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Effects Of Formative Assessment On Senior School Students' Performance In Mathematics In Ejigbo, Osun State, Nigeria

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Abstract

The purpose of this research was to examine the effects of formative assessment on students' academic performance in mathematics. Mixed method research was used to conduct the study. The sampled consisted of 92 SS 2 students in the two selected senior secondary school in Ejigbo, Osun State, Nigeria. Experimental procedure was carried out for 4 weeks. Students' Mathematics Academic Test (SMAT) was used as data collection instrument. Findings from the study showed that students in the experimental group in which the formative assessment was used had a significantly higher academic performance than the students in the control group. On the other hands, gender had no influence on students' performance while the use of formative assessment improved the performance of the low ability students significantly. It was recommended among others that mathematics teachers should incorporate the use of formative assessment in classroom in order improve students' performance in the subject.

Keywords: Formative Assessment, Performance, Mathematics, Gender, Score Levels

Introduction

The performance of Nigerian students in Senior Secondary Examinations in the mathematics in the recent years has remained consistently poor. Studies carried out by researchers such as Adeniyi (2012); Ayinla (2011); Ayinla, Fajemidagba, Salman & Akanmu

(2015) showed that students' performance in SSCE Mathematics examinations for years have remained worrisome and below stakeholders expectations.

Ayinla (2015) submitted that both parents and government are in total agreement with the view that their huge investments on education are not yielding the desired dividends as a result of students' low performance in Mathematics. Senior School Mathematics Teachers also complained of students' low performance at both internal and external examinations (Ashiaka, 2010). In an attempt to find lasting solution to the students' low performance in mathematics. Salman, Mohammed, Ogunlade and Ayinla (2012) carried out a study on causes of students mass failure in Mathematics, the researchers concluded that students' lack of frequent practice of Mathematics is one of the leading factors responsible for the mass failure. For students proper understanding of mathematics concepts, there is need for students to be regularly examined in order for the teacher to ascertain whether the students are learning new skills/knowledge instead of waiting to the period of test or examinations. This can only be achieved with the teachers incorporating the use of formative assessment into the classroom.

Formative assessment is defined by McManus (2008) as a process in which teachers and students provide feedback during instruction to organize the learning and teaching process in order to increase student performance. Miller and Lavin (2007) viewed formative assessment as a valid and vital part of the blending of teaching and assessment. Formative assessments inform teachers about whether the students have learned and they have an indicator qualification for how the teachers should plan their next lessons (Wuest & Fisette, 2012). There are four main components of formative assessment (William, 2011; William & Thompson, 2007): (i) Explaining learning objectives and success criteria to the learners; (ii) increasing the quality of inquiry/dialogue of the learners; (iii) increasing the quality of marking/feedback/record keeping by the teacher; and (iv) using self and peer assessment.

One of the principle elements of formative assessment is asking questions (Hodgson & Pyle, 2010). Teachers can spend one-third of their teaching time asking students questions (Borich, 2014), more questions are typically asked during lesson time. Sometimes more than 50% of the lesson time can be spent on questions and answers. Asking questions in formative assessment is crucial to obtaining information about students' learning and understanding. This objective can be achieved if the questions are active and effective at determining the learner's depth of knowledge of the subject matters (McMillan, 2014).

The effect of formative assessment rises from the strength of the feedback provided to students about their learning and to teachers about their teaching (Andrade, Lui, Palma, & Hefferen, 2015). Teachers are not the only source of feedback. Self and peer assessments can be taught carefully, guiding learners in how to provide constructive and learning-oriented feedback on their own (Andrade et al., 2015).

Bulunuz, Bulunuz, and Peker (2014) examined the effects of formative assessment on eighth-graders on physics concepts. 197 students participated in the study, and according to the findings of the study, the formative assessment significantly improve students' level of understanding of the underlying physics concepts. Bala (2013) researched into the formative assessment practices in teaching the "structure and properties of matter" in seventh-grade science and technology classes. The study was conducted for six weeks with 44 students in a secondary school in Ankara. The results of the study showed that the formative assessment improve students' understanding of the concepts taught.

Formative assessment improves the teaching and learning process by reducing learning deficits among learners through the use of active feedback. According to the related literature, formative assessment has a positive impact on many student behaviors, especially with regard to learning outcomes. In literature, formative assessment is ranked at the top of the list in studies comparing many teaching strategies, methods, and techniques in terms of the degree of impact on students' academic achievement (Bennett, 2011; Filsecker &

Kerres, 2012). From this point of view, it is expected that this study, which examines the effects of formative assessment on students' academic performance in mathematics will contribute to the existing body of knowledge. Hence, this study aimed at examining the effects of formative assessment on senior school students' academic performance in Mathematics in Ejigbo, Osun State, Nigeria.

