A Study of the Enrolments and Achievements of Male and Female Students in Integrated Science in Colleges of Education in Nigeria: Implications for Basic Science Education in Nigeria

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Abstract—The purpose of the study was finding out if differences exist in the enrolments and achievements of male and female students' in integrated science in colleges of education in Nigeria. The populations of the study are all the students' that enrolled and studied integrated science in colleges of education in Nigeria. The sample consisted of 839 students', made up of 129 males and 710 females. The sampling technique was purposive. The design of the study was ex-post-facto. The instruments for data collection were students' enrolment lists and integrated semester results for 2014-2018. The, semester results were selected by cluster, and as well, simple random sampling techniques. Two research questions and two hypotheses posed for the study. Mean, standard deviation, t-test and Z-test statistics at 0.05 significant levels were used to analyze the data collected. The results obtained showed that differences exist in the enrolments and achievements of male and female students' in integrated science, and these differences were not statistically significant. The observation above implies that there are no gender differences in the enrolments and achievements of male and female students' in integrated science in colleges of education in Nigeria. The researcher also highlighted the implications of the findings to the teaching and learning of basic science in primary and junior secondary schools in Nigeria. The researcher recommended, among another, that authorities of colleges of education in Nigeria shall endeavour to enroll, without discrimination, male and female candidates to study integrated science in their schools.

Index Terms— Achievement, enrolment, integrated science, female, male.

I. INTRODUCTION

Education is an instrument of change in any society. The National Policy on Education (FGN, 2013) emphasized that education is for all and a tool for national development. Equal education for males and females is crucial to develop a nation like Nigeria. Same knowledge in the sense of the study implies training where all males and females receive a quality education without discrimination. On the other hand, access to education involves making it possible for everyone who is entitled to learning to accept it. Hence, male and female, whether able or challenged, poor or rich, should be able to obtain an equal formal education. The colleges of education in Nigeria are teacher training institutions meant to train teachers at the Nigeria Certificate in Education (NCE) level to handle basic knowledge in Nigeria. It is open to male and female irrespective of status.

There have been enrolment differences between males and females in science subjects in Nigeria. In a study by Olatoye, Fatokun, Olasehinde and Abdulmalik (2016), female students' are under-enrolled in science subjects, with percentage enrolment as 31.8% and 31.6% respectively in senior secondary schools in Katsina State, Nigeria. Similarly, Onyekwelu (2019) found out in a study that male enrolment in STEM is significantly higher than that of females in Nigerian universities. Likewise, there are differences in the achievements of male and female students' in science subjects. For example, Amedu (2015) and Ezeudu and Obi (2013) found out in separate studies that males achieve more in Biology and Chemistry respectively than the females.

Moreover, over the years, the performances of students' in the senior school certificate examinations have not been satisfactory when compared with arts and social science subjects. The low performance of the students is due to weak foundations in science experienced by pupils and students' at the primary and secondary school levels. A major factor responsible for this weak foundation is the dearth of qualified basic science teachers. For example, Otarigbo and Oruese (2013) reported in a study that lack of specialist teachers in integrated science (basic science) is a problem of teaching integrated science in secondary schools in Warri, Delta State Nigeria. The situation is such that individuals who specialized in other fields of science and who lack the skills and integrated science methods called-up to teach basic science. These unspecialized teachers were not prepared for the demands of integrated science instruction. However, one of the main objectives of preparing teachers of integrated science is to enable students' acquire and demonstrate the intellectual-competence and professional skills necessary for the teaching of integrated science (now basic science) in primary and junior secondary schools in Nigeria (FGN, 2012). According to Islahi and Nasreen (2013), male and female teachers behave differently in the classroom, and students' may react differently to their teachers' behaviour.

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Therefore, any severe differences in the enrolments and achievements of male and female students' in integrated science in colleges of education will have some implications in the teaching and learning of basic science in primary and junior secondary schools in Nigeria. The interest of the researcher is to find out if differences exist in the enrolments and achievements of male and female students' in integrated science in colleges of education in Nigeria.

II. PURPOSE OF THE STUDY

The targets of the study were to find out if differences exist in the enrolments and achievements of male and female students' in integrated science in colleges of education in Nigeria.

III. RESEARCH QUESTIONS

The following research questions guided the study:
1. What difference exists in the total enrolments of male and female students' in integrated science in colleges of education in Nigeria?
2. What is the difference that exists in the mean achievement scores of male and female students' in integrated science in colleges of education in Nigeria?

IV. HYPOTHESIS

The following hypotheses were posed for the study:
$H_{o1:}$ The mean enrolment figure of the male students' does not significantly differ from the mean figure of the female students'.
Ho2: The mean achievement score of the male students' does not significantly differ from the mean achievement score of the female students'.

V. RESEARCH METHODS
A. Design of The Study: The plan of the study was ex-post facto. The plan was ex-post-facto because data collection instruments not developed by the researcher but in existence before the commencement of the study.
B. Area of the Study: The study took place in Federal College of Education Eha-Amufu, Enugu State of Nigeria.
C. The Population of the Study: All the students' registered to study integrated science in colleges of education in Nigeria constituted the population of the study.
D. Sample and Sampling Techniques: The sample of the study comprised of 839 students'. The 839 students were composed of 129 male and 710 female students. The students' were those that sat for and had results in semester examinations between 2014 and 2018. The sample was selected by purposive method.

