

## Evaluating Secondary School Students' Science Achievement: Implication for Curriculum Implementation

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### **Abstract:**

*Science education is believed to be a vital tool for individual and societal development at large. The persistent low levels of students' achievement in sciences at the various public examinations in Nigeria have continued to draw the attention of major stakeholders in education. This study examined academic achievement of Senior Secondary School students in science subjects, the relationship between the three subjects; Biology, Chemistry and Physics and gender difference in students' achievement were examined. Ex-post facto design of descriptive research was adopted for the study. A proforma was used to collect data from a sample of three hundred (378) students, selected using stratified random sampling procedure from the Science secondary schools in Kano state Nigeria. The data collected were the students' performances in in three science achievement tests. The data were analysed using descriptive statistics, Pearson Product Moment Correlation Coefficient ( $r$ ) and Independent-Sample  $t$ -test. Overall results showed that students performed above average ( $M=55.10$ ,  $SD=14.256$ ,  $55.10\%$ ) and a significant correlation exists between students achievement in the three key science subject  $r(376)=0.763$ ,  $r(376)=0.781$ ,  $r(376)=0.714$ . Similarly, gender difference exists in science achievement. The implication of this finding is that, though students' sciences achievements are satisfactory and generally encouraging, there are*

*distinguishing differences in the cognitive, affective and psychomotor skills of students with respect to gender. It is recommended among others that, that teachers should encourage students to manage their own learning, engage in co-operative tasks in order to improve their academic achievement in sciences and minimise gender disparity in students' achievement.*

**Key Words:** Examination, Sciences, Students, Academic achievement, Curriculum

### **Introduction**

The importance of science education to individual and society at large is acknowledged globally. It is an essential tool in our society (Baroody, 1987). The National Policy on Education (FRN, 2004) have advocated improvements in the teaching and learning of Science, Technology and Mathematics (STM) in order to lay a solid foundation of technologically oriented manpower in line with the needs of national development efforts. Therefore, learning sciences becomes more important not only for the well-being of the individual, but also for the society as a whole (Odubunmi, 2006). Sciences occupy a special position in the senior secondary school curriculum in Nigeria. In the National Policy on Education (FRN, 2004), each student at senior secondary school irrespective of

his/her stream is expected to study at least a science subject (Biology, Chemistry or Physics).

The federal government of Nigeria in an effort to equip students to live effectively in the modern age science and technology lays emphasis on science education which is taught at all levels of education and made compulsory at both primary and secondary schools. At tertiary level, science is a compulsory subject and formed part of the requirement for admission especially in pure sciences, medical sciences, Agricultural sciences, Environmental sciences and Engineering programmes. It is part of general studies for students in all fields of studies in Nigerian colleges, Polytechnics and universities. Similarly, for admission purposes into the Nigerian institutions of higher learning; the ratio of sciences to liberal arts is 60 to 40 per cent with functionality and integration of theory and practical as paramount aims (Adegun and Adegun, 2013).

Biology, Chemistry and Physics are core science subjects and are among the major subjects taught at the Senior Secondary School level. The students need to pass these subjects at the end of their senior secondary education at credit level to fulfil the requirements for admission to study natural/pure, physical, environmental, and Agricultural sciences as well as Engineering at the higher institutions of learning in Nigeria.

Despite the vital role played by science and technology in advancing the society and the much government support at all levels, standard tests and evaluations revealed that students' performances in sciences can be place below the expected level. The students' academic achievements in Sciences at senior secondary schools in Nigeria have been very low and unimpressive.

Academic achievement is used as an index of students' future in this highly competitive environment. It has been one of the most essential purpose of the educational process. Academic achievement is considered as a key criterion to judge an individual's total potentiality and capability (Abdullahi and Bichi, 2015). Similarly, academic achievement occupies a very important place in any educational system. In the words of Crow and Crow (1969) Academic Achievement is the "extent to which a learner is profiting from instructions in a given area of learning i.e., achievement is reflected by the extent to which skill or knowledge has been imparted to him". Academic achievement also denotes the knowledge attained and skill developed in the school subject, usually designated by test scores (Karthigeyan and Nirmala, 2012).

