



JUNIOR SECONDARY CERTIFICATE EXAMINATION SCORES IN INTEGRATED SCIENCE AS PREDICTOR OF SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE IN SCIENCE

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ARTICLE INFO

Article History:

Received 5th February, 2018

Received in revised form 20th

March, 2018 Accepted 8th April, 2018

Published online 28th May, 2018

Key words:

Examination, Integrated Science, Predictor, Science

ABSTRACT

The study investigated the extent to which scores obtained by students in Integrated Science at the Junior Secondary Certificate Examination (JSCE) predict scores obtained in science subjects (Biology, Chemistry and Physics) at the Senior Secondary Certificate Examination (SSCE). The study adopted an ex-post facto design. Using multi-stage sampling technique, a total of 1800 students were selected from six Local Government Areas each of Delta and Edo States. An inventory titled Secondary Education Students Inventory (SESI) was used to collect data for the study from school records. The hypotheses were tested using Multiple Regression Analysis and F-test incorporating the use of shift and slope dummy variables to isolate threshold effects for the qualitative factors of gender and location by state. The chosen level of statistical significance was 5 percent. The results of the empirical analysis showed that the scores obtained by students in Integrated Science do predict performance of students in science at the SSCE level. The gender of students has significant relationship with SSCE science. A significant relationship between school location by state and students' performance in science at the SSCE was also found. Based on the findings, it was recommended that the teaching of Integrated Science at the Junior Secondary School should continue to be emphasized, if Delta and Edo States are to be recognized among the states to produce scientists for the future technological development of Nigeria.

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INTRODUCTION

Achieving the goals of the Vision 2020 in Nigeria requires a good grounding in the sciences at the Senior Secondary School (SSS) level. Graduating as the engineers, scientists and technologists needed to drive the process of development may not be possible without a solid foundation in these subjects. Poor performance of students at the Senior School Certificate Examination (SSCE) in the science subjects is therefore a potential threat to the realization of the education-related goals of Vision 20-20-20. Integrated Science at the Junior Secondary School (JSS) level provides students with a sound base for further science education study. The Federal Republic of Nigeria (2004) through the National Policy on Education (NPE) made Integrated Science a core subject at the JSS. Students that are not well-grounded in it may not show significant interest in offering the core science subjects at higher school levels (Oludipe, 2011). However, in the present arrangement, a student could move on to the SSS1 class in Science even if he or she failed Integrated Science at Junior Secondary Certificate Examination (JSCE), provided the student passed Mathematics and English Language among other subjects at the JSCE.

One of the purposes of educational testing as stated by Nwana (2007) is to predict the future performance of learners. The JSCE provides the basis for selecting those students who are most likely to be successful in their academic work and promoting them to SSS1, while rejecting those who are likely to be failures, if they are promoted to SSS1. It is expected that a student who is admitted into the SSS1 class possesses the basic skills to cope with the challenges of studying at that level (Nigerian Educational Research and Development Council – NERDC, 2008). Das (2008) also opined that the integrated approach to the study of science would enhance the child's transfer of knowledge from the JSS to SSS level.

It has however been observed that some students who were promoted to the science class at SSS1, because they obtained acceptable minimal pass grades in Mathematics, English Language and Social Studies or Integrated Science among others, at the JSCE, later failed related subjects at the SSCE (Asikhia, 2010; Nbina, 2012; Matawal, 2013; Nja & Neji, 2014). This observation questions the predictive validity of the JSCE as an adequate frame for evaluating the performance of students at the SSCE (Faleye & Afolabi, 2008). Studies on predictive validity provide a framework for establishing the degree of credibility that can be placed on any prior examination (Orubu, 2012). It is the extent to which test scores relate to a benchmark or criterion scores (Osadebe, 2003).

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This study took its point of departure from the foregoing observations, with specific emphasis on the extent to which the performance of students in Integrated Science at the JSCE could predict their performance in the science subjects (Biology, Chemistry and Physics) at the SSCE, using the gender of students and location of students' school as moderating variables. The findings from previous studies on the predictive validity of Integrated Science examination at a lower level are divergent. Osokoya (1999) investigated students' achievement in Integrated Science at the JSCE as a predictor or achievement in Biology, Chemistry and Physics at the SSCE in Ibadan, Oyo State. The results showed that scores in Integrated Science are fairly strong predictors of students' performance in Biology, Chemistry, and Physics. Adeyemi (2008) examined the predictive relationship between the performance of students at the JSCE and SSCE. The results of the analysis revealed among others that, there is a significant relationship between students' performances in JSCE Integrated Science and performance in SSCE Chemistry and Biology. However, no significant relationship was recorded between students' performances in JSCE Integrated Science and performance in Physics at the SSCE. Edokpayi and Suleman (2011) carried out a research on students' Integrated Science achievement in JSCE as predictor of later achievement in Chemistry among selected secondary schools in Zaria metropolis, Nigeria the result of the study revealed that the academic achievement of students in Integrated Science at JSCE was a poor predictor of later achievement in Chemistry at the SSCE. Faley and Afolabi (2008) also carried out a research on the predictive validity of Osun State JSCE results and performance at the SSCE level. The study revealed among others that, Osun State, JSCE is a poor predictor of students' performance in SSCE.

