

## **Achievement in Basic Science as a Predictor of Students' Achievement in Senior Secondary School Chemistry in Anambra State.**

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### **Abstract**

The study investigated achievement in Basic Science as a predictor of students' achievement in Senior Secondary School Chemistry. The correlation study was carried out in Onitsha Education Zone of Anambra state. The population of the study consisted of all the 1624 SS1 students who sat for chemistry at the end of year examination of the Anambra State Post-Primary Schools Services Commission of (ANPPSSC) in 2012. From this population, a sample of 367 students from thirteen schools drawn by stratified proportionate random sampling was studied. Basic Science results of the students in the Basic Education Certificate Examination (BECE) for 2011 were used as the predictor variable while SS1 Chemistry annual examination scores of the same students for 2012 were the criterion variable. Two research questions and two hypotheses guided the study. The BECE Basic Science grades of the students were converted to raw scores using stannine scale and then correlated with their SS1 Chemistry annual examination scores. Analyses of the results using Pearson Product Moment Correlation, regression analysis, and ANOVA revealed that Basic Science results significantly predicted the achievement of the students in SS1 Chemistry. Based on this finding, it was recommended that at least a credit pass in Basic Science in the BECE should be a criterion for admission of students to study Chemistry in SS1.

**Key words:** predictive validity, achievement, predictor, criterion, correlation.

### **Introduction**

Science and Technology have long been recognized as instruments par excellence for nation building. Science and Technology are also used as parameters for classifying nations as developed, developing and underdeveloped (Danjuma, 2006). Science deals with systematic investigation of nature and natural phenomena while technology deals with the practical application of science. Thus, the products of science are ideas, theories and principles arrived at through a process of continuous enquiry, while the products of technology are techniques, devices, procedures and materials (Ademola, 2004). Almost all aspects of human endeavour are directly or indirectly affected by one technological innovation and device or the other (Nnaka & Anaekwe, 2009). The benefits of science and technology can be seen in every facet of human life; at home, office, transportation, in hospitals just to mention a few. Chemical theories and principles are fundamental to many of these scientific discoveries and technological inventions (Longjohn, 2009).

Chemistry is one of the branches of pure Science studied at the Senior Secondary School (SSS) level of education in Nigeria. It deals with the study of matter, its structure, composition, properties and the changes it undergoes (Ojokuku, 2012). The importance of chemical education in the development of any nation cannot be over-emphasized. It is a widely held view that the scientific development of any nation is enhanced by the quality of chemical education in its schools (Ifeakor 2006). In view of this, it becomes imperative that the study of Chemistry in our schools especially secondary schools must be given the emphasis it deserves for optimum achievement by the students. This must be so if the much expected scientific and technological development will not remain a mirage because as Ali (1998:1) noted, "the secondary school population is the source of recruitment (admission) for further training of prospective research scientists, applied and basic science teachers and other science and technology-related training programmes".

These notwithstanding, the achievement of our secondary school students in Chemistry has been reported to be consistently poor (Mordi, 1983; Olatoye 2002; Olatoye & Afuwape, 2004a; Achimugu 2012; WAEC 2008-2014). This poses a serious threat to sustained science education on one hand and technological advancement in Nigeria on the other hand (Echekwube, 2009). The poor achievement of students in Chemistry has been of great concern to researchers and Chemistry educators who have also from researches come out with various factors responsible for this poor trend. Some of these factors are poor quality of Chemistry teachers, lack of adequate resources and facilities for teaching Chemistry, use of ineffective teaching methods, overloaded curriculum to mention but a few (Ezeliora, 2004; Njelita, 2008; Ifeakor, 2009; Ogunneye as cited by Achufusi-Aka, 2011). However, it must be noted that whatever achievement a student makes in the Senior Secondary School Chemistry may not be unconnected with the foundation laid at the Junior Secondary School (JSS) level and the only subject expected to lay such a foundation is Basic Science. The importance of this foundation is succinctly captured in the words of Ivowi in Mohammed and Funtua (2009: 245).

It is a fact of modern times that functional education has become crucial for the survival of individuals and the development of society. Unless a proper foundation is laid at the lower (basic) education level, much of what occurs at the upper levels of education may not be sound, appropriate and appreciative.

