Comparative Study of the Academic Performances in Biology, Chemistry and Physics of Male and Female Students in a Nigerian Tertiary Institution

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Abstract

The study examines the academic performance of students in Biology, chemistry and physics in relation to their gender effect among the Nigeria Certificate in Education (NCE) students of Federal College of Education, Zaria,Kaduna State, Nigeria. A total of 2,884 students comprising 1,349 males and 1,105 females registered in 2009/2010, 2010/2011 and 2011/2012 academic sessions were used for the study. The study adapts an ex-post-facto research design to analyze existing data without any manipulation. The study also used the final cumulative grade point average (CGPA) of students' examination results in 2011/2011, 2012/2013 and 2013/2014 respectively, obtained from the examination officers of each department for the analysis. Descriptive, Analysis of variance (ANOVA) and independent t-test statistics were used to test the hypotheses at 0.05 levels of significance. The findings of the study revealed that there was no significant difference between the academic performance of students in Biology, Chemistry, Physics and overall science in the studied period except in Biology 2011/2012 session. There was also no gender disparity in the students' performance in all the subjects and overall science. It was recommended among others that admission of students into Colleges of Education and other Nigerian tertiary institutions should be done without gender bias.

Keywords: Effect, Gender, Academic performance, Biology, Chemistry, Physics, College of Education.

1.   Introduction

Colleges of Education are among the tertiary institutions that train teachers for the primary, junior and secondary schools in Nigeria. They are in greatest number among teacher training institutions in the country (Nneji, 2012). The Federal Government of Nigeria through the National Policy on Education (2004) proscribes the NCE as the minimum qualification for all teachers in our schools with the aim to produce quality teachers. This is particularly important because the success of any educational system is dependent on the quality of teachers who implement it. The Federal Government of Nigeria (FGN, 2004: 39) states that no education system may rise above the quality of the teachers who operate it. Teachers drive educational policies and curricula; if the teacher is weak or incompetent, the result will be weak or dysfunctional educational outcome (Offorma, 2012).

This may be the case with the female science teachers produced in Colleges of Education in Nigeria. The implication of this if determined empirically is not good for the country. Science rules the world. Science education lays foundation to work in science-related fields in acquainting learners with certain knowledge and skills (Olatoye, 2000). The integration of science subjects such as Biology, Chemistry and Physics into the Minimum Standard of Colleges of Education is in recognition of the intrinsic values of these subjects in all spheres of human activity. Their teaching and learning should be such as to produce competent, effective and efficient teachers irrespective of gender who having acquired the requisite skills, should be able to impart same to their pupils/students. However, it has been observed (Arighabu and Mji, 2004), that gender bias is still very prevalent particularly in science. Gender is one of such factors that have considerable effects on students' academic performances especially in science subjects (Adigun, Onihunwa, Irunokhai, Sada, and Adesina, 2015).

Gender differences in academic achievements of students have been examined over the years with conflicting results. For instance, it has been reported (Peterson and Fennema, 1985) that in general, males out performed females in Mathematics during the school years. Ayodele (2001) reported that male students performed better than female students with larger differences in Physics. The findings of Billings (2001), Okebukola (2002), Bamidele, Odusola and Dibu – Oyerinde (2006), Kolawole (2007), Aguele and Uhumaiah (2008) and Lawal and Jiya (2012) also found in their separate studies at various times that male students achieved significantly better than female students in different science subjects studied. Ezeliora (1998), Christine (2004), Umar (2008) and Amoo (2011) in their separate studies were of a different view that the performances of female students in science subjects studied were better than that of the male counterparts.

In another conflicting view also, Oguboyede (1996), Abe (2004), Bichi (2004), McGreith and Lapointe (2005), Atadoga (2005), Lynn and Jaan (2008), Lawal (2009) and Olasehinde and Olatoye (2014) indicated that there was no significant differences in achievements between male and female students in their various science subjects studied Ayodele (2009) also revealed that significant difference was detected in students' science (Mathematics and Integrated science) but there was no significant difference between male and female students

in private and public schools.