E. Instruments for Data Collection: An instrument for data collection was the lists of registered students' in integrated science between 2014 and 2018. Another instrument was semester examination summary of students' results for 2014 to 2018. In the study, the researcher adapted cluster and simple random sampling techniques to select the semester results for the study. The use of cluster sampling technique was to ensure that at least a semester result for a given academic year chosen. The semester results put into five clusters: 2014/2015, 2015/2016, 2016/2017, 2017/2018 and 2018/2019. Simple random sampling technique was adapted to select a one-semester result from each group. The semester results selected were ISC 114 (Component of Environment 1) (2014/2015), ISC 122 (Processes of Life) (2015/2016), ISC 322 (Reproduction and Growth) (2016/2017), ISC 213 (Man and the Environment) (2017/2018) and ISC 211 (Components of the Environment 11) (2018/2019).

VI. METHODS OF DATA COLLECTION

As the lists of registered students bore the gender of the students', the number of male and female students' admitted were counted to get the total number of registered students for the selected periods, 2014 to 2018. Consequently, the total number of students' entered for Integrated Science between 2014 and 2018 were determined by adding up the enrolment figures of male and female students'. The difference between the enrolment figure of male students and that of the female students was calculated to determine if difference exists in the enrolment of male and female students' in integrated science. The researcher concluded the total scores of the students in the selected courses with the first and second semester summaries of students' results. The overall scores identified from the selected integrated science courses. Subsequently, the researcher calculated the mean achievement scores (MAS) of male and female students' in integrated science. To do this, the raw scores of all the male students', as well the female students' in all the selected courses summed up to get the total score for the male students' and female students' respectively. The overall rating obtained for the male and female students' was divided by the total number of male students' and female students' respectively, to get the mean achievement score for each category. The Z-test and t-test carried out to test the hypotheses at 0.05 significant levels.

VII. DATA ANALYSIS METHODS

The researcher analyzed data collected with mean, standard deviation, t-test and Z-test. The t-test tests the

significance of the difference in the enrolment figures of male and female students' in integrated science. The t-test was applied because the number of cases (years considered for enrolment of students') was less than thirty (30) (Nworgu, 2006). The Z-test tests the significance of the difference in the mean achievement of male and female students' in integrated science. The z-test was applied because the number of cases (total number of male and female students' respectively) was higher than thirty (30) (Nworgu, 2006). The following formulae applied for mean, standard deviation, Z-test and t-test, respectively (Nworgu, 2006):

$$\text{Mean } (\ddot{X}) = \frac{\Sigma fx}{\Sigma f}$$

Where Σ = sum of; x = score and f = frequency

$$\text{Standard deviation (SD)} = \sqrt{\frac{\Sigma f(X-\ddot{X})}{N}}$$

Where Σ = sum of; X = sum of; N = score number

$$Z = \frac{\ddot{X}_1 - \ddot{X}_2}{S_D\dot{x}}$$

Where $\ddot{X}$ = mean score; and $S_D\dot{x}$ = standard error between means.

Decision rule: Reject H_o if Z_{cal} is higher than Z_{tab}, otherwise do not reject H_o.

$$t = \frac{\ddot{X}_1 - \ddot{X}_2}{S_{Dx}}$$

Where $\ddot{X}$ = mean score; S_{Dx} = standard error between means.

Decision Rule: Reject H_o if t_{cal} is higher than t_{cal}, otherwise do not reject H_o.

VIII. . RESULTS

Research Question 1: What difference exists in the total enrolments of male and female students' in integrated science in colleges of education in Nigeria?

Table 1: Enrolments of male and female students' in integrated science.

S/N	Year	Males	Females	Total	Enrolment Differences
1	2014	42	177	219	135
2	2015	25	200	225	175
3	2016	28	158	186	130
4	2017	20	150	170	130
5	2018	18	187	205	169
	Total	**133(13.2%)**	**872(86.8%)**	**1,005(100%)**	**739(73.6%)**

Source: Department of Integrated Science, Federal College of Education, Eha-Amufu, Enugu State Nigeria.

Table 1 showed that a total of 1,005 students' registered in integrated science in Federal College of Education, Eha-Amufu, Enugu State of Nigeria between 2014 and 2018. Out of the 1,005 students' 133(13.2%) were males and 872(86.8%) were females. The total enrolment difference of 739(73.6%) indicates that variation exists in the total enrolments of male and female students' in integrated science in favour of the females.

Research Question 2: What difference exists in the mean achievement scores of male and female students' in integrated science in colleges of education in Nigeria?

