessments to improve teaching and learning instructions. Ajogbeje, (2013) emphasis that the utilization of formative testing in the teaching-learning process involve breaking up the subject matter content or course into smaller hierarchical units for instruction; specifying objectives for each formative test; offering a group based remediation in areas where students are deficient before moving to another units and then administration of summative test on completion of all units. Ojugo, (2013) stated that the breaking up of subject or course into small units makes for adequate preparation for the test by the students. Moreover, such frequent test enable the student to get more involved and committed to the teaching-learning process thereby enhancing their performance. Philius, (2012) when quoted Bloom, Hasting, and Madus, (1971) whom were of the opinion that formative evaluation is useful to both the students (as a way of diagnosing students' learning difficulties and the prescription of alternative remedial measures) and to the teacher (as means of locating the specific difficulties that the students are experiencing within subject matter content and forecast summative evaluation result. Ajogbeje, (2013) also cited Gronlund and Linn (1990), that formative evaluation serves three specific uses namely: (i) to plan corrective action for overcoming learning deficiencies; (ii) to aid in motivating learners and (iii) to increase retention and transfer of learning. According to them, students' response to a formative test could be analysed to reveal group and individual errors needing correction. Tahir, Tariq, Mubashira and Rabbia (2012,) also defined formative assessment as the diagnostic use of assessment to provide feedback to teachers and students over the course of instruction, it stands in contrast to summative assessment, which generally takes place at final end of an instruction. Marsh (2007) stated that formative testing is a strategy designed to identify learner's learning difficulties with a view to providing remediation measures to enhance the performance of majority of students. Jung (2012) has reported that the result of investigation into the extent to which cognitive entry characteristics and formative evaluation measured students' academic performance among university undergraduates show that teacher formative assessment has the highest predictive strength on academic achievement out of all variables, that is, certificate worth and Joint Admission and Matriculation Board (JAMB) results considered. In a similar study carried out among Polytechnic students, Ajogbeje, (1998) reported that cognitive entry characteristics West African School Certificate (WASC) and Polytechnic and Colleges Entrance Examination (PCEE) are not significantly related to academic achievement of polytechnic students in Mathematics and that most of the

students with good grades in WASC and PCEE examinations often times rely too much on these results which, in turn, affect their academic achievement. However, the study revealed that semester results (i.e. continuous assessment scores) are the best predictors of academic achievement in Mathematics. Ughamadu ,(1990) in his study on the interactive effect of formative testing and cognitive style on students' learning outcomes in secondary school Mathematics found out that analytical students exposed to formative testing with remediation performed significantly higher in composite concept attainment at classification and formal level than global students. Also Oluwatayo, (2007) reported positively about formative assessment when he stated his study carried out on continuous assessment as predictors of students' grades SSCE Chemistry that formative assessment improves students academic achievement in Chemistry subject. Kathy, (2013) maintained that common to all his studies is the fact that formative testing allows for a diagnosis of learners' learning difficulties. However he maintained that there are variations in the efficacy of the strategies adopted in the studies and agreed that some of the strategies are less applicable because of some obstacles inherent in mastery learning. The present study therefore investigated the effect of formative assessment on students' academic achievement in senior secondary school Mathematics in Iseyin Local Government of Oyo State, Nigeria.

Statement of the Problem

Frequent failure of Nigerian students in Mathematics subject has been the concerned of all stakeholders in Education industry. One of the major problems identified is poor assessment method adopted by many Mathematics teachers in senior secondary schools. This study investigated the effect of formative assessment on the students' academic achievement in Mathematics in senior secondary school in Iseyin local Government of Oyo state, Nigeria.

Research Questions

The following questions directed the study:

- i. To what extent would the use of formative-assessment affect the achievement scores of students in Mathematics in senior secondary schools?
- ii. Will there be any significant difference between students exposed to formative Assessment?
- iii. Will there be any significant gender difference in the achievement of Mathematics students who are exposed to formative Assessment method of evaluation?

Research Hypothesis

Ho₁: There is no significant difference in the students' achievement scores of an experimental group or formative students group.

Ho₂: There is no significant difference in the students' achievement scores of non-formative group (control group)

Ho₃: There is no significance gender difference on the achievement scores of students in Mathematics after exposed to formative evaluation testing.