Generally in Nigeria if not Africa as a whole, it is a belief that male students are at the forefront when compared to the female counterparts (Adigun, OnihunwaIrunokhai, Sada and Adesina, 2015). Most of these literature on gender differences strikingly are based on findings from secondary schools. If these findings were also to be obtainable in Colleges of Education in Nigeria, the implication is that the female student teachers produced will be of lower quality than the male students and may be incompetent to impart the knowledge of science to the teeming population of their pupils/students. National Bureau of Statistics (2016) reported that in 2014, there were 11,874 public junior secondary schools with the total student enrolment of 4,434,979 and 62,906 public primary schools with the total pupil enrolment of 23,129,927 in Nigeria. It is against this background that this study was undertaken to empirically determine the academic performance of students in Biology, Chemistry and Physics at the Nigeria Certificate in Education level of tertiary institutions at Federal College of Education, Zaria, Kaduna State, Nigeria with the aim to ascertain the real effect of gender on their performance.

1.1   *Objectives of the Study*
The objectives of the study include the following:
  i.   To examine the difference in the academic performance of students in Biology in the period studied.
  ii. To determine the difference in the academic performance of male and female students in Biology.
  iii. To examine the difference in the performance of students in chemistry in the period studied.
  iv. To determine the difference in the academic performance of male and female students in Chemistry
  v.   To examine the difference in the academic performance of students in Physics in the period studied.
  vi. To determine the difference in the academic performance of male and female students in Physics
  vii. To evaluate the difference in the academic performance of overall students in Biology, Chemistry and Physics (Science) in the period studied.
  viii. To evaluate the difference in the academic performance of overall male and female students in Science.

1.2   *Research Questions*
The following research questions become imperative:
  i.   What is the difference between the performances of students in Biology in the period studied?
  ii.   To what extent do the performances of male female students differ in Biology?
  iii. What is the difference in the performance of students in Chemistry in the period studied?
  iv.   To what extent do the performances of male and female students differ in Chemistry?
  v.   What is the difference in the performance of students in Physics in the period studied?
  vi.   To what extent do the performances of male and female students differ in Physics?
  vii. What is the difference in the performances of overall students in Science in the period studied?
  viii. To what extent do the performances of overall male and female students differ in Science?

1.3   *Research Hypotheses*
The following research hypotheses were formulated:
  i.   There is no significant difference in the academic performance of students in Biology in the period studied.
  ii.   There is no significant difference in the academic performance of male and female students in Biology.
  iii. There is no significant difference in the academic performance of students in Chemistry in the period studied.
  iv.   There is no significant difference in the academic performance of male and female students in Chemistry.
  v.   There is no significant difference in the academic performance of students in Physics in the period studied.
  vi.   There is no significant difference in the academic performance of male and female students in Physics.
  vii. There is no significant difference in the academic performance of the overall students in Science in the period studied.
  viii. There is no significant difference in the academic performance of the overall male and female students in Science.

2.   Methodology
2.1   *Research Design*
This study adopted an ex-post-facto research design in which the dependent and independent variables have already occurred and the researchers cannot manipulate them.

2.2   Population and Sampling Technique

All the NCE students in the Federal College of Education, Zaria, Kaduna State that were registered for 2009/2010, 2010/2011 and 2011/2012 sessions and graduated in 2011/2012, 2012/2013, and 2013/2014 academic sessions respectively, constituted the population for the study.From this population, a sample was drawn using the purposeful sampling technique which was considered the most appropriate. Those selected were all the Biology Chemistry and Physics students with a total number of 2,884 comprising 1,349 males and 1,105 females.

2.3   Instrumentation and Data Collection

The only instrument used was the documentary source. The data were the students final examination results in 2011/2012, 2012/2013 and 2013/2014 academic sessions obtained from the examination officers of Biology, Chemistry and Physics departments. The score and gender of each student were recorded accordingly.