The implication of the statement above is that if a good foundation is laid for the students in the Basic Science course taught at the JSS level, the students will be predisposed to achieve well in their SSS Science. Odetoyinbo (2004) noted that Integrated Science (now Basic Science) is the only subject offered at the Junior school level meant to integrate the students into the world of science having been exposed to the rudiments of science called Primary Science.

A cursory look at the Basic Science curriculum shows that it contains chemistry topics. A detailed analysis will however show what amount of Chemistry is contained in it. The question that will arise then is this: is the amount of chemistry contained in the Basic Science curriculum sufficient to lay a good foundation for further studies in Chemistry at the senior secondary level? If the content is sufficiently related to SS1 Chemistry curriculum, one will expect that a good achievement by students in Basic Science will provide an appropriate foundation for good understanding and achievement in Chemistry after undergoing instruction in Chemistry at the SSS level.

Predictive validity is a concept used to describe the capacity of a measuring instrument to forecast future performance in a related task (Graduate Management Admission, Council, GMAC cited in Faleye & Afolabi, 2005). It can also be seen as the accuracy with which test scores makes it possible to predict some criterion variable of educational, job or life performance. In other words, predictive validity is the ability of a measuring instrument to correctly predict a future performance in a related field of study or endeavour.

Studies have been done by previous researchers (Adeyemi, 2008; Edokpayi & Suleiman, 2011; Olatoye & Afuwape, 2004b) on the relationship between students' achievement scores in Junior School Certificate Examination (JSCE) Integrated Science and their achievement scores in the SSCE Science and Mathematics. Whereas some found a significant relationship between Integrated Science scores and the achievement scores in SSCE Science and Mathematics, others found no significant relationship.

Olatoye and Afuwape (2004b), investigated how achievement of students in Integrated science predicted their latter achievement in Biology, Chemistry and Physics at the SSS level. Students' performance in Integrated Science was found to significantly account for 12.2% of the total variance in the overall achievement in the science subjects. Similarly, achievement in Integrated Science was found to significantly predict later achievement in each of the basic science subjects. The highest prediction was in Biology followed by chemistry and lastly Physics.

In a similar study, Adeyemi (2008) correlated Integrated Science scores at the JSCE with the SSCE scores for the basic sciences and found a significant relationship between JSCE Integrated Science achievement and the students' achievement in SSCE Chemistry and Biology while no significant relationship was found between JSCE Integrated Science and SSCE Physics achievement.

Contrary to the findings of Olatoye and Afuwape (2004b) and Adeyemi (2008), Edokpayi and Suleiman (2011) who studied the predictive strength of JSCE Integrated Science in predicting the performance of students in the SSCE Chemistry in Zaria metropolis of Kaduna State, found out that the achievement of students in Integrated Science at the JSCE was a poor predictor of later achievement in Chemistry at the SSCE. The findings are thus divergent and inconclusive, hence the need for more study.

Moreover, with the takeoff of the nine-year basic education programme and replacement of Integrated Science with Basic Science, and JSCE with BECE, it becomes necessary to undertake this study as the Basic Science curriculum was borne out of curriculum review, revision and restructure. Furthermore, the inclusion of many more subjects in the SSS curricula has made it imperative that students in many schools should choose the subjects to offer in SSS1 to accommodate the numerous subject options in the school time-table. Establishing the predictive validity of BECE Basic Science achievement on students' achievement in SSS chemistry will go a long way to fulfilling one of the important uses of evaluation: for placement. Correct placement of students will invariably predispose them to achieve better in science and Nigeria's quest for scientific and technological advancement will be on the way to being actualized. The researchers therefore want to find out whether the BECE results in Basic Science in Anambra State can predict the achievement of the same students in Chemistry at the SSS level.

### **Purpose of the study**

The purpose of this study is to determine the predictive strength of students' achievement in BECE Basic Science for their achievement in SSS Chemistry in Anambra State. Specifically, the study determined:

1. The relationship between students' achievement in BECE Basic Science and their achievement in SS 1 Chemistry examination.
2. The extent to which students' achievement in BECE Basic Science can predict their achievement in SS1 Chemistry examination.

