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Students integrated science achievement as predicator of later achievement in chemistry: A case study among selected secondary schools in Zaria metropolis

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ABSTRACT

In this article, the predictive strength of the Junior Secondary Certificate (JSC) examinations in integrated science in predicting the performance of students in the Senior Secondary Certificate (SSC) examinations in chemistry in Zaria metropolis, Nigeria was examined. The study employed the ex-post facto design. The study population comprised of four hundred students from four purposefully selected secondary schools in Zaria metropolis. Out of this population, a sample of two hundred students was selected through the stratified random sampling technique. Data were collected through an inventory and analysed with the use of z-test and correlation analysis. The results of the investigation revealed that the academic achievement of students in integrated science in the Junior Secondary School Certificate (JSC) examinations among the selected Secondary schools in Zaria metropolis was a poor predictor of later achievement in chemistry at Senior Secondary School Certificate (SCE) examination. It is recommended that more qualified and competent teachers should be trained and employed to teach Integrated Science in Junior Secondary School and classroom teachers should try as much as possible to relate the concept of integrated Science to chemistry and other basic sciences.

Keywords: Predicator, Secondary School, Chemistry, Integrated Science, Nigeria.

INTRODUCTION

The term ‘academic performance’ has been described as the scholastic standing of a student at a given moment. It refers to how an individual is able to demonstrate his or her intellectual abilities. This scholastic standing could be explained as the grades obtained in a course or groups of courses taken [1-2]. Thus, in predicting academic performance, Daniels and Schouten (1970) emphasized the use of grades in examinations and reported that grades could serve as prediction measures and as criterion measures. They argued that a prediction of a future examination result

could be made with reasonable success on the basis of the results of a previous examination. Findings made by Al-Shorayye (1995) and Adeyemi (1998) led credence to this point [3-4]. The findings supported the findings of other researchers that the General Certificate Examination (GCE) and Secondary School Certificate examination (SSCE) results provided the best predictor of university performance [5]. Findings made by Peers and Johnston (1994) confirmed the validity of the number and grades of passes in the Scottish Certificate of Education in predicting first year and final year university performance [6]. Gay (1996) also reported that high school grades could be used to predict college grades [7]. These findings were contrary to O'Rourke *et al* (1989) findings that the Scholastic Aptitude Test (SAT) is unable to predict examination performance as effectively as the Leaving Certificate Examination (LCE) point scores [8].

In Nigeria, researchers have had divergent findings on the predictive validity of some examinations [8-9]. In other developing countries, the index of academic performance varied from one country to another. Othuon and Kishor (1994) found that the Kenya Certificate of Primary Education scores had a moderate positive linear relationship with the Certificate of Secondary Education grades [10]. In some other States, performance in JSCE has been found to be significantly related to the performance in SSCE [11]. However, some researchers have found no significant relationship between the performance in JSC examinations and performance in SSC examinations [12]. Considering the divergent views and findings of previous researchers on the predictive validity of the JSC examinations, this study intended to examine student's performance in integrated science in the JSC examinations to determine whether or not it could effectively predict students' performance in chemistry in the SSC examinations among some selected schools in Zaria metropolis, Nigeria.

Research Questions

This study is intended to find answers to the following questions;

1) To what extent do the student's academic achievements in integrated science at Junior Secondary School Examination predict their achievements in chemistry at the Senior Secondary School Examination?

2) To what extent do boy's academic achievements in integrated science predict later academic achievement in chemistry?

3) To what extent do girl's academic achievements in integrated science predict later academic achievement in chemistry?

Research Hypotheses

The following null hypotheses were formulated to answer the research questions above:

Ho 1: There is no significant relationship between students' academic achievements in integrated science at JSCE and on their achievements in chemistry at the SSCE?

Ho 2: There is no significant relationship between boy's academic achievement in integrated science and their later academic achievement in chemistry?

Ho 3: There is no significant relationship between girl's academic achievement in integrated science and their later academic achievement in chemistry?

MATERIALS AND METHODS

Research design

The ex-post-facto survey design was used in this study. Akuezuilo and Agu (2003) stated that an ex-post-facto design is where a researcher carried out empirical inquiry but did not have direct control of the independent variables because their manifestations had already occurred [13].

Research Instrument

There was no instrument for the purpose of this study. This study is a one short-case study of the previous student's scores of subjects was collected from the schools under study. The results are already standardized by external examining body. Therefore this could be used for this study [14].

Population

The research population comprised of four hundred (400) secondary school students from which two hundred students were randomly drawn from four (4) secondary schools in Zaria metropolis was used as sample for the study. Also population of group of only those who have the results of Junior School Certificate Examination in integrated science and Senior School Certificate Examination in chemistry of the year 2005/2006 and 2008/2009 respectively were considered for the study. These schools were chosen owing to their reputation of academic excellence and because of their proximity to the researcher.

Data Collection

The data were collected from the four schools used in this study. The results were collected from the principals/examination officers of each of the schools and were recorded accordingly and student's numbers were coded with M_1-M_n and F_1-$F_{n'}$ (where M = Male student and n = the total number of male student and F = Female student and n' = the total number of female student) in line with their scores in integrated science and chemistry achievement test. The two data were collected and recorded for data analysis.