Methodology

The experimental research design was employed for the study. The purposive random sampling technique was used to select two public secondary schools out of the Eighteen in Iseyin Local Government of Oyo State, Nigeria. All students in the senior secondary school II Art classes formed the study population. The SS3 students could not be used for the study at the time of the research because they have covered much of the syllabus in Mathematics. In each of the two schools selected, sixty (60) students among those who did not score up to forty marks (40%) in their term examination in Mathematics were randomly chosen as the study sample, thus the sample consisted of one hundred and twenty (120) Mathematics students from the Arts classes of both schools. One school was randomly assigned the training and remediation group while the other was the control group.

Four instruments namely Formative Test I, II and III (which were administered on the respondents after the coverage of each selected topic during treatment) and Mathematics Achievement Test (MAT) which served as pre-test and post-test to the respondents on the topic covered during treatment were used to collect all relevant data for the study. The MAT, the Formative Test I, II, and III were reviewed and vetted for face and content validities by panel of experienced senior secondary school Mathematics teachers who were experts in the subject and had been teaching the subject for a period not less than 10 years. Kuder Richardson formula 21 (KR_{21}) was used to establish a reliability coefficient estimate of approximately 0.79 for MAT, 0.86, 0.84 and 0.83 for the Formative Tests I, II and III respectively. The Mathematics Achievement Test item was administered to both group at the beginning of the term as pre-test and the scripts were marked and collated by the researcher. The experimental group were exposed to expository class teaching followed by formative class test with feedback and remediation, while the control group were exposed to only expository class teaching. The same Mathematics Achievement Test was re-administered to both groups at the end of term to test the effect of formative assessment on the academic achievement of the experimental group. The data were collected and analysed.

The statistical tools used were the mean, standard deviation, t-test and independent sample t-test. The study hypotheses were tested at 0.05 level of significant.

Results

The result of the data analysis carried out is presented below:

HO₁: There is no significant difference in the students' achievement scores of an experimental group that are exposed to formative assessment.

In order to find out if there is significant difference in the students' achievement of students exposed to formative assessment. The pre-test and post-test score of the experimental group who are exposed to formative assessment were analyzed using paired sample t-test and the result is presented below in Table 1.

Table 1: Result of the Paired t-test of the Pre-test and Post-test of Experimental group that are exposed to formative assessment

Variable	N	Mean	Std. Dev.	t-cal	Df	Sig.	Remark
Pre-test score of Experimental group	60	21.1	4.72	36.54	59	.000	Significant
Post-test score of Experimental group with remediation	60	29.1	5.92				

The mean score of the experimental students in the pre-test is 21.1 while the mean score in the post test is 29.1. This implies that for the mean score of these students to be higher during the post-test, the formative assessment has significant impact on the students which has made the t-calculated of 36.54 to be significant as $p < 0.005$. This led to the rejection of the null hypothesis that stated that there is no significant difference on the achievement scores of students' undergoes formative assessment on Mathematics in secondary school.

HO₂: There is no significant difference in the achievement scores of Mathematics students of control group.

In order to test the above hypothesis, the control group are the set of students that are not expose to formative assessment, the pre-test and post-test of the control group were analyzed using the paired sample t-test. The result of the analysis is presented in Table 2 below:

Table 2: Result of the Paired t-test of the Achievement Score of Control group who are not expose to formative

Variable	N	Mean	Std. Dev.	t-cal	Df	Sig.	Remark
Pre-test	60	14.48	6.38	2.053	59	0.045	Not Significant
Post-test n	60	14.68	6.75				

Table 2 above revealed that the students who are not expose to formative assessment has the mean score of 14.48 and 14.68 in the pre-test and post-test respectively with standard deviation of 6.38 and 6.75 respectively. Although there is difference in the mean scores of pre-test and post-test of 14.48 and 14.68 respectively but the difference is not significance with t-calculated of 2.053 at 5% level of significant which make $P = 0.045$ not significant since $P > 0.005$. Therefore, the null hypothesis that stated that there is no significant difference in the achievement scores of Mathematics students of control group who are not expose to formative assessment was accepted.

HO₃: There is no significant gender difference in the achievement scores of Mathematics students that are exposed to Formative Assessment.

The focus of the above hypothesis is on gender differences in the achievement scores of the experimental group that are exposed to formative assessment. The independent sample t-test of post-test of the experimental group according to their gender was used. The result is presented in Table 3 below.

Table 3: The Result of the Independent t-test of The Post-Test Mean Scores of Experimental Group by their Gender

Variable	Gender	N	Mean	Std. Dev.	t-cal	Df	Sig.	Remark
Pre-test result of Experimental Group	Male	31	29.01	5.22	0.112	58	0.053	Not Significant
	Female	29	29.17	6.68				

Table 3 above shows that the mean scores of male students in the Experimental group is 29.01, and that of the female students was 29.17.