2.4   Data Analysis

Descriptive and One Way Analysis of Variance (ANOVA) statistics were used to determine the difference between the academic performances of the students in each of the subjects and combined subjects. T-test statistics was also used in the data analysis for the determination of the gender-based performances of the overall students in the combined subjects. All data were analyzed at $p \leq 0.05$ level of significance with statistical package of version IBM 23. Each item is presented on a table for clarity of purpose.

3   Presentation of Results

Hypothesis 1:

There is no significant difference between the academic performances of students in Biology in the period studied.

Table 1a.Descriptive and Analysis of Variance (ANOVA) of the difference between the academic performances of all students in Biology in the period studied

Descriptive

	N	Mean	Std. Deviation	Std. Error
2011/2012	101	2.5743	1.03292	.10278
2012/2013	133	2.8195	1.02864	.08919
2013/2014	132	2.9242	1.03098	.08974
Total	366	2.7896	1.03738	.05422

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7.196	2	3.598	3.387	.035
Within Groups	385.605	363	1.062		
Total	392.801	365			

Scheffe

Year	N	Subset for alpha = 0.05	
		1	2
2011/2012	101	2.5743	
2012/2013	133		2.8195
2013/2014	132		2.9242
Sig.		.184	.734

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 120.021.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Results of the descriptive and ANOVA statistics of the difference between the academic performances of students in Biology presented in Table 1a show that the calculated p-value of 0.04 is lower than the0.05 alpha levels of significance and the computed F-value of 3.39 is higher than the critical F-value of 2.60. Their computed mean academic performances in the three academic sessions studied were 2.57, 2.82 and 2.92 respectively. The Sehefe post hoc homogeneous subset put the means of 2011/2012 session in the least subset 1 while the means of 2012/2013 and 2013/2014 sessions were put in higher significant subset 2. This shows that

the academic performance of all students in Biology were significantly higher in 2012/2013 and 2013/2014 academic sessions than in 2011/2012 session. Therefore the null hypothesis which states that there is no significant difference between the academic performances of students in Biology in the academic sessions studied is hereby rejected and the alternative is accepted.

Hypothesis 2

There is no significant difference between the academic performance of male and female students in Biology

Table 1b. T-test statistics of the gender based performances of students in Biology

Variable	Types	N	Mean	STD	Std.Err	Mean Difference	df	t calculated	t critical	p
	Male	258	2.8411	1.07769	.06709					
Performance in Biology+						0.174	364	1.469	1.96	0.143
	female	108	2.6667	.92726	.08923					

Table 1b shows that the calculated p-value of 0.14 is higher than the 0.05 alpha level of significance and the computed t-value of 1.47 is lower than the critical t-value of 1.96 at degree of freedom (df) of 364. Their computed mean academic performances are 2.84 and 2.67 for male and female students respectively which indicates an insignificant difference. This shows that the null hypothesis which states that there is no significant difference between the academic performance of male and female students in Biology was accepted and retained.

Hypothesis 3

There no significance difference between the academic performances of students in Chemistry in the period studied.

Table 2a.Descriptive and ANOVA statistics of the difference between the academic performances of all students in Chemistry in the period studied

Descriptive

	N	Mean	Std. Deviation	Std. Error	Maximum
2011/2012	182	2.7692	1.00910	.07480	5.00
2012/2013	211	2.6445	1.13461	.07811	5.00
2013/2014	228	2.5263	1.14738	.07599	5.00
Total	621	2.6377	1.10678	.04441	5.00

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.987	2	2.994	2.455	.087
Within Groups	753.491	618	1.219		
Total	759.478	620			

Table 2a shows the descriptive and ANOVA statistics of the difference between the academic performances of students in Chemistry in the three academic sessions studied. The results show that the calculated p-value of 0.09 is greater than the 0.05 alpha levels of significance and the computed F-value of 2.46 is lower than the F-critical value of 2.60. The computed mean academic performances in the three academic sessions are 2.77, 2.64 and 2.53 respectively which indicate an insignificant difference. Therefore the null hypothesis which states that there is no significant difference between the academic performances of students in the studied sessions is hereby accepted and retained.

Hypothesis 4

There is no significant difference between the academic performance of male and female students in Chemistry.

