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Assessment of students performances in biology: Implication for measurements and evaluation of learning

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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 biology and gender difference in students' achievement was examined. Ex-post facto design of descriptive research was adopted for the study. A proforma was used to collect data from a sample of two hundred (200) students, selected using stratified random sampling procedure from the Science secondary schools in Kano state Nigeria. The data collected were the students' performances in biology achievement tests. The data were analysed using descriptive statistics and independent-sample t-test. Overall results showed that the test internal consistency reliability is low and unsatisfactory; the students performed below average (M=47.02, SD=16.493 (47%). Similarly, gender difference exists in biology performance with another significant difference between performance of urban and rural school students. The study concludes that, biology test used in Kano state qualifying examinations to assess students potential ability in biology is not a reliable measurement tool and that, academic performance of students in biology is unsatisfactory and evidence of differential performance between gender and schools locations. The implication for measurements and evaluation of learning as well as recommendations has been discussed.

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1. INTRODUCTION

Education is regarded as a key that unlocks the development of potential personal and national values and all other kinds of rights and powers in the world. Education is the only tool that can guarantee all aspect of human development which includes economic growth, social development, environmental protection, scientific development and employment opportunities in an equitable manner.

Secondary school education in Nigeria refers to the form of education, which children receive after primary education and before the tertiary level [1]. The importance of secondary education in educational system cannot be overemphasized. The broad aims of secondary school education in Nigeria, as stated in the National Policy of Education [2], are to prepare the individual child for (i) useful living in the society; and (ii) for higher education. In reality these aims are very often defeated as most secondary school graduates fail to adapt adequately to society and fail to succeed in post-secondary education, despite their possession of excellent or good certificates.

The federal government of Nigeria in order 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, biology is one of the important subjects that, formed part of the requirement for admission especially in pure and social sciences programmes and it is part of general studies (science technology and society) for students in many fields of studies in Nigerian colleges, Polytechnics and universities [3]. Similarly [4] revealed that 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. Report indicated that, low level of students' achievement in biology at the senior school certificate examinations was due to lack of qualified teachers, low level of interest and commitment on the part of students, the nature of some of the topics, teachers poor knowledge of the subject matter, non-availability of resource materials and over loaded curriculum [5].

However approaches made towards understanding the concept of biology impose a negative attitude especially in the learning situation. The learning of biology is fast becoming an enormous task among student whose perception with regards to teaching and learning process, may lead to negative implication. The end of which is a poor performance standard.

Over the years the persistent senior secondary school students' low level of achievement in biology at the various public examinations in Nigeria has continue to attract the attention of major stakeholders in education. Performance of students in biology has consistently been unimpressive [6]. Despite all the considerable efforts made by policy makers 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)] SSCE indicates that, students achievement in biology at the senior secondary school level continue to decline [7].

The percentage of students that passed biology at credits was very low compared to the total entry. In 2014-33.9%, in 2015-28.6% and in 2016-33.9% throughout the examination results, the performance of biology students was always below 50% of the total number students who offered biology in the external examination [8-10]. In the years 2018 only 28% of the students passed biology at credit level [11]

Furthermore, the fallen trends in the performance of the student in biology result from factors neglected by some negative approaches taken by student toward achieving a better yield in the subject matter, moreover, the situation becomes apparent for the fact that the low performance of student were largely witnessed in the past few years also the situation equality witnessed an imposed, these were seen on the number of enrolment on Student in biology in most of our science secondary schools [12].

In Kano State, Nigeria, the state government usually conducts qualifying examination for all senior secondary school (SSS II) students, to assess their suitability for sponsorship to write the final examinations being conducted by the two public examining bodies in Nigeria [i.e. WAEC and NECO)] the main idea behind the conduct of this examination according to [6]. is to select those students who are found competent enough to take the senior secondary school certificate examination (SSCE) and also help to sharpen the student ability and prepare them for the final examination (SSCE). It has been observed that the qualifying examination provides a form of predictive validity on a candidate on his\her senior secondary school certificate examination. Although the Kano state qualifying examination is used as a criteria to sponsor students to write their final examination conducted by WAEC and NECO. However, there has been no evidence from the literatures that any study was conducted to assess the magnitude of students' performances' in this subject.