Procedure for Data Analyses

The data collected for the study were sorted out. In analyzing the data, the z-test statistic and the Pearson's product moment correlation coefficient was used to determine the degree of relationship existing between the student's academic achievement in chemistry and their academic achievement in integrated science.

Analyses and Presentation of Results

Data collected for analysis in the study were guided largely by the demands of the three null hypotheses stated. A 95% confidence interval was used in rejecting or retaining the stated null hypotheses. For the purpose of scoring, JSCE grade of A, C, P and F were awarded 3, 2, 1 and 0 points respectively, while the SSCE grade of Distinction, Credit, Pass and Fail were treated likewise. The research hypotheses stated were as follows:

Research Hypothesis One

There is no significant relationship between student's academic achievement in integrated science and their later achievement in chemistry. To test this hypothesis, scores from the student

academic achievement in JSCE integrated science of the National Examination Council (NECO) were correlated with their scores in SSCE chemistry also of the National Examination Council (NECO) using the Pearson's product moment correlation coefficient and the z-test statistics. The results obtained are presented in table 4.1;

Table 4.1: The Pearson's product moment correlation coefficient and the z-test statistics for the total population

	X	*Y*
Mean	1.53	1.7
Known Variance	0.51	0.43
Observations	100	100
Z calculated	-1.75	
z Critical two-tail	1.96	
Pearson's Correlation	0.17	

From the result in the table above, the z-calculated value is greater than the z-critical implying that the null hypothesis will be retained and this result is re-enforced by the poor linear correlation observed using the Pearson's product moment correlation.

Research Hypothesis Two

There is no significant relationship between boy's academic achievement in integrated science and their later academic achievement in chemistry. Scores from the student academic achievement of the male students in JSCE integrated science of the National Examination Council (NECO) were correlated with their scores in SSCE chemistry also of the National Examination Council (NECO) using the Pearson's product moment correlation coefficient and the z-test statistics. The results obtained showed a poor linear correlation but quite better than that of the overall population. The z-calculated was found to greater than the z-critical thus retaining the stated hypothesis.

Table 4.2: The Pearson's product moment correlation coefficient and the z-test statistics for the boy's population

	X	*Y*
Mean	1.54	1.68
Known Variance	0.62	0.43
Observations	50	50
Z calculated	-0.97	
z Critical two-tail	1.96	
Pearson's Correlation	0.22	

Research Hypothesis Three

There is no significant relationship between girl's academic achievement in integrated science and their latter academic achievement in chemistry. The Scores from the student academic achievement of the female students in JSCE integrated science of the National Examination Council (NECO) were correlated with their scores in SSCE chemistry also of the National

Examination Council (NECO) and the z-test statistics. The results obtained are presented in table 4.3

The results obtained showed a very poor linear correlation which is poorer than that of the total population and the boy's population. The z-calculated was found to greater than the z-critical thus retaining the stated hypothesis.

Table 4.3: The Pearson's product moment correlation coefficient and the z-test statistics for the girl's population

	X	*Y*
Mean	1.54	1.68
Known Variance	0.51	0.43
Observations	50	50
Z calculated	-1.02	
z Critical two-tail	1.96	
Pearson's Correlation	0.07	

DISCUSSION

The concept of predictive validity has been described by many authors [15-17]. The concept is used to describe the capacity of a measuring instrument to forecast the future performance in a related task [15]. A number of factors are found to potentially affect the predictive validity of test items. These include factors that are capable of affecting reliability [18], since reliability is essential (but not sufficient) factor in ensuring validity. The data collected were based on the performance of the students academic achievements in integrated science of the JSCE and their later achievement in chemistry of the SSCE (The National Examination Council Results was used) among some selected schools ion Zaria metropolis. They were analyzed according to the demand of the research questions, hypotheses formulated and the designs of the study. The discussions of the results are presented below:

Research Question One

To what extent do the student's academic achievements in integrated science at Junior Secondary School Examination predict their achievements in chemistry at the Senior Secondary School Examination?

From the results in Table 4.1, there exist a poor significant relationship between students integrated science achievement in the JSCE and their later achievement in chemistry in the SSCE. This shows that the results of the JSCE in integrated science cannot be used to predict their later achievement in chemistry. This is not surprising as interview with students in the JSS showed that their major difficulty in integrated science is the chemistry aspect of it. The findings were, however, in consonance to the findings made by Adebayo (2002) who found no significant relationship between students' overall performance in the JSC and the SSC examinations in Ekiti State, Nigeria [19]. The findings were also similar with that reported by Afolabi and Adewolu (1998) who reported that the Osun State JSC examination is a poor predictor of students in the