The educators, policy makers, parents and society in general have always been interested in the academic achievement of students (Lydia and Nasongo, 2009; Yusuf and Adigun, 2010). According to Adeyemi (2010), teachers play vital role in determining the academic achievement of their students. Scholars have never reached a consensus on the specific teacher factors that affects students' academic achievement (Rivkin et al., 2005). Adaramola and Obomanu (2011) found that lack of well trained teachers led to consistent poor performance of students in SMT subjects in Nigeria

Onwuachu and Nwakonobi (2009) are of the view that accepted approaches to overcome poor academic achievement in science have included the creation of more positive attitudes towards the learning of science and promotion of more effective teaching strategies. It has also been accepted that an effective strategy for achieving better examination results was to

provide and maintain more effective learning environments through the development of more student-centred classrooms and greater reflectivity in classroom interactions of teachers (Henderson, Fisher & Fraser, 2000; Scott, 2003).

### **Statement of the Problem and Justification for the study**

The persistent low level of senior secondary school students' achievement in science at the various public examinations in Nigeria have continue to attract the attention of major stakeholders in education. Performance of students in science has consistently been poor and unimpressive. Despite all the considerable efforts made by stake holders at various levels, very little improvement in students' achievement has been recorded. Available data from the two public examination bodies i.e [the West African Examination Council (WAEC) and National Examination Council (NECO)] in their appraisal report on SSCE indicates that, there was a downward trend in performance in Nigeria.

Available records shows that from 2008 to 2012, there was a negative trend in the performances of students in the three sciences subjects with the average performances of 56.01% in Physics, 46.30% in Chemistry and 37.27% in Biology, this is in addition to an increasing failure rate in Biology and Chemistry (Sakiyo and Badau, 2015). It was generally observed that performance of candidates in WASSCE in the Nigeria in the subjects and for the period reviewed was not quite impressive except in Government where most of the candidates in Nigeria had credits and above. This calls for concern as these are core subjects for admission into tertiary institutions (Bello and Oke, 2012).

The government of Kano State in Nigeria regularly conducts qualifying

examination for all senior secondary school (SSS II) students, to assess their suitability to write the final examinations being conducted by the two public examining bodies in Nigeria (WAEC and NECO). Though, the examination is used as a criterion to sponsor students for the final examination. However, there has been no evidence from the literatures that any research was carried out to evaluate the level of students' performances' in these subjects (Biology, Chemistry and Physics).

The researchers agreed that, the objectives of secondary education can only be realized if there is an effective evaluation and assessment machinery. Thus, gaining an appreciation of their performance in science may provide useful insight into their area of weakness and future performance as well as their suitability to be sponsored by the relevant agencies.

The findings of the study might help the ministries of education and relevant stake holders including the teachers in evaluating students' performances in their various capacities. It will also give curriculum developers new insights into emerging issues on performance and influence the authorities on policy formulation. Students will also benefit from the findings; because improved science performance will give them opportunities to pursue career in Medial, Environmental, Pure and other related sciences programmes in institutions of higher learning in the country

### **Research Objectives**

The main objective of this study is to assess the academic achievement of senior secondary schools students in science subjects. Specifically this study intends to

1. Determine the overall secondary school students' performance in science subjects

2. Find out whether there is significant correlation between students performances in the three key science subjects (Biology, Chemistry and Physics).
3. Find out whether gender difference exist in the secondary school students performance in science subjects

### Research Questions

The following research questions were raised to guide the study

1. How well did the secondary school students' performance in science subjects?
2. Is there significant correlation between students' performances in the three key science subjects (Biology, Chemistry and Physics)?
3. Is there any significant gender difference in the secondary school students' performance in in science subjects?