On gender and students' academic performance in Science, Abubakar and Oguguo (2011) carried out a research on the correlation between age and gender on academic achievement of Mathematics and Science students in Federal College of Education (Technical) Omoku, River State, Nigeria. The result of the study revealed among others that gender was a predictor of the academic performance of Mathematics and Science students. In a related study, Islam and AL-Ghessani (2015) evaluated the performance of students of Sultan Qaboos University (SQU) in the Sultanate of Oman in Calculus 1 course, and examined the predictive validity of students' high school performance and gender for Calculus 1 success. The analysis revealed among others that gender was a significant predictor of subsequent performance in Calculus 1 course at College level. There are however, other studies that produced contrasting evidences. The finding of Onuka and Durowoju (2008); Onuekwusi and Ogomaka (2013) indicated that gender was not a significant determinant of students' academic achievement at the senior secondary school level.

On the intervening role of school location and students' academic performance in Science, findings of the study by Onuekwusi and Ogomaka (2013) indicated that students in urban schools performed better than those in rural schools. There are several reasons why differences in school location may influence the academic performance of students. Schools located in urban areas tend to have more and better qualified teachers, better facilities, and probably better supervisory control, by virtue of their proximity to the seat of education authorities, compared to schools located in rural areas. These

characteristics may also vary across different states, thereby resulting in heterogeneous influences on the academic performance of students. However, the study by Onah and Ugwu (2002) found out that the effect of school location on the performance in secondary school Physics in Ebonyi State Nigeria was not significant. To a large extent therefore the predictive ability of lower level examinations, students' gender and school location are therefore at best empirical issues which, can only be resolved by reference to the data and facts relating to a particular situation.

It was also found that in many of the studies reviewed, the correlation coefficient and the coefficient of determination were the main statistics used to investigate the proportion of predictive validity. In a few cases, regression methods were applied, but the models specified for estimation did not incorporate techniques that make it possible to isolate threshold and differential predictive effects. This study therefore builds on a methodological framework that differs from the ones applied in previous studies.

The theoretical framework under-pinning this study, is that of Lewin's (1979) functional theory. It clearly identifies a set of explanatory changes, which are expected to influence the dependent variable. In this study, dependent variable is the performance of students' in science subjects (Biology (BIOL), Chemistry (CHEM), and Physics (PHYS)) at the SSCE while the independent variable is the students' JSCE Scores in Integrated Science (INTS). The framework can be expressed in terms of a functional equation; $Y = F(X, V1, V2)$,

In the analytical model adopted, Y is the dependent variable, the scores obtained by students in Integrated Science is represented by X at JSCE. The $V1$ and $V2$ are the moderating variables representing students' gender and students' school location respectively by states.

Hypotheses

The following null hypotheses were tested

1. Students' JSCE Integrated Science scores, gender and location are not significantly predictors of their scores in Biology at SSCE
2. Students' JSCE Integrated Science scores, gender and location are not significant predictors of their scores in Chemistry at SSCE
3. Students' JSCE Integrated Science scores, gender and location are not significant predictors of their scores in Physics at SSCE

METHODOLOGY

The study involves correlation and ex-post facto because the independent variables of gender and location were not manipulated which helped to predict students performance in science. The population comprised of 67,178 students with intact records, who sat for the JSCE in 2008 and the WAEC version of SSCE in 2011 in Delta and Edo States. Multi-stage sampling technique was used to select a sample of 1800 students. Stratified random sampling technique was employed to select six (6) Local Government Areas (LGAs). There are 449 schools in Delta State and 270 Schools in Edo State. From each of the two states fourteen (14) schools were selected out of the 6 LGAs from Delta State, while 12 schools were selected out of 6 LGAs in Edo States representing 13.5% and

19.4% of schools in the sampled LGAs in Delta and Edo States, respectively. A valid and reliable self-structured research instrument titled "Secondary Education Students Inventory (SESI)" was used to collect data for the study from school academic records. The SESI is made up of three sections. These include: demographic information, data on sex and grade, and corresponding grade of students in Biology, Chemistry and Physics. The estimation technique adopted was Ordinary Least Squares (OLS), using the F Statistics to test the statistical significance of the estimated parameters at the five percent (0.05) level of significance. Shift and slope dummy variables were used to represent the qualitative data of gender and location of students' school by state.

RESULTS

The data collected were analysed in line with the hypotheses in tables.