SSC examinations. This suggests that further research should still be conducted in this area [20]. The findings on indicating that performance in JSC Integrated Science could effectively predict performance in SSC chemistry and biology also agrees with Omonijo (2001) studies who reported that the JSC integrated science could not singly predict the performance of students at the SSC chemistry and biology [12]. Olowa (2009) has observed that not all JSCE subjects have adequate predictive strength [21]. This however negates the principle of testing (especially for public examinations) where all the items are expected to have been pre-test and all necessary psychometric strength (of adequate predictive power, discrimination of index and moderate difficulty level) ensured before they are administered on real candidates [17]. The predictive strength of the JSC examinations in predicting performance at the SSC examinations in Ondo State, Nigeria was examined by Adeyemi (2008) although the performance level was low in the examinations thereby supporting the earlier findings [22-25] the performance varied considerably from one subject to another. This result disagrees with those of some other researchers [2, 26]. Therefore the findings indicating significant relationship between the performance of students in the JSC 2000 and the performance of the same students in the SSC 2003 examinations agreed with those of Othuon and Kishor (1994) who found that the Kenya certificate of primary education (CPE) had a moderate linear relationship with the Cambridge secondary certificate (CSE) examination grades [10].

Research Question Two

To what extent do boy's academic achievements in integrated science predict their later academic achievement in chemistry? As far as this present study is concerned, the results in respect of male students as shown in Table 4.2 indicated that there is a poor linear relationship between the male student academic achievements in the JSCE and their achievements in chemistry in the SSCE. Thus the achievement of boys in the JSCE integrated science is a poor predicator to their later achievement in chemistry. Abraham (1980) has shown that the relationship between the performance of students in theoretical physics and practical physics is insignificant [27]. It has been reported that boys perform better than girls on item that has to do with calculations [28].

Research Question Three

The correlation studies revealed that the performance of girls in integrated science and chemistry showed a very poor linear relationship. Science laboratory programme comprises mainly of physics, mathematics, chemistry and biology in which physics, mathematics and chemistry involves a lot of calculation. There is a common belief that females are less mathematically capable than males: this belief is fairly constant across population [28]. Classroom studies have shown that this belief is in place when children enter their junior secondary schools [29]. Although, the differences in performance are usually small, parents and teachers always expect large discrepancies between boys' and girls' performance in mathematics class [30].

Physics and chemistry is a major component of science programmes which involves a lot of calculations and reasoning. So the vigor and discipline it takes to study physics and science in general may affect performance and even enrolment in science laboratory programme. This assertion can be supported by Ohakwe (1999) (in a research conducted by Isa and Balarabe (2009)) findings which state that female students exhibit poor attitudes towards the study of mathematics, and this is portrayed in their achievement in this subject in public examinations

[28]. Failure in physics and mathematics will invariably deter the students from pursuing science based programmes, science laboratory technology inclusive. It is also reported that boys perform significantly better than girls in manipulative reasoning task [31]. Women in general do have a strong presence in science and technology. This is attributed to two broad issues: First, women's perception of their role and functions in the society and societal expectation of their contribution. Women's involvement in science and technology encounters barriers in regard to discipline and academic or professional level of responsibility; women are divided into two spheres called the management of home and family and the fulfillment of job responsibilities. Family commitments, either as the women's choice or as a result of cultural enforcement, have impaired women's capacity to meet their potentials and put them at a disadvantage in many science and technology related jobs that are dynamic and qualitative in nature.

Implication of Findings

This research was prompted as a result of poor academic performance of students in the senior secondary examination in chemistry. Poor academic achievement of students as observed Mani (1981) and Usman (1992) have attributed to many factors some of which include the use of tradition lecture method, lack of trained and competent chemistry teachers among others [14, 32]. The move to integrate the teaching of science had been a worldwide decision. The integrated science curriculum was to be child centered and broad field. It was supposed to provide a reasonable foundation for the study of chemistry and other science subject at the SSS level. Through integrated science the students are exposed to various concepts and principles of science so as to make them effectively in the technological age even without formal education but unfortunately this purpose have not yet been achieved as integrated science cannot be used as a predicator for later student's performance in chemistry. One of the problems could be that integrated science is not taught by specialist. It has been established that predominately the junior and less qualified teachers handle the teaching of integrated science and that majority of the teachers either have no university degree or teaching qualifications.

Jegede (1978) in an attempt to identify the problems facing integrated science teachers noted that most of the teachers are single subject specialist in chemistry, biology, physics, or agricultural science who often feels more secure to teaching their own subject area at the detriment of other areas in the integrated science lesson [33]. Many teachers in Nigeria secondary schools are therefore handicapped by inadequate background for the teaching of integrated science or may have little philosophy behind it or the method of teaching it.

CONCLUSIONS

From the findings of this study, the following conclusions are made:

(1) Student's academic achievement in integrated science cannot be used as a predicator to their later achievement in chemistry.

(2) Male student's academic achievement in integrated science is a poor predicator to their future achievement in chemistry.

(3) Female student's academic achievement in integrated science cannot be used as a predicator to their later achievement in chemistry.

Recommendations

The following recommendations are made based on the findings from this study:

(1) The teaching and learning of integrated science in Junior Secondary School should be enhanced so as to adequately equip students as it relates to their future studies in their career.
(2) More qualified and competent teachers should be trained and employed to teach both integrated science and chemistry
(3) Classroom teachers should try as much as possible to relate the concept of integrated science to chemistry and the relationship between them

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