### Research Hypotheses

The following hypotheses were generated and tested at 0.05 level of significance

- H<sub>01</sub>:** There is no significant gender difference in secondary school students' performance in in science subjects.
- H<sub>02</sub>:** There is no statistically significant correlation between students' performances in the three key science subjects (Biology, Chemistry and Physics)

### Methodology

#### Research Design

The study employed is Ex-post-facto research design to collect data and measure senior secondary school students' performance in science subjects. The data used was the students' sciences performances collected from the Monitoring and Evaluation Unit of the Kano State Sciences and Technical Schools Board.

#### Participants

The population of this study comprises the entire students of sciences secondary schools in Kano state. According to the available record of Monitoring and Evaluation Unit of the Science and Technical Schools Board, there are 23,320 students in the 17 science schools. Similarly, 378 students, age 16-18 were selected based on Research Advisor (2006) guideline for selecting sample. A stratified random sampling technique was employed in selecting the sample. The strata recognised gender 197 male (52.11%) 140 female (47.88%), as presented in table 1 below;

**Table 1:** Distribution of the Participants

Gender	Number	Percentage
Male	197	52.11%
Female	181	47.88%
<b>Total</b>	<b>378</b>	<b>100</b>

#### Research Instruments

The instrument used to assess students science performance was the three Science Achievement Tests (Biology, Chemistry and Physics Achievement Tests) constructed by Kano State Science and Technical Schools Board. The Achievement Tests comprises essay and multiple choice forms as well as practical in the three subjects. The test items covered the whole senior secondary school science syllabus prepared for Senior Secondary Certificate Examination by WAEC and NECO as well as the science curriculum prepared by the Ministry of Education in Nigeria.

#### Data Collection Procedure

The three Science Achievement Tests (Biology, Chemistry and Physics) was administered to the students by teachers with the supervision of Monitoring and Evaluation Unit of the Science and Technical Schools Board Kano State in July 2014. The data used are the scores obtained from the test after marking by

teachers following the designed marking scheme. A proforma designed and validated by the researchers was used to collect the available records of the students' performance from the official students' records of Kano State Science and Technical Schools Board

*Data Analysis*

The data collected were analysed using SPSS 20v. The Mean, Standard Deviation, Pearson Product Moment Correlation Coefficient (r) and Independent Sample t-

test statistics were used. The level of significance was set at 0.05 for all statistical tests

**Results and Discussion**

*Research Question 1: How well did the secondary school students' perform in science subjects?*

To answer this question, mean and standard deviation with the percentage of the students' performances were computed and presented in table 2 below;

**Table 2: Performance of Students in Science Achievement Tests**

SN	Variables	N	Mean	Std. Dev	% Performance
1	Biology Performance (Scores)	378	57.02	16.493	57.02%
2	Chemistry Performance (Scores)	378	55.48	13.816	55.48%
3	Physics Performance (Scores)	378	52.81	16.449	52.81%
<b>Overall Science Performance (Scores)</b>		<b>378</b>	<b>55.10</b>	<b>14.256</b>	<b>55.10%</b>

Information presented on table 2 above reveals the mean students' academic achievement as measured by their performance in the three science subjects' achievement tests. The result revealed the mean performance of Biology to be M=57.02, SD=16.493 (57%); Chemistry, M=55.48, SD=13.816 (55.48%) and Physics M=52.81, SD=16.449 (52.81%). These results show that, students' achievements in the three sciences subjects are all above average (50%). Comparing the hypothetical pass mark of 40.00 with the students' mean scores of 57.02, 55.48 and 52.81 for Biology, Chemistry and Physics respectively the students performed well in these subjects. Similarly, the global (overall) mean score of these sciences subjects is M=55.10, SD=14.256 (55.10%), this further show that the overall students achievement in

science is good. Moreover, considering the requirements for admission into higher institutions of learning in Nigeria at the credit level (50%), the overall secondary student achievement in science is satisfactory and therefore met the said standard.

