

School-Based Assessment Scores in Mathematics as Predictors of Students' Final Grade in Mathematics at the JSCE Level in Delta State, Nigeria.

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Abstract

This study examines the influence of scores from School Based Assessments (SBA) on students' grades in Mathematics at the Junior Secondary Certificate Examination (JSCE) level in Delta State. A total of 120 students (76 females and 44 males) were randomly selected from six schools, out of 26 secondary schools in Ethiope East Local Government Area. Data from the students' academic records were collected using an inventory. The statistical technique used to test the formulated hypothesis is the multiple regression analysis. The results of the analysis showed generally that SBA scores positively predict the performance of students in the JSCE in Mathematics, although the predictive power of the model is relatively low. In view of this finding, it is recommended that school-based assessment should be taken as a core component of the assessment process in Mathematics at the secondary school level, as it prepares the student to face examination situations, several times, before the certificate examination.

Introduction

Education as stated in the National Policy of Education (NPE) by Federal Republic of Nigeria (FRN) (2004) is an instrument as well as investment that can be used to achieve a more rapid economic, social, political, technological, scientific and cultural development. It thus explains why the Federal Government of Nigeria has been devoting a relatively significant proportion of its annual budget to the development of the educational sector. A number of educational researchers in Nigeria hold the very strong view that education must be treated as a matter of national emergency and must move with the momentum of a revolution (Asuru, 2010). Besides Government, parents, communities and different organizational bodies also expend quality time, money and effort in the education of their children and wards both in and outside of school system. Odiba (2007) holds the view that the school is essentially a social system consisting of well defined boundaries within which individuals inter-relate in the performance of activities for the purpose of attaining educational goals. However to determine the effectiveness of these attainment, the learners must be assessed.

Nwahunanya (2007) defined assessment as the process of gathering information about a student in order to make decisions about his or her educational attainment. Omole (2007) stipulated that assessment in education connotes fixing the amount of knowledge acquired by students in the course of an instructional programme over a period of time. It can therefore be defined as a method of determining how well the learners have mastered the educational process as stated in the taxonomy of educational objectives.

On a broad line of classification, there are two types of assessment. Assessment could be administered at the school level; this is known as School-Based Assessment (SBA). Accordingly to Omole (2007), SBA is sometimes conterminously referred to as continuous assessment (CA). The second type of assessment is the Externally-Based Assessment (EBA), or External Examination (EE). In Nigeria, as in other West African countries, the EE is usually conducted by public examination bodies, such as the West African Examinations Council (WAEC), National Examinations Council (NECO), as well as the Ministry of Education.

The Junior Secondary Certificate Examination (JSCE) is one form of EE in Nigeria. It is conducted by each state of the federation through their respective Ministries of Education for the final year students of state-owned Junior Secondary Schools, at the end of the third year of the upper basic education system, private schools may also opt to register their pupils for the JSCE conducted by the State Ministries of Education. The different State Ministries develop, administer, mark, award grades and certificates to students under their jurisdiction (Falaye & Afolabi, 2005). However, the responsibility to conduct the JSCE for Federal Government Colleges located in all states of the federation, including the Federal Capital Territory (Abuja) and some interested private schools is vested in NECO (Ojerinde, 2011).

Several educational researchers in Nigeria have noted that EEs as presently conducted have some flaws. Egbule (2002), Okpala, Onocha and Oyedeji, (1993) opined that the EEs, including the JSCE only assess the cognitive aspects of students' behavioural domain. They also lack cumulative marks and student guidance approach thereby neglecting the role and relevance of the teacher in contributing to students' final assessment. Above all, Omole (2006), Owolabi (2004), viewed that the undue emphasis on certificate awarded, based on the performance in these final examinations to a large extent, has been the major cause of most examination malpractices in Nigeria. In a bid to find a lasting solution to the above problems and the high rate of failure that characterizes EEs in Nigeria, SBAs are now being given more, emphasis. Essentially, SBAs lay more emphasis on "assessment for learning" as an integral part of the learning process, as well as on the teaching and assessment cycle (Adediwura, 2012). The main purposes of SBA are to enhance students' learning, provide feedback to parents and students, award certificate qualification through continuous assessment, monitor overall nationwide educational standards, and identify learning needs to effectively allocate resources (Crooks, 2002).