Therefore, gaining an appreciation of their performance in biology 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. Similarly, it is anticipated that, the findings of this research will give curriculum developers new insights into emerging issues on performance and influence the authorities on policy formulation. It is also expected that, students will benefit from the findings; because improved mathematics performance will give them opportunities to pursue sciences and other related courses in institutions of higher learning in the country.

The central point of this study entails an Assessment, appraised based on evaluation measures taken to assess the performance of student in biology qualifying examination. Trends in the past showed a downward decline in the performance of student in this discipline, thus the need to curb these trends becomes necessary which is possible when the implications to educational measurement and evaluation of classroom learning.

It is the objective of this study to investigate student performance in biology in some selected science secondary school with aim of achieving the following objectives:

- Examine the reliability coefficient (estimate of internal consistency) of the biology Examination

- Determine the overall secondary school students' performance in biology subjects
- Find out whether gender difference exist in the students' performance in biology
- Find out whether the schools location influences students' performance in biology in Kano

The following research questions guided the study:
- What is the reliability coefficient (Estimate of Internal Consistency) of the biology Examination?
- What are the levels of secondary school students' performances in biology?
- Is there any significant gender difference in the students' performance in in biology?
- Does schools location school influences students' performance in biology in Kano??

The following hypotheses were formulated and tested for the study:
Ho_1: There is no significant gender difference in secondary school students' performance in biology
Ho2: There is no significant difference in students' performance with respect to schools location.

2. RESEARCH METHOD

2.1. Research design

Ex-post-facto research design was employed to assess students' performance in biology. Ex-post-facto research is ideal for conducting research when is not possible to manipulate the characteristics of human participants. It can be used to test hypotheses about cause-and-effect or correlational relationships, where it is not practical to apply a true or even a quasi-experimental design [13]. The data to be used will be collected from the Kano State Sciences and Technical Schools Board.

2.2. Participants

The population of this study comprises all the senior secondary school (SSII) students in Kano state Sciences and Technical Schools who are ready to write their final examination. According to the Monitoring and Evaluation Unit of the Science and Technical Schools Board, the population of the students is twenty-three thousand, three and twenty (23,320). A sample of 200 senior secondary school sciences students was selected.

A stratified random sampling technique was used to select the required sample from the selected schools for the study. In a stratified random sampling procedure, the population is divided into strata (groups) that have similar characteristics, and the samples are drawn from each group [14, 15]. The distribution of the respodents are presented on Table 1.

Table 1. Distribution of participants

Gender	Frequency	Percentage
Male	89	44.5%
Female	111	55.5%

2.3. Instruments

The biology Achievement Test (BAT) constructed for Kano state senior secondary school qualifying examination will be used for this study. The BAT comprises of essay and 40 multiple choice items with five answer choices/options (A-E). The test items covered the whole senior secondary school biology syllabus prepared for SSCE by WAEC and NECO as well as the biology curriculum prepared by the Federal Ministry of Education in Nigeria.

2.4. Procedure for data collection

The Science Achievement Test (Biology) 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 2015. The data used are the scores obtained from the test after marking by teachers following the designed marking scheme. A proforma form, 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 at the Monitoring and Evaluation Unit of the Board.

2.5. Data analysis procedure

The data collected were analysed using SPSS 20v. The Mean, Standard Deviation and Independent Sample t-test statistics will be used. The level of significance was set at 0.05 for all statistical tests.

3. RESULTS AND DISCUSSIONS

The results of this study as explained in the preceding section of data analysis procedure are presented in form of descriptive and inferential analysis. Similarly, the results are presented under each research question and hypothesis and discuss in relation to the findings of other studies, expert opinions' and other validated assertions.

3.1. Research question 1: *What is the reliability coefficient (estimate of internal consistency) of the biology examination??*

To answer the above research question the responses of the examinees from biology test items were scored and used to conduct an item analysis to determine the internal consistency reliability of the test items. The result of the analysis is presented on Table 2 below.