**Hypothesis 1: There is no statistically significant correlation between students' performances in the three key science subjects (Biology, Chemistry and Physics)**

To test this hypothesis the students' sciences performances as measured by their scores in the three sciences subjects (Biology Chemistry and Physics) was correlated. The correlation coefficient of the relationship was determined using Pearson Product Moment Correlation coefficient (r); as presented in table 3 below;

**Table 3: Correlation between Students Performance in Science Subjects**

		N	Mean	Std. Dev.	Biology	Chemistry	Physics
<b>Biology</b>	Pearson Correlation	378	57.02	16.493	1	<b>0.763**</b>	<b>0.781**</b>
	Sig. (2-tailed)					.000	.000
<b>Chemistry</b>	Pearson Correlation	378	55.48	13.816	<b>0.763**</b>	1	<b>0.714**</b>
	Sig. (2-tailed)				.000		.000
<b>Physics</b>	Pearson Correlation	378	52.81	16.449	<b>0.781**</b>	<b>0.714**</b>	1
	Sig. (2-tailed)				.000	.000	

The analysis of the correlation matrix presented on table 3 above indicates a positive, strong and significant relationship between students' science achievements in the three subjects. The relationship between Biology and Chemistry achievement is  $r(376)=0.763$ , significant ( $P=0.00 < \alpha=0.05$ ). The relationship between Biology and Physics Achievements is  $r(376) = 0.781$ , significant ( $P=0.000 < \alpha =0.05$ ). The relationship between Chemistry and Physics is  $r(376) =0.714$ , significant ( $P=0.000 < \alpha =0.05$ ). These results revealed that, the students achievement in these three subjects are strongly correlated, the correlation is statistically significant ( $P=$

$0.000 < 0.05$ ). The null hypothesis which says there is no statistically significant correlation between students' performances in the three key science subjects (Biology, Chemistry and Physics) is rejected.

**Hypothesis 2:** *There is no significant gender difference in secondary school students' performance in in science subjects.*

To test the above hypothesis the mean sciences achievement of male and female students were used to conduct a test of differences. The coefficient of the differences was determined using independent sampled t-test at 0.05 level of significance as presented in table 4 below;

Table 4: Difference between Male and Female Science Performance

Sex	N	Mean	Std. Dev.	df	t-cal	sig. (2-tailed)	H <sub>02</sub>
Female	181	48.60	15.071	376	-9.45	0.00	Rejected
Male	197	61.08	10.360				

The descriptive statistics and a test for differences using the independent sample t-test obtained, as shown in Table 4, indicates that male students on the average performed better ( $M = 61.08$ ,  $SD = 10.360$ ) than female students ( $M = 48.60$ ,  $SD = 15.071$ ), Where  $t(376) = -9.45$ ,  $p = 0.00$ ,  $\alpha = 0.05$ . The result of the analysis revealed the mean of male students is significantly higher ( $t = -9.45$ ,  $df = 376$ , two – tailed probability  $< 0.05$ ) than the mean of female. The null hypothesis which says there is no statistically significant gender difference in secondary school students' performance in in science subjects is rejected since  $0.00 < 0.05$ . This implies that there is significant gender difference in secondary school students' performance in in science subjects. The difference was in favour of male students, meaning that they performed better than female students in sciences.

**Discussion of findings**

This study assessed the students' academic achievement in Sciences Qualifying examination in senior secondary schools in Kano state Nigeria. The findings, revealed that, the achievement of students in sciences qualifying examination is well all above average as measured by the mean scores of the students in their academic achievement in science (Biology, Chemistry and Physics) Qualifying Examination. the students achievements in all the three science subjects is above average and is at the credit level (50%) which is an indication that performance is satisfactory and met the requirement for admission into higher institutions of learning in Nigeria.