### **Research questions**

Two research questions guided the study

1. What is the relationship between students' achievement scores in BECE Basic Science and their achievement scores in SS 1 Chemistry examination?
2. To what extent would students' achievement in Basic Science in the BECE predict their achievement in SS1 Chemistry examination?

### **Hypotheses**

Two hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

H<sub>01</sub>: there is no significant relationship between students' achievement scores in BECE Basic Science and their achievement scores in SS1 Chemistry examination.

H<sub>02</sub>: there is no significant prediction of students' achievement in SS1 chemistry examination by their achievement in BECE Basic Science.

### **Study Method**

This study employed a correlational survey design.

The population of the study consisted of all the 1624 SS1 students in Onitsha Education Zone who sat for Chemistry at the end of year examination of the Anambra State Post-Primary Schools Service

Commission (ANPPSSC) in 2012. Out of this population, a sample of 367 students (representing 23% of the total population) from thirteen schools (out of the thirty schools in the zone) drawn by random sampling was studied.

The instrument for data collection consisted of BECE result in Basic Science for the year 2011 and SS1 annual examination result scores in Chemistry for the year 2012 for all the students sampled. The researchers obtained the annual result scores of SS1 chemistry students for the year 2012 from the Educational Services Department of the Onitsha Zonal Office of the ANPPSSC. The names and scores of the students in their intact classes of 40-50 for each school were copied. With this, the researchers went to the Examination Development Centre (EDC) of the Anambra State Ministry of Education Awka to trace their 2011 BECE Basic Science results. Those students whose BECE results were not seen in their current schools were dropped.

### Data analysis

The BECE Basic Science grades of the students were first converted to raw scores using stannine scale for uniformity with the SS1 Chemistry scores. The data were thereafter analyzed using Pearson Product Moment Correlation, regression analysis, and ANOVA.

### Results

The results are presented according to the research questions and hypotheses

**Research question one:** What is the relationship between students' achievement scores in BECE Basic Science and their achievement scores in SS1 Chemistry?

**Table 1: Correlation of students' achievement score in BECE Basic Science and SS1 chemistry**

|            |                     | BECE Score         | CHEM Score         |
|------------|---------------------|--------------------|--------------------|
| BECE Score | Pearson Correlation | 1                  | .312 <sup>xx</sup> |
|            | Sig. (2-tailed)     |                    | .000               |
|            | N                   | 367                | 367                |
| CHEM Score | Pearson Correlation | .312 <sup>xx</sup> | 1                  |
|            | Sig. (2-tailed)     | .000               |                    |
|            | N                   | 367                | 367                |

xx Correlation is significant at the 0.01 level (2-tailed)

Table 1 shows the correlation between the students' achievement in BECE Basic science and their achievement score in SS1 chemistry. The correlation coefficient between the students' scores in BECE Basic Science and SS1 chemistry is 0.312. This shows that there is a low positive relationship between the scores of students in BECE Basic Science and in SS1 Chemistry.

**Hypothesis one:** There is no significant relationship between students' achievement scores in BECE Basic Science and their achievement scores in SS1 Chemistry.

Table 1 shows that the probability associated with the calculated value of  $r$  (.312) is 0.000. This implies that there exists a significant low positive relationship between students' achievement scores in BECE Basic Science and their achievement scores in SS1 Chemistry since the probability value of 0.000 is less than the 0.05 level of significance.

**Research question two:** To what extent would students' achievement in BECE Basic Science predict their achievement in SS1 Chemistry?

**Table 2: Regression analysis of students' achievement scores in BECE Basic Science as a predictor of their achievement in SS1 Chemistry**

| Model | R                 | R Square | Adjusted R square | Std. Error of the Estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1     | .312 <sup>a</sup> | .098     | .095              | 10.723                     |

a. Predictors: (constant) BECE Score

Table 2 shows that the correlation between the predictor variable and the criterion variable is 0.312 with a coefficient of determination of 0.098. This implies that only 9.8 percent variation in the achievement scores in SS1 Chemistry can be attributed to the variation in their achievement scores in BECE Basic Science.

**Hypothesis two:** There is no significant prediction of student's achievement in SS 1 Chemistry by their achievement in BECE Basic Science.