Table 2. Internal consistency reliability of biology test

SN	Indicator	Value
1	Number of Item	60
2	Kuder Richardson (KR-20)	*0.620*
3	Cronbach's Alpha Based on Standardized Items	*0.617*
4	Mean Item Difficulty	0.56
5	Mean Item Difficulty	0.41

In an achievement, all the items of a certain domain must measure such construct not a different one. Similarly, items are dichotomously scored '1' correct '0' wrong. Moreover, in item analysis Cronbach's Alpha and Kuder-Richardson (KR-20 and 21) have the same procedure but KR-20, is reported for a dichotomous variables as in the biology test items. The overall internal consistency reliability of the test as measured by the KR-20 is 0.620, which is low in line with the [16], recommends acceptable value of 0.70. KR20 is generally considered to be a better reliability estimate than KR21 [17].

Finding on the reliability coefficient (Estimate of Internal Consistency) of the biology examination items revealed that, the items have low and unacceptable internal consistency reliability, this is because the reliability coefficient is lower than the recommends acceptable value of 0.70 [16]. Also as generally, established in the literature that, KR20 is considered to be a better reliability estimate than KR21 [17]. This means that, the biology examination can be considered as not a good and reliable tool to assess students' biology ability thus failed in satisfying its purpose. Similarly, test items with poor reliability value do not measure the same skill or ability or that they are confusing or misleading to examinees [18].

3.2. Research question 2: *What are the levels of secondary school students' performances in biology?*

To answer this question, mean and standard deviation with the percentage of the students' performances were computed and presented in Table 3 below.

Table 3. Performance of students in biology

SN	Indicator	Value (s)
1	Maximum Total Score	100
2	Number of Students	200
3	Mean Score	47.02
4	Standard Deviation	16.493
5	% Performance	47.02%

Information presented on Table 3 above reveals the mean students' academic achievement as measured by their performance in biology. The result revealed the mean performance of biology to be M=47.02, SD=16.493 (47%). This result shows that, students' achievement in the biology is below average (50%). Comparing the hypothetical pass mark of 40.00 with the students' mean scores of 57.02, the students performed above pass mark in this subject. This further shows that, the overall students' achievement in biology is below average. Moreover, considering the requirements for admission into higher institutions of learning in Nigeria at the credit level (50%), the overall secondary student achievement in biology is unsatisfactory and therefore did not meet the said standard.

This finding means that, the achievement of students in biology examination is well all below average as measured by the mean scores of the students in their academic performances in biology examination. the students achievements in in the subjects is below average and credit level (50%) which is

an indication that performance is unsatisfactory and did not meet the requirement for admission into higher institutions of learning in Nigeria.

3.3. Hypothesis 1: *There is no significant gender difference in students' performance in biology*

To test the above hypothesis the mean biology performances of male and female students were used to conduct a test of differences. The coefficient of the differences was determined using two tailed t-test at 0.05 level of significance as presented in Table 4 below.

Table 4. Difference between male and female performance

Sex	N	Mean	Std. Dev.	df	t-cal	sig. (2-tailed)	H_{O2}
Male	89	40.60	12.071				
				198	-9.45	0.00	Rejected
Female	111	51.08	9.360				

The descriptive statistics and a test for differences using the independent sample t-test obtained, as shown in Table 4, indicates that female students on the average performed better (M = 51.08, SD = 9.360) than male students (M = 40.60, SD = 12.071), Where t (198) = -9.45, p = 0.00, α = 0.05. The result of the analysis revealed the mean of female students is significantly higher than the mean of male. This implies that there is significant gender difference in secondary school students' performance in biology. The difference was in favour of female students, meaning that they performed better than male students in biology.

The finding shows that, the female have higher mean scores compared to male in their academic performances in biology. This gives an indication that the female performed better than male in biology. This difference in favour of female students is statistically significant. This finding is consistent with that of [19] 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 [20, 21] etc whose revealed that gender difference in science achievement has disappeared

3.4. Hypothesis 2: *There is no statistically significant difference in students' performance in biology with respect to schools location*

To test the above hypothesis the mean biology performances of Urban and Rural students were used to conduct a test of differences. The coefficient of the differences was determined using two tailed t-test at 0.05 level of significance as presented in Table 5 below.