The above result shows that both male and female has the same scores of approximately 29. Although the result showed that there is difference but the difference is not statistically significant as the $t\text{-cal} = 0.112$ at 5% level of significant which make $P = 0.053$ not significant since $P > 0.005$. Therefore, the null hypothesis was accepted.

Discussion

The result of the study showed that formative assessment has a strong significant different in the mean achievement scores of Mathematics students in secondary school which enhanced the performance of students' academic achievement. This supported previous finding by Ajogbeje, (2013) who stated that with effective utilization of formative assessment, it enables adequate preparation of the students for the test and such frequent test enables the students to get more involved and committed to the teaching-learning process thereby enhancing their academic performance in the subject. Also Ojugo ,(2013). Bloom, Husting and Madus (1971) all agreed that formative assessment is useful to both the students as it helps to diagnose students' learning difficulties and the prescription of alternative remedial measure all towards improvement in the academic achievement in the subject concerned, and to the teacher as means of locating the specific difficulties that students are experiencing within the contents of the subject and forecast the appropriate teaching strategies to help the students understand the difficulties contents in order to improve their academic achievements in the subject. This result also agreed with Ajogbeje, (2013) when cited Gronlund and Linn (1990) who enumerated the importance of formative assessment on students' academic performance as an effective tool that improve the academic achievement of the students in any subject.

Moreover, Marsh, (2007) stated that formative assessment is an evaluation method designed to correct the student's difficulties on the content of subject with the aim of enhancing the performance of students in the subject.

Kathy, (2013), stated that formative testing aims for a diagnosis of learners' learning difficulties in order to improve the student academic achievement.

The result from the study also revealed that there is no significant difference in the mean achievement scores of Mathematics students who were not exposed to formative assessment. This result agreed with agitation of all stakeholders in the education sector such as Government, teachers; parents and even the students which has been the purpose of continuous setting-up of panels of enquiry by Government to find-out the causes of mass failure of students in Mathematics subject and the teachers are wondered upon all their efforts to improve the students' academic achievement has failed overtime. This result also agreed with Ajogbeje, (2012) who stated that one of the key factors which seem to contribute to the problem of poor students' achievement in Mathematics is the essence 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 with the aim of improving students' academic achievement of the students in Mathematics subject. Also, Johnson (2009) agreed with this result when explaining formative assessment as one of the assessment strategies that diagnose student learning difficulties on a subject with the aim of improving their academic performance. While Christana et al, (2015) stated that if formative assessment is effectively used there is tendency for the student's achievement to be constantly improved.

Lastly, the result from this research concluded that there is no significant gender difference in the achievement scores of Mathematics students that are exposed to formative assessment. This finding agreed with Ajogbeje, (2013) who stated that gender difference is not significant issue in the use of formative assessment among male and female students when enumerating problem of poor performance in Mathematics. He concluded that the performance of the students depends on how the evaluation / assessment strategies have been effectively implemented and dedication of students to their learning process. The female can even perform far better than male if the male students are not dedicated to their learning process.

Conclusion

Based on the findings of this study, it could be concluded that when formative assessment are used for diagnostic purposes, it improve the academic performance of the students on the subject and also enable them to understand the contents of the subject more better than the use of summative test only. Also formative test serve as a basis for finding out the sources of difficulties on the contents of the subject. In this way, the teacher is able to give necessary remediation and correctives measure to improve the understanding of students on the contents of the subject in order to improve their academic achievements in the subject concerned. The study has revealed that those students who are not exposing to formative assessment have no significance difference in their achievement score in Mathematics. In light of findings from this study, the following recommendations are being made:

- 1) The school administrators should emphasize to their teachers on regular basis that the teaching of Mathematic in secondary school should be carried out by providing regular formative assessment for regular diagnostic of students learning difficulties on the contents of the subject and adequate feedback and remediation for learners to improve their academic achievement.
- 2) The government and school administrators should allow and provide incentives for teachers to attend seminars, workshops, conferences and in-service trainings to enhance their performances and to acquire necessary skills for constructing formative tests, and how to blend formative assessment with classroom procedures.
- 3) Curriculum designers should take into cognizance while designing tasks for learners that learning in Mathematics is not solely a cognitive affair. Hence, Mathematics curriculum should be designed to include the use of methods / strategies and material media which would make the learning of Mathematics very active, investigative and adventurous.

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