**Table 3: Analysis of variance of the students' achievement scores in BECE Basic Science as a predictor of their achievements in SS1 Chemistry**

| Model |            | Sum of squares | Df  | Mean square | F      | Sig               |
|-------|------------|----------------|-----|-------------|--------|-------------------|
| 1     | Regression | 4541.859       | 1   | 4541.859    | 39.500 | .000 <sup>b</sup> |
|       | Residual   | 41989.591      | 365 | 114.985     |        |                   |
|       | Total      | 46511.540      | 366 |             |        |                   |

a. Dependent variable: CHEM Score. B. Predictors (Constant), BECE Score

Data analysis in table 3 shows that the calculated value of F (39.500) for the prediction of students' achievement in SS1 Chemistry by their achievement in BECE Basic Science has a probability value of 0.000. Since this value is less than 0.05 level of significance, the null hypothesis is rejected meaning that students' achievement in BECE Basic science predicts their achievement in SS1 Chemistry.

## Discussion of results

### Relationship between students' achievement scores in BECE Basic Science and their achievement scores in SS1 Chemistry.

The results of analysis presented in table 1 show that there is a positive relationship between the achievement scores of students in BECE Basic Science and their achievement scores in SS1 Chemistry ( $r=0.312$ ). This relationship though low was nevertheless found to be significant this is in support of the findings of Adeyemi (2008) who found a significant positive relationship between achievement in JSCE Integrated Science and SSCE Chemistry and Biology in Ondo State and Olatoye and Afuwape (2004b) who also reported a significant positive relationship between JSCE Integrated Science and SSCE basic sciences (Physics, Chemistry and Biology). The results however negates the findings of Edokpayi and Suleiman (2011) who found that academic achievement of students in Integrated Science in JSCE was a poor predictor of later achievement in Chemistry at the SSCE.

### Achievement in BECE Basic Science as a predictor of achievement in SS1 Chemistry

The result of analysis presented in Table 2 and 3 show that achievement of SS1 students in Chemistry can be predicted by their achievement in BECE Basic Science. This shows that the Basic Science curriculum is relevant in the preparation of JSS students for further studies in Chemistry at the SSS level. With a coefficient of determination of 0.098, 9.8% of the achievement scores of students in SS1 Chemistry can be attributed to their achievement in BECE Basic Science. This means that the predictive strength of BECE Basic Science for achievement in SS1 Chemistry is low. This low predictive strength could imply that there is need to include more Chemistry concepts in the Basic Science Curriculum. It could also arise from differences in the difficulty level of test items in both the predictor and criterion measures or even poor content validity of either the predictor or criterion test items.

## Summary of Findings and Conclusion

The following findings were made from data analysis

1. There exists a significant low positive relationship between students' achievement in BECE Basic science and their achievement scores in SS1 Chemistry.
2. There is a significant prediction of students' achievement in SS1 Chemistry by their achievement in BECE Basic Science.

The findings that there exists a significant positive relationship between students' achievement BECE Basic Science and their achievement in SS1 Chemistry examination implies that for students to achieve better in senior secondary Chemistry, much attention must be given to the foundation course of Basic Science at the JSS level. This will involve ensuring that the contents of Basic Science curriculum is well enriched to lay the needed foundation for further studies in Chemistry at the SSS level; and that the necessary instructional materials and facilities are put in place for meaningful teaching and learning of Basic Science at the JSS level.

The finding that Basic Science achievement in BECE is a significant predictor of achievement in SS1 chemistry implies that to get good students to study chemistry at the SSS level, a good grade in BECE Basic Science ought to be a requirement. When the right caliber of students are admitted into chemistry classes at the SSS level, the students will most likely achieve highly in their Senior Secondary Certificate Examination and the quest for scientific and technological growth of the nation will be on the way to being realized.

### Recommendations

The following recommendations are hereby made based on the findings of this research

1. Only students who obtain credit grades and above in BECE Basic Science should be admitted to study Chemistry at the SSS level
2. The Chemistry content of Basic Science curriculum should be enriched to strengthen the predictive strength of Basic Science on achievement in SSS Chemistry

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