Research Questions

The following questions were raised and answered in this study:

1. what are the effects of formative assessment on the performance of Senior Secondary school students in Mathematics?
2. what is the influence of gender on students' performance in mathematics when taught with the use of formative assessment?
3. what are the effects of formative assessment on students' academic performance in mathematics based on scoring ability?

Research Hypotheses

The following research hypotheses were formulated and tested to find in the study:

HO₁: There is no significant difference in the performance of students taught Mathematics using formative assessment and their counterpart in the control group.

HO₂: There is no significant difference in the academic performance of students taught Mathematics using formative assessment based on gender.

HO₃: There is no significant difference in the academic performance of low, average and high scoring ability students taught Mathematics using formative assessment.

Method

The study was a quasi-experimental, non-randomized pre-test, post-test non-equivalent control group design. The study was carried

out in Ejigbo, Osun State, Nigeria.

The sample of the study comprised 92 SS2 Students. A purposive sampling method was used to select two public secondary schools for the study. Intact classes participated in the study. One school (with formative assessment procedure) was assigned experimental group and the other school (without formative assessment procedure) was assigned as control group. Both the experimental and the control groups were taught the same topic.

The instrument used was Students' Mathematics Academic Test (SMAT). The SMAT instrument was validated by two Mathematics Educators. A reliability Coefficient of 0.68 was obtained using the Pearson's Correlation Coefficient. The SMAT was administered to the two groups as pretest for the treatment while a shuffle of SMAT was administered to the two groups as post-test after the treatment. The experimental group underwent formative assessment for a period of four weeks.

Data obtained from the study were analysed using mean and standard deviation (SD) to answer research questions while t-test and ANCOVA was used to test the null hypotheses at $P < 0.05$ level of significance.

Results

Hypothesis 1

There is no significant difference in the performance of students taught Mathematics using formative assessment and their counterpart in the control group.

Table 1: Independent Samples t-test of the students exposed to formative assessment and those in the control group

Levene's Test for Equality of Variances		t-test for Equality of Means							
								95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig.	Mean Diff	Std. Error Diff	Lower Upper
Posttest Scores	Equal variances assumed	46.319	.000	-10.900	91	.000	-10.552	.968	-12.455 -8.649
	Equal variances not assumed			-10.932	90.243	.000	-10.552	.965	-12.450 -8.653

Table 1 shows the independent sample t-test for the post-test scores, t-test value is 10.900, degree of freedom = 91, and p-value = 0.000. Since the p-value is less than 0.05 level of significance, the mean of posttest scores of experimental group is significantly greater than the mean of posttest scores of control group. Therefore, the null hypothesis one is rejected, it is thus affirmed that a significant difference existed in the performance of senior school students taught Mathematics using formative assessment and their counterpart in the control group. This showed that the use of formative assessment had significantly improved the performance of students in the experimental group.

Hypothesis 2

There is no significant difference in the academic performance of students taught Mathematics using formative assessment based on gender.

Table 2: Independent Samples t-test of the students exposed to formative assessment based on gender

Levene's Test for Equality of Variances				t-test for Equality of Means						
				95% Confidence Interval of the Difference						
		F	Sig.	t	Df	Sig.	Mean Diff	Std. Error Diff	Lower	Upper
Posttest Scores	Equal variances assumed	0.132	0.717	0.285	46	0.776	-0.456	1.600	-3.611	2.699
	Equal variances not assumed			0.285	44.243	0.776	-0.456	1.599	-3.609	2.697

Table 2 shows the independent sample t-test for the posttest scores based on gender. For the posttest scores, Levene's test for equality of variance, F calculated value = 0.132 and p -value = 0.717. Since the p -value is not less than 0.05 level of significance, there is no significant difference between the variance of male and of female students. Therefore, equality of variances can be assumed. The t-test that assumed equal variances is therefore employed. The t-test value is 0.285, degree of freedom = 46, mean difference = -0.456, standard error of mean difference = 1.600 and p -value = 0.776. Since the p -value is not less than 0.05 level of significance, there is no significant difference in the means of posttest scores of male and female students. Therefore, the null hypothesis 2 is not rejected. It is concluded that, there is no significant difference between the academic performance of male and female students taught Mathematics using formative assessment.