The finding on the relationship between students' academic achievement in three sciences subjects (Biology, Chemistry and Physics) revealed a positive, strong and statistically significant relationship between students' science achievements in the three subjects. The

relationship between Biology and Chemistry achievement is positive, strong and statistically significant, the relationship between Biology and Physics Achievements is positive, strong and statistically significant, and the relationship between Chemistry and Physics is positive, strong and statistically significant. This positive, strong and significant relationship between students achievement in the sciences subjects means that, students who do well in Biology also did well in Chemistry, Physics and vice versa. The null hypothesis which says there is no statistically significant correlation between students' performances in the three key science subjects is rejected.

The findings analysis based on gender difference revealed that the male have higher mean scores compared to female in their academic achievement in sciences. This gives an indication that the male performed better than females in sciences. This difference in favour of male students is statistically significant. Thus the hypothesis 2 which stated that, no significant gender difference in students' academic performance in sciences is rejected. This finding is consistent with that of Bozdoğan, Ünaydin & Okur (2015); Kolawole, (2007) etc who discovered a significant gender difference between the students' academic achievement in science course and at various times, that male students achieved significantly better than female students in science subjects. However, the finding is in contrast with that of Oludipe, (2012); Bilesanmi-Awoderu (2006); Erinoso (2005); Samuel & John (2004) etc whose revealed that gender difference in science achievement has disappeared

### **Implication for Curriculum Implementation**

The results from the present study have important implications for curriculum implementation such that;

The favourable results discovered in this study can be attributed to the teachers' commitment to their task. Science teachers can still provide more academic support to students who to increase their performance. Evaluation of students learning is an important part of the teaching and learning process, because it is through evaluation that the objectives of schools curriculum could be assess. The quality of learning and evaluation systems used are conceptually related, it is important for science teachers to understand the relationship between standardized tests and curriculum. For teachers who directly involved in curriculum implementation, more guidance may be needed as teachers work with new standards and content. Gender difference found in this study implies that, the teacher need to structure the classroom activities in such a way that both genders are allowed freedom to participate in science classes using a variety of activities, reinforcement and feedback. It is important for teachers to work towards a classroom where responsibilities are shared with students (male and female). This means that teachers should encourage students to manage their own learning, engage in co-operative tasks so that gender disparity in students' achievement could be minimised

### **Conclusion and Recommendations**

Based on the finding of this study, it can be conclude that the academic achievement of students in sciences is satisfactory and above hypothetical pass mark and generally encouraging. Secondly, a positive, strong and significant relationship exists between students achievement in the sciences subjects, this means that, students who do well in Biology also did well in Chemistry, Physics and vice versa. Lastly, gender

differences in students' sciences achievement exists. This implies that there are distinguishing differences in the cognitive, affective and psychomotor achievements of students with respect to gender. Additionally, science subjects at the senior secondary school level prepare students for the study of science-oriented courses at the higher institutions. Thus, courses such as medicine, engineering, pure sciences, physical sciences would continue to attract more male.

Based on the findings of this study and considering the vital role of sciences in our educational system it is recommended that;

- 1) Teachers and other stake holders should pay a special attention to encourage and motivate students to develop a good study habit in order to improve their academic achievement in sciences.
- 2) Authorities should provide schools with high quality science instructional materials. Teaching with instructional materials is likely to improve sciences teachers' classroom interactions.
- 3) Teachers may need to be more sensitive with the different needs of the male and female students. Therefore, caution has to be placed when teaching both genders.
- 4) Authors of science textbooks and curriculum developers should shift emphasis from teachers' activities to students' activities that will promote learning by doing.
- 5) A study should be conducted to evaluate the quality of on the Kano State Qualifying Examinations items to ensure standardization for better performance in external examination
- 6) Lastly, further research should be conducted to establish other factors which determine students' academic performance in science.

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