Generally SBA consists of tests, quizzes, projects, assignments, self-assessments and self-reports, peer assessments as well as end of year examinations (Egbule, 2002). The advantages of SBA according to Nwana (2007) stem from the fact that it employs comprehensive and formative techniques and as such, it assesses the cognitive, affective, and psychomotor domains of the learner. SBA also provides a cumulative teacher judgment about the performance of individual students' work, based on systematic collection of grades or marks thereby, recognizing the place of the teacher in the assessment of the learner (Yusuf, 1994). However, Ogunkola (2007) viewed that SBA is not without its own flaws. First, there are the issues of quality, scoring, grading and comparability of standards of the assessment tools, which could vary from one school to another (Osunde 2007). Second, is the issue of validity and reliability of most SBA scores, which may result from lack of competence by most teachers in construction and administration of SBA (Eraikhuemen, 2004).

Ideally, students' performance in SBA should impact on their performance in externally conducted assessments. In support of this view, a number of studies have identified SBA scores as predictors of students' final grades in different subjects and in different states. For example Ogunkola (2007) investigated the combined and relative influences of SBA scores on the final grades of Integrated Science students in JSCE in Ogun State Nigeria, and concluded that the scores for SBA in Junior Secondary School (JSS) 1, 2, and 3 significantly predicted students' performance in JSCE. In a related study, Omole (2007) had established that students performed significantly better in SBA in English Language and Mathematics at the Upper Basic Education level in the Federal Capital Territory than they did in Certificate Examination in the same subjects. On the basis of this conclusion, he recommended that SBA should be encouraged and improved upon to replace certificate examinations.

This study provides empirical evidence on the relationship between SBA scores and scores obtained at the JSCE in Delta State, using selected schools in Ethiope East Local Government Area (LGA) as case studies. No work has been published on this linkage for Mathematics; using data for secondary schools in the State. This gap in knowledge therefore provides a point of departure for this study. Theoretical Framework underpinning this study is derived from the theory of prediction formulated by Thorndike and Hagen, (1977). They viewed that an instrument can only be valid for a specific purpose, assessed against explicit criteria such as predicting performance in JSCE from students' performance in SBA in JSS1, JSS2 and JSS3. The frame work can be expressed in terms of functional equation as,

$$Y = f(X_1, X_2, X_3).$$

Where Y which is the dependent variable, is a function of several others independent variables, such as X_1 , X_2 and X_3 .

The aim of this study is to contribute to the debate on the role of prior achievement as a predictor of current academic performance in science among secondary school students. The specific objective is to determine if scores from SBA in Mathematics are adequate predictors of grades of students in Mathematics at the JSCE. Mathematics is an important subject which deals with numbers, shapes, arrangements, orders, patterns, models, graphs, statistics and probabilities. Mathematics is fundamental requirement for the study of science and other related disciplines (Adegbule, 1990). In Nigeria, pass in Mathematics is a requirement for promotion from one class to another at the secondary school levels. The choice of Mathematics in this study is based on the fact that is a core subject at the secondary levels of education in Nigeria as stated in the NPE (FRN, 2004). Given the importance attached to Mathematics, therefore, all students must enroll for it in order to earn an acceptable certificate. It is hoped that the results of this study would highlight the premium that should be attached to SBA methods and hence in improving the performance of students' in Mathematics at the Junior Secondary School (JSS) level.

To achieve the purpose of this study, the following research hypotheses were formulated

1. Scores in mathematics from SBA at JSS I, JSS II and JSS III levels have no effect on students' grades in Mathematics at JSCE level

2. There is no significant relationship between the pooled average students' scores in SBA and the students' grades in Mathematics at the JSCE.