Table 2b. T-test statistics of the gender based performance of students in Chemistry

Variable	Types	N	Mean	STD	Std.Err	Mean Difference	df	t calculated	t critical	p
	Male	327	2.6606	1.15557	.06390					
Performance in chemistry						0.483	619	0.543	1.96	0.588
	Female	294	2.6122	1.05124	.06131					

Table 2b shows that the calculated p-value of 0.59 is greater than the 0.05 alpha level of significance and the computed t-value of 0.54 is lower than the critical t-value of 1.96 at df 619. Their computed mean academic performances are 2.67 and 2.61 for male and female students respectively. This shows that the null hypothesis which states that there is no significant difference between the academic performance of male and female students in Chemistry was accepted and retained.

Hypothesis 5

There is no significant difference between the academic performances of all students in Physics in the period studied.

Table 3a. Descriptive and ANOVA statistics of the difference between the academic performances of all students in Physics in the period studied

Descriptive

	N	Mean	Std. Deviation	Std. Error
2011/2012	513	2.6511	.97482	.04304
2012/2013	287	2.7526	.95243	.05622
2013/2014	377	2.8011	.98941	.05096
Total	1177	2.7239	.97558	.02844

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5.202	2	2.601	2.141	.075
Within Groups	1114.057	1174	.949		
Total	1119.259	1176			

Table 3a reveals the descriptive and ANOVA of the difference between the academic performance of students in Physics in the three academic sessions studied. The results show that the calculated p-value of 0.08 is greater than 0.05 alpha levels of significance and the computed F-value of 2.14 is lower than the F-critical value of 2.60. In addition, the students' computed mean academic performance in the three sessions studied are 2.65, 2.75 and 2.80 respectively indicating insignificant difference. Therefore the null hypothesis which states that there is no significant difference between the academic performances of all students in Physics in the academic sessions studied is hereby accepted and retained.

Hypothesis 6

There is no significant difference between the academic performance of male and female students in Physics.

Table 3b. T-test of the gender based performances in Physics

Variable	Types	N	Mean	STD	Std.Err	Mean Difference	df	t calculated	t critical	p
	Male	621	2.7359	1.01337	.04067					
Performance in Physics						0.025	1175	0.447	1.96	0.655
	female	556	2.7104	.93228	.03954					

Table 3b reveals that the calculated p-value of 0.66 is greater than the 0.05 alpha level of significance and the computed t-value of 0.45 is lower than the t-critical value of 1.96 at df1175. Their computed mean academic performances also are 2.74 and 2.71 for the male and female students respectively which show insignificant difference. This shows that the null hypothesis which states that there is no significant difference between the male and female students in Physics was accepted and retained.

Hypothesis 7

There is no significant difference between the academic performances of overall students in Science in the period studied.

Table 4a.Descriptive and ANOVA of the difference between the academic performances of overall students in Science

Descriptive

	N	Mean	Std. Deviation	Std. Error
2011/2012	796	2.6683	.99080	.03512
2012/2013	631	2.7306	1.03295	.04112
2013/2014	737	2.7381	1.05710	.03894
Total	2164	2.7103	1.02609	.02206

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.232	2	1.116	1.060	.347
Within Groups	2275.101	2161	1.053		
Total	2277.332	2163			

The descriptive and ANOVA of the difference between the academic performance of overall students in

Science in the three academic sessions studied presented in Table 4a reveal that the calculated p-value of 0.35 is greater than the 0.05 alpha level of significance and the computed F-value of 1.06 is lower than the F-critical value of 2.60. Their computed mean academic performance in addition are 2.67, 2.73 and 2.74 in the 2011/2012, 2012/2013 and 2013/2014 academic sessions respectively which show insignificant difference. Therefore the null hypothesis which states that there is no significance difference between the academic performances of overall students in Science in the period studied is hereby accepted and retained.