Table 5. Students' performances with school location

Location	N	Mean	S.D	t	df	sig. (2-tailed)	H_{O1}
Urban	105	48.04	12.30				
				6.16	198	0.00	Reject
Rural	95	39.95	10.40				

The descriptive statistics and a test for differences using the independent sample t-test obtained, as shown in Table 5, indicate that Urban school students on the average performed better (M = 48.04, SD = 12.30) than Rural school students (M = 39. 95, SD = 10.40), Where t (198) = 6.16, p = 0.00, α = 0.05. The result of the analysis revealed the mean of Urban school students is statistically and significantly higher (t = 6.16, df = 198, two – tailed probability < 0.05) than the mean of Rural students. The null hypothesis which says there is no statistically significant difference in students' performance in biology with respect to schools location is therefore rejected since 0.00 < 0.05. This implies that there is significance difference in performance between Urban and Rural school students in biology. The difference was in favour of Urban, meaning that they performed better than rural school students in biology. This is evident in the fact that the mean scores recorded were 46.84 and 39.59 for Urban and rural school students respectively were significantly different. The conclusion is that urban school students do well in biology achievement test than and rural school students.

This result is possible since biology is taught at both urban and rural schools and is made for both conventional and sciences specialised schools, hence the students in the urban areas received adequate monitoring and inspections by authorities whose offices are centrally located in most urban areas, highly motivated with extra lessons and exposed to good study habits. Perhaps the availability of facilities in the urban centres has even made it possible for urban students to have access to modern facilities which rural

students may be lacking. These could help the urban students to favourable attitude towards biology which has manifested their high performance.

4. IMPLICATION FOR MEASUREMENTS AND EVALUATION OF LEARNING

The results from the present study have important concerns for measurements and evaluation of learning. The findings highlighted some important implications for educational measurements and evaluation of learning especially in the area of quality of the test items and item bias

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.

The results obtained through testing and test scores of this nature have an important use for the educational system of Nigeria. The results of score are used to make informed decision on the suitability of students for promotion and placement in appropriate position or class as the case may be. In such a situation the instrument used biology in this study should be of adequate quality to perform its expected roles. Unreliable nature of this test as revealed by the result of reliability test means the test lack a very essential feature to produce valid results that can support inferences and action, it is therefore an important challenge for the school administrators and measurement community to rise up to ensure that only valid and reliable instruments are used in assessing students true ability in Nigerian schools.

The biology test use in this study been administered to the heterogeneous samples in terms of gender and schools location revealed that, these different groups of students though at the same level of study and received instructions from the same curriculum content with almost the same facilities and resources has significantly differed in their performances. In normal circumstances even with the presence of psychological factors such a difference should not have been very significant; however, the significant difference obtained in this study might be as a result of presence of bias in the test items. This means that, some items favour one group of students over others which signify a presence of differential item functioning or item bias in the biology test used in this study. In educational; settings especially classroom, all decision are been made using test scores. Nigeria has been a heterogeneous state with diverse geographical locations, tribes and religion. The test items to be use in assessing students at all levels should be fair to all. Otherwise, if the test items are potentially biased like what might have led to differential performances in this study, then there is a major concern regarding the validity of scores to warrant a decision making process.

5. CONCLUSION

The study examine the performances of secondary school students in biology, on the basis of its findings, it can be conclude that the biology test used in Kano state qualifying examinations to assess students potential ability in biology is not reliable measurement tool based on its internal consistency coefficient and that, academic achievement of students in biology is below average and unsatisfactory though above hypothetical pass mark is generally discouraging. Secondly, gender differences in students' biology achievement exists. This implies that there are distinguishing differences in the cognitive, affective and psychomotor achievements of students with respect to gender and schools locations. Additionally, biology 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, pure sciences and paramedical sciences would continue to attract more female.

6. RECOMMENDATIONS

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

a. Biology test items used in assessing students' performances in Kano state qualifying examinations should be, made to pass through all process of standardization. This will help in addressing the silent issue of test bias raised in this paper and properly addressed reliability and validity inadequacy found in the instrument. When these steps are properly followed, the instrument would be valid and reliable to make inferences and decision with regards to students' ability and justification of the attainment of the objective spelt out in the curriculum.
b. Policy makers should promote programmes and provide facilities that could be used in teaching biology that would help remove the dreaded difficult areas in biology. Similarly, they should ensure strict adherence to the assessment policies and procedures spelt out in the curriculum.

c. Biology teachers should adopt the innovative teaching strategies in teaching some of the difficult topics in biology and should present the difficult concepts in clearer terms starting from simple to complex.
d. 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 biology.

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