Methods and Materials

The ex-post facto design is used in this study. This design is justified because the event under investigation has already taken place. The population for this study comprised all students who took the JSCE in 2010/2011 academic session in Ethiopia East LGA in Delta State. A sample of 120 students which included 44 males and 76 females was selected using multi-stage random sampling method from six schools out of 26 schools in Ethiopia East Local Government Area. Twenty (20) students each from the six schools were used for the study. The study was restricted to only students' scores in School-Based Assessment (SBA) and Junior Secondary Certificate Examination (JSCE) grades in Mathematics. The dependent variable is final grade in JSCE, while the independent variables are the SBA scores obtained by the students at the Junior Secondary School one (JSS1), Junior Secondary School two, (JSS2) and Junior Secondary School three (JSS3) respectively.

The instrument for the study is an inventory which was used to collect data from each school's students' academic records. The instrument was subjected to expert judgment by two experts in measurement and evaluation to determine its face and content validity. Recommended amendments were effected; the instrument was therefore considered to have an acceptable level of validity. The records used are predetermined and already entered into school records, and are generally considered to be reliable.

For the purpose of scoring JSCE grades of A, C, P and F were given the scores 4, 3, 2, and 1, respectively. The statistical technique used to test the formulated hypothesis is the multiple regression analysis (MRA) using R^2 , F and T statistics to test for statistical significance. The level of significance was set at 0.05 for all estimated parameters. The general form of the regression model estimated is:

$$JSCE = \beta_0 + \beta_1 JSS1 + \beta_2 JSS2 + \beta_3 JSS3 + \beta_4 Gender + u$$

Where:

$JSCE$	=	students final grade in mathematics at JSCE level
$JSS1$	=	SBA in JSS1
$JSS2$	=	SBA in JSS2
$JSS3$	=	SBA in JSS3
$Gender$	=	Sex of student
u	=	Random error term
β_i	=	Parameter to be estimated

In the equation estimated, Gender is added as a control variable. It is a dummy variable that assumes a value of 1 when the student is female, and 0, when the student is male. All the parameters are expected to be positive, except β_4 , which could either be positive or negative. It is assumed that the random error term has the normal properties of zero mean and non-serial correlation.

Presentation of Regression Results

The analysis begins with the results of the all subset regression algorithm, which enables the researcher to select a combination of the independent variables that produces the regression coefficients with the best fit. The estimation procedure reports the number of restrictions in the equation, defined by the number of variables in the estimated equation, plus the intercept (constant term). The gender variable used as a control is forced through all the equations estimated. The basic statistics used in selecting the “best” equation include R^2 (coefficient of determination and adjusted R^2), the residual sum of squares (resid.ss), as well as Mallows’ C_p statistic, used to test for goodness of fit, which is calculated by the formula,

$$C_p = (RSS_p)/\sigma^2 - (n-2p)$$

Where:

C_p = Mallows’ statistic

RSS_p = Residual sum of squares of the particular equation

p = Number of parameters in the equation

σ^2 = Estimated variance of the regression line

n = Sample size

The subset regression algorithm is essentially a model selection procedure. It enables the researcher to establish the best combination of independent variables within the context of multiple regression analysis. The selected equation is usually one that has the highest R^2 (or R^2), combined with smallest residual sum of squares, and value for $C_p - P$ closest to zero. The results of the subset regression are summarized in Table 1. Combining these criteria, it is evident that the best subset equations are the ones that combine the variables A (the constant), C (JSS2 – school based assessment in JSS2), and D (JSS3 – school based assessment in JSS3). Equation number 5, and Equation number 8 (that is the asterisks equation numbers 5&8) combining all the variables.

Table 1: Subset Regression Equations for JSCE

Equation Number	P	CP	Adj. R^2	R^2	Residual Sum of Square	Equation Variables
1	2	36.6	0.0917	0.0993	35.5467	A
2	3	4.5	0.2884	0.3004	27.6108	A D
3	3	16.1	0.2188	0.2320	30.3121	A C
4	3	17.3	0.2115	0.2248	30.5952	A B
5*	4	3.4	0.3011	0.3187	26.8876	A C D
6	4	4.9	0.2920	0.3099	27.2372	A B D
7	4	13.2	0.2421	0.2612	29.1580	A B C
8*	5	5.0	0.2976	0.3212	26.7907	A B C D

Note: Forced Independent Variables: (A) Gender; Unforced Independent Variables: (B) JSS1 (C) JSS2 (D) JSS3. Three "best" models from each subset size are listed; Cases Included= 120; Missing Cases= 0. The asterisk indicates equation selected for analysis.