Hypothesis 3

There is no significant difference in the academic performance of low, average and high scoring ability students taught Mathematics using formative assessment.

Table 3: ANCOVA on Posttest scores of Students performance in Experimental groups based on scoring level

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	797718.046 ^a	4	199429.511	4533.050	.000
Pre-Test	1475.219	1	1475.219	33.532	.000
Scoring	20610.449	3	6870.150	156.159	.000
Error	8446.954	45	187.710		
Total	806165.000	47			

In Table 3 pretest is the covariate, scoring level is the factor considered and the dependent variable is posttest scores. Since the p-value = 0.000 is less than 0.05 level of significance, Scoring level is a significant factor.

Also, table 3 shows the analysis of covariance table containing the source of variations, sum of squares, degree of freedom, mean squares, *F*-values and corresponding p-values. From the table $F(3, 45) = 156.159$ at $p = 0.000$, since the p-value is less than 0.05 level of significance, the null hypothesis was rejected (there is no significant difference in the means of post-test scores of students taught Mathematics using formative assessment based on scoring levels). Therefore, there is a significant difference in the performance of low, medium and high scoring students exposed to formative assessment.

Pairwise comparisons analysis was conducted to determine the actual source and direction of the difference that existed among the three groups.

Table 4: Pairwise comparison on the Performance of Low, Medium and High Scoring Students exposed to Formative Assessment

(I) General (Scoring Level)	(J) General (Scoring Level)	Mean Diff (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
Low Scorers	Medium Scorers	-1.473	2.039	.471	-5.494	2.548
	High Scorers	-4.738	3.192	.139	-11.034	1.557
Medium Scorers	Low Scorers	1.473	2.039	.471	-2.548	5.494
	High Scorers	-3.265	1.768	.066	-6.752	.221
High Scorers	Low Scorers	4.738	3.192	.139	-1.557	11.034
	Medium Scorers	3.265	1.768	.066	-.221	6.752

Based on estimated marginal means

From table 4, the multiple comparisons fail to show significant differences in the three scoring levels at 0.05 level of significance. This implies that, even though, table 4 shows that scoring level is a significant factor, there is no significant differences among the three levels of Scorers. This shows that the use of formative assessment in the teaching and learning of Mathematics is good to all the three scoring levels.

Discussion

The mean performance scores of students exposed to formative assessment was higher than that of the control group. The student taught mathematics with formative assessment performed better than their counterparts taught without the use of formative assessment. Hence the use of formative assessment has a significant positive effect on students' performance in Mathematics. This could be as a result of

the students' exposure to more and frequent assessment and critical thinking developed by the students as they were easily motivated to learn during the lesson. The result obtained was in agreement with the findings of Bulunuz, Bulunuz and Peker (2014) and Bala (2013) who stated that formative assessment significantly improve students' understanding of the concepts taught.

The result of the findings also revealed that the mean scores of male and female students were higher in the post-test compared to the pretest of the experimental group. The difference between the mean scores of male and female students was found to be non- significant. This implies that gender was not a significant factor on students' performance in mathematics when taught with the use of formative assessment. This shows that the use of formative assessment in teaching and learning of Mathematics in senior secondary school is gender friendly. This result was in agreement with that of Adeniyi (2012) and Akanmu (2013), who stated in their various research works that gender of a student does not influence his or her performance in Mathematics.

Findings from the study showed that all the three categories of scoring level benefitted from the study with the low scoring students benefited most, followed by the medium scoring students and high scoring students respectively. These conform to the findings of Adeniyi (2012) and Ayinla (2015), who reported that the three categorized scoring level benefitted from their various studies. This implies that the use of formative assessment procedures can be used to enhance students' better performance in Mathematics regardless of the students scoring level

Conclusion

Based on the findings of this study, it could be concluded that students taught with formative assessment procedures performed significantly better than their counterparts taught in the control group. While the use of formative assessment in the teaching and learning of mathematics

was found to be gender friendly, both male and female students benefited almost equally. Also, the use of formative assessment procedure improved low scoring ability students' performance in mathematics. By implication, mathematics teachers may incorporate the use of formative assessment procedure into the classroom in order to improve students' performance in the subject.

Recommendations

Based on the conclusion of this study, the following recommendations were made:

1. The use of formative assessment in mathematics lessons should be advocated in schools by education authorities.
2. Federal and State Governments should incorporate the use of formative assessment into senior secondary school curriculum.

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