Table 1 Regression analysis of JSCE scores on Integrated Science, Gender, Location as predictors of SSCE score in Biology at SSCE

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	163.22	5	32.6445	51.88	0.006
	Residual	1128.78	1794	0.6292		
	Total	1292.00	1799			

P<0.05

The table 1 showed that the calculated F value of 51.88 has a P-value of 0.006. The p-value is less than the alpha level of 0.05. Therefore, the null hypothesis that students JSCE Integrated Science scores, gender and location are not significant predictors of their scores in Biology at SSCE was rejected. The result revealed that students' JSCE Integrated Science scores, gender and location are significant predictors of their scores in Biology at SSCE.

Table 2 Regression analysis of JSCE Integrated Science scores, gender and location are not significant predictors of their scores in Chemistry at SSCE

ANOVA						
Model		Sum of Squares	Df	Mean Square	F	Sig
1	Regression	294.45	5	58.8905	107.86	0.0013
	Residual	979.55	1794	0.5460		
	Total	1274.00	1799			

P<0.05

The table 2 showed that the calculated F value of 107.86 has a p-value of 0.0013. The p-value is less than the alpha level of 0.05. Thus, the null hypothesis that students' JSCE Integrated Science scores, gender and location are not significant predictors of their scores in Chemistry at SSCE was rejected. The result indicated that students JSCE Integrated Science scores, gender and location are significant predictors of their scores in Chemistry at SSCE.

Table 3. Regression analysis of JSCE scores on Integrated Science, gender, location as predictors of SSCE score in Physics

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	214.77	5	42.9541	69.45	0.007
	Residual	1109.58	1794	0.6185		
	Total	1324.35	1799			

P<0.05

The 3 indicated that the calculated F value of 69.45 has a p-value of 0.0007. The p-value is less than the alpha level of 0.05. The null hypothesis that students' JSCE integrated Science scores, gender and location are not significant predictors of their scores in Physics at SSCE was rejected. The result showed that students' JSCE Integrated Science scores, gender and location are significant predictors of their scores in Physics at SSCE.

DISCUSSION

The finding established that there was a significant predictive relationship between students' scores in Integrated Science at the JSCE and their scores in Biology, Chemistry and Physics at the SSCE. These results conform to the research findings of Osokoya (1999) and study by Adeyemi (2008), which revealed that performance in Integrated Science does predict performance in Biology and Chemistry at the SSCE. These results, to a large extent, validate the expectation that there should be a link between the performance of students in Integrated Science at the JSCE and their performance in science subjects at the SSCE. Under the National Policy on Education, the study of Integrated Science at the Junior Secondary School was meant to provide a sound foundation for students in the sciences, given the curriculum content for Integrated Science at the Junior Secondary School. The results confirmed the view of Das (2008), that the study of Integrated Science would enhance the child's transfer of knowledge from the JSS to SSS level. The finding of this study is however at variance with one of the findings of Adeyemi (2008), in which it was concluded that performance in Integrated Science at the JSCE does not predict performance at the SSCE in Physics. Edokpayi and Suleman (2011) and Faleye and Afolabi (2008) on the contrary, found that scores obtained in Integrated Science at the JSCE are poor predictors of students' performance in science at SSCE. However, for the results of the studies by Faleye and Afolabi (2008), and Edokpayi and Suleiman (2011), their results were based largely on correlation analysis, which is not a very robust tool of prediction analysis.

This finding that gender predict performance, is in agreement with the findings of Abubakar and Oguguo (2011) of Islam and Al-Ghessan (2015), where gender had significant effects on performance of students in Science. The result however disagrees with the findings of Onuekwusi and Ogomaka (2013), Onuka and Durowoju (2008) that gender does not predict performance of students in Science.

The finding that location by State affects students' performance in science agrees with the findings of Onuekwusi and Ogomaka (2013), but contrary to the finding of Onah and Ugwu (2002) who found that school location does not predict performance.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The teaching of Integrated Science at the Junior Secondary School level should continue to be encouraged, and it should be taught by experienced teachers that appreciate the subject as the true foundation for the study of Science.

2. Based on the findings that competency in science subjects is gender-invariant, preferential treatment should not be given on any particular gender in the teaching and learning of science subjects.
3. Since the results of the findings provided evidence in support of heterogeneous characteristics of the data sets, the data for each State could be considered as having been drawn from different hypothetical samples and therefore are more appropriately analysed independently.

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How to cite this article:

Patrick. U. Osadebe and Margaret E. N. Orubu (2018) 'Junior Secondary Certificate Examination Scores In Integrated Science As Predictor of Senior Secondary School Students' Performance In Science', *International Journal of Current Advanced Research*, 07(5), pp. 12268-12271. DOI: <http://dx.doi.org/10.24327/ijcar.2018.12271.2149>