The full results of Equations 5 and 8 are as shown below:

$$\text{JSCE} = 0.22935 + 0.262\text{Gender} + 0.007\text{JSS2} + 0.013\text{JSS3} \quad (\text{Eq. 5})$$

(1.09) (2.82) (1.77) (3.84)

$$R^2 = 0.32$$

Adj. $R^2 = 0.30$; F Value = 18.09; Durbin-Watson Statistic = 2.10

$$\text{JSCE} = 0.224 + 0.255\text{Gender} + 0.003\text{JSS1} + 0.006\text{JSS2} + 0.012\text{JSS3} \quad (\text{Eq. 8})$$

(1.06) (2.72) (0.64) (1.38) (3.19)

$$R^2 = 0.32$$

Adj. $R^2 = 0.30$

F Value = 13.60; Durbin-Watson Statistic = 2.09

Discussion of the Results

As already indicated, the reference equations for the analysis are Equations 5 and 8. In Equation 5, the estimated coefficients have the right signs. However, only the coefficients attached to Gender and JSS3 are statistically significant. In terms of overall fit, the F value estimated at 18.09 is statistically significant at 1 percent, although the explanatory variables, taken together only explain about 30 percent of the systematic variation in JSCE. The Durbin-Watson (DW) statistic is close enough to the value of 2, implying that there is no problem of serial correlation in the errors. In equation 8 which contains all the variables, the pattern of the results remain virtually the same with only the coefficients attached to Gender and JSS3 being statistically significant, while the adjusted R^2 remains at 0.30.

The scores obtained from the SBAs for the three Junior Secondary School years were further aggregated and averaged to produce a new variable JSS Average, to see if this would alter the results obtained. The following results of the estimated equation are as follows:

$$\text{JSCE} = 0.23872 + 0.247\text{Gender} + 0.021\text{JSS Average} \quad (\text{Eq.9})$$

(1.21) (2.64) (5.95)

$$R^2 = 0.31$$

Adj. $R^2 = 0.30$

F Value = 26.10

Durbin-Watson Statistic = 2.06

In Equation 9, the results remain virtually as in the previous ones (Eq. 5, and Eq. 8), with the coefficients attached to Gender and JSS Average being statistically significant at 1 percent. The statistical significance of the coefficient attached to the Gender variable implies that there is a significant difference between the performance of female and male students at the externally conducted final Junior Secondary School Certificate Examination. The absence of serial correlation in the errors is an indication that school-based assessment (SBA) could be used to predict the performance of students in Mathematics at the Junior Secondary School Examination, although with a low R^2 , the predictive linkage would be expectedly low. Thus, as shown by the results in Equation 9,

an increase in scores obtained from SBA in Mathematics by 1 percent would be accompanied by an increase in scores obtained at the JSCE by just 0.02 percent.

In relationship to the formulated hypothesis for this study, given the statistical significance of the coefficient attached to the SBA variable, particularly the scores obtained in the third year (JSS3), the null hypothesis that SBA scores have no effect on scores obtained at the JSCE is rejected in favor of the alternative hypothesis, namely that SBA scores do predict performance at the JSCE level. This conclusion is in line with the work of Ogunkola (2007). Additionally, the statistical significance of the gender dummy variable is an indication that female students tend to perform better in the JSCE than male students.

Conclusion and Recommendations

The main objective of this study was to investigate the connection between scores obtained in school-based assessment (SBA) in Mathematics and performance of students at the Junior Secondary Certificate Examination (JSCE) in the same subject, using selected secondary schools in Ethiopie East Local Government Area in Delta State, Nigeria. The results of the analysis showed generally that SBA scores positively predict the performance of students in the JSCE in Mathematics, especially at the (JSS3) level; this result is in line with previous research by Ogunkola (2007) – although the predictive power of the model is relatively low.

In view of this finding, it is recommended that school-based assessment should be taken as a core component of the assessment process in Mathematics at the secondary school level, as it prepares the student to face examination situations, several times, before the certificate examination.

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