Hypothesis 8

There is no significant difference between the academic performances of overall male and female students in Science

Table 4b. T-test of the gender-based performances of overall students in Science

Group Statistics

	gender	N	Mean	Std. Deviation	Std. Error Mean
performance	male	1205	2.7394	1.06756	.03075
	female	402	2.6269	1.01857	.05080

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.872	.351	1.851	1605	.064	.11255	.06080	-.00669	.23180
Equal variances not assumed			1.895	716.709	.058	.11255	.05939	-.00404	.22914

Table 4b reveals that the calculated p-value of 0.36 is higher than the 0.05 alpha levels of significance and the computed t-value of 1.85 is lower than the t-critical value of 1.90. Their computed mean academic performances also are 2.74 and 2.63 for the male and female students respectively. This shows that the null hypothesis which states that there is no significant difference between the overall male and female students in Science was accepted and retained.

4.   Discussion of Results

Tables 1a, 2a, 3a, and 4a reveal that there were no statistically significant difference in the academic performances of students in Chemistry, Physics and overall Science in the NCE level in Federal College of Education, Zaria in the period studied. There is however significant difference in the performances of students in Biology. This is as a result of better performances of the students in the 2012/2013 and 2013/2014 sessions than in 2011/2012 session. Sequential better achievement of students could be attributed to the conducive learning environment the students have been exposed to and which has continued till present. Ajayi, Ekundayo, & Osalusi (2010) and Lakpini & Atadoga (2012) empirically attested that learning environment has direct influence on students' academic performance.

Results from Tables 1b, 2b, 3b and 4b further goes to reveal that the male and female students of the tertiary institution studied have no significant difference also in their Biology, Chemistry, Physics and overall Science performances even though the male students had slightly higher mean scores than the female students in all cases. This finding supports those of Olasehinde and Olatoye (2014) and Tambaya, Subitu & Mutazu (2016) who also found no gender differences in the performance of students in the same subjects and overall Science in Katsina State, Nigeria. The finding is also in agreement with the works of Irheogbu (1998); Abe (2004); Bichi (2004); McGreith & Lapointe (2005); Atadoga (2005); Lynn and Jaan (2008) who also indicated that there was no significant difference in the performances between the male and female students in their various science subjects studied.

This finding however negates the findings of Ayodele (2001); Raimi & Adeoye (2002). Kolawole (2002); Okwo & Otumba (2007); Umar (2008); Amoo (2011) and Olorunkooba, Lawal & Jiya (2012) who asserted significant differences between male and female students' performances and vice versa in science subjects studied.

5. Conclusion

The study compared the performance of students in Biology, Chemistry, Physics and overall Science at the NCE level in Federal College of Education, Zaria in 2011/2012, 2012/2013 and 2013/2014 academic sessions. Based on the findings of the study, there is no significant difference in the academic performance of students in Chemistry, Physics and overall Science; significant difference however exits in the performance of students in Biology in the period studied. The study further reveals that these achievements of students in the subjects and overall science show no gender disparity since male and female students performances were at par implying that there are no longer distinguishing differences in the academic performances of students in respect to gender. This also implies that the belief that male students perform better than the female counterpart in science subjects does not hold at the NCE level in Federal College of Education, Zaria (and perhaps in all the other Colleges of Education) as in other tertiary institutions in Nigeria as suggested in literature. It further supports global trending literature on the narrowness of gender gap between students' achievements in all levels of educational institutions. This may not be unconnected with the encouragement in various forms from the different levels of Nigerian Government, Non-Governmental Organizations (NGOs) and concerned individuals/ Philanthropists, given to the girl child to develop positive attitudes towards science education.

6. Recommendations

Based on the findings of this study the following recommendations were made:
1. Admission of students into Colleges of Education and other Nigerian tertiary institutions should be done without gender bias.
2. There should always be provision for well qualified teachers who will teach the science subjects with suitable teaching strategies in Colleges of Education and other tertiary institutions to continuously improve the performance of student teachers and sustain the gender equality.
3. Adequate facilities should be provided by the relevant authorities for the teaching and learning of all science subjects in Colleges of Education and other Nigerian tertiary institutions.
4. Female students in Colleges of Education and other Nigerian tertiary institutions, should be encouraged to read Science through special awards of scholarship by philanthropists, State and Federal Governments so as to have more representations.

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