Table 2: Mean achievement scores of male and female students' in integrated science

S/N	Course	Title	Academic year	Males		Females		Mean Score Difference
				No	T. Score*	No	T. Score*	
1	ISC 114	Components of the Environment 1	2014/2015	37	2,108	161	9,516	
2	ISC 122	Processes of Life	2015/2016	25	1,449	198	11,464	
3	ISC 322	Reproduction and Growth	2016/2017	35	1,862	150	8,339	
4	ISC 213	Man and the Environment	2017/2018	14	931	122	8,256	
5	ISC 221	Components of the Environment 11	2018/2019	18	725	80	5,115	
		Total		**129**	**7,075**	**711**	**42,690**	
		Mean Score		**54.8**		**60.04**		**5.24**

*T. Score: Total Score

In Table 2, the mean achievement score (MAS) for male students' was 54.8, while that of female students' was 60.04. The mean score difference of 5.24 suggests that variation exists in the mean achievement scores of male and female students' in integrated science.

Null hypothesis H_{01}: The mean enrolment figure of male students' does not significantly differ from the mean enrolment figure of the female students'.

Table 3: The result of the t-test analysis of the difference in the enrolments of male and female students' in integrated science.

Gender	Mean	SD	n	Degree of Freedom	Standard Error	t_{cal*}	t_{tab**}
Males	26.6	8.48	5	8	119.78	-1.234	2.31
Females	174.4	18.41	5				

*t_{cal} = Calculated t-value; **t_{tab} = Tabulated/Critical t-value ; SD= standard deviation; n= number of cases (academic year).

The t-test result shown in table 3 shows that the calculated t-value is -1.234, while the table or critical value is 2.31. Since the calculated t-value (t_{cal}) is less than the table t-value (t_{tab}), the null hypothesis, H_{01}, was not rejected. The above result implies that the difference between the enrolments of male and female students' in integrated science is not statistically significant.

Null Hypothesis, H_{o2}: The mean achievement score (MAS) of the male students' is not significantly different from the mean achievement score of the female students' in integrated science.

Table 4: The result of Z-test analysis of the difference in the mean achievement score (MAS) of male students' and that of female students' in integrated science.

Gender	Mean	SD	n	Standard Error	Z_{cal*}	Z_{tab**}
Males	54.8	16.28	129	2.44	-2.475	1.96
Females	60.4	16.66	711			

*Z_{cal} = Calculated Z-value; **Z_{tab} = Tabulated/Critical Z-value

The Z-test result in table 4 showed that the calculated value of Z (-2.475) is less than the table or critical value of t (1.96); hence the null hypothesis, H_{02}, was not rejected. The above observation suggests that the mean achievement score of male students' is not significantly different from the mean achievement score of the female students' in integrated science.

IX. DISCUSSION AND IMPLICATIONS TO BASIC SCIENCE EDUCATION IN NIGERIA

The result of the study shown in table 1 suggests that difference exists in the enrolments of male and female students' in integrated science. The t-test result shown in table 3 indicated that the observed difference is not statistically significant. The insignificance of the variation implies that there is no gender imbalance in the registrations of male and female students' in integrated science in colleges of education in Nigeria. The admissions of male and female students' in integrated science are vital in the teaching and learning of basic science in primary and junior secondary schools. Male and female students' enrolments imply potential male and

female graduates of integrated science who will teach basic science in primary and junior secondary schools. Male, and as well the female is naturally endowed with psychological and physical attributes that influence teaching and learning. According to Islahi and Nasreen (2013), female teachers exhibit good teaching qualities such as being more supportive, expressive, spending more time with the students' and involving students' more in their learning. On the other hand, male teachers' tend to be dominant, exerting more control on the students' and encourages group work by the students'. These characteristics of male and female teachers are collectively necessary to effectively impart knowledge and skills of basic science to pupils' and students' in the primary and junior secondary schools in Nigeria.

Result of the analysis, as shown in table 2, suggests that difference exists in the mean achievement scores of male and female students' in integrated science. Still, the results of Z-test shown in table 4 indicate that the observed difference is not statistically significant, meaning that male and female students' have the potentials or the ability to perform well in integrated science. Achievement, which is a measure of the knowledge and skills acquired by students', is necessary for basic science education. The most common indicator of success is a student's performance in academic areas as measured by achievement tests (Cunningham, 2012). Male and female teachers are needed to implement the basic science curriculum successfully. Modern teaching in basic science demands high-quality male and female teachers who possess the knowledge and skills to meet the demands of quality education. With qualified male and female teachers, pupils and students' in primary and junior secondary schools will gain full and balanced learning experiences in basic science. According to Darling-Hammond, quality of teachers is related to improvement in students' performance.

X. CONCLUSION AND RECOMMENDATIONS

The results of the study indicate that no significant differences exist in the enrolments and achievements of male and female students' in integrated science in colleges of education in Nigeria. The findings are vital in the teaching and learning of integrated science because qualified male and female teachers are needed to effectively implement the basic science curriculum in primary and junior secondary schools in Nigeria. As a result of the findings of the study, the researcher made the following recommendations:

- Authorities of colleges of education in Nigeria should enroll, without discrimination, male and female candidates to study integrated science in their schools.
- Employers of teachers should recruit both male and female graduates of integrated science to teach basic science in their schools.

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