GENDER AND SCHOOL TYPE AS CORRELATES OF STUDENTS PERFORMANCE IN BIOLOGY, CHEMISTRY AND PHYSICS IN ONDO STATE, NIGERIA

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Abstract
Research has shown that the provision of equal educational opportunity to male and female children in different school types has not been substantially met in area of Science Education. This study investigated gender and school types as correlates of students' performance in Senior Secondary Schools in Biology, Chemistry and Physics. Descriptive survey research design was used for the study. A total of 1080 science students and was used as samples. A Science performance test was used for data collection. Two Research questions were answered and one hypothesis was tested at 0.05 levels of significance, using t-test and Multiple Regression Analysis. The result revealed that male students performed better than their female counterparts in science subjects except in Biology (male = 10.06 and female = 10.03). The highest difference is in chemistry (7.09 for males and 5.22 for females) followed by physics (9.76 and 8.67 for males and females respectively).Male students in single-sex schools had higher overall performance mean scores (9.33) than female students (8.76) in co-educational, Also, female students in single sex schools performed better (8.10) than their male counterparts (7.92) from co-educational schools. School type has the most profound predictive strength on students' performance in Chemistry (B = 1.055). This is closely followed by Physics (B = .686); while the least came from Biology (B = -.189). It was therefore, recommended that gender and School type held potency in predicting academic performance of senior secondary schools students' science.

Keywords: Gender, School Types, Senior Secondary Schools Students, Performance in Science Subjects

Introduction

Science is the foundation upon which the bulk of present technological breakthrough is built. Science is also the bedrock for the production of the needed scientists, technologists, technicians and craftsmen who are required to turn the nation's economy around and usher in the technological advancement which is very much required for the elevation of Nigeria from a 'consumer' nation to a 'producer' nation. Acquisition of appropriate scientific skills is necessary to cope with the challenge presented by the evolving needs of the growing population. Therefore, teaching and learning of science that responds adequately to these demands from the foundation will contribute to efforts aimed at overcoming the growing unemployment and scientific illiteracy. It is against this background that science education has been accorded a prime position world-wide. Within the context of science education, chemistry, biology and physics has been identified as very important science subjects and their importance in scientific development of any nation has been widely reported (Adodo, 2007; Bell, 2008). They are pre-requisite for offering most other science subjects; a foundation to all science subjects. Through the application of science, man ensures the longevity of his existence.

Gender is seen as a socially ascribed attribute which differentiates female from male. Ayeni (2012) observed that difference in the performance of male and female students in science could be addressed using good methods, material and appropriate teaching strategies. Jack (2010) reported that many parents do not want to spend much on female education compared with that of the male child because of their (parents) social or cultural beliefs. This contributes to gender stereotype in schools. As soon as a child is born a female, people start limiting her possibilities, regardless of what she displays (Jackson, 2012). It is, therefore, not in doubt that from the beginning of civilization, women have suffered subjugation, degradation, oppression and all forms of in-human treatment on account of their gender (Avan 2007).

Several factors account for loss of interest in school work by females. Some of these are curriculum design and other educational materials as well as the teaching – learning approach (Duyilemi, 2005). It should be noted that scientific pursuit should not be only for males. This attitude, coupled with the bias of parents at home against science may not encourage female students to study science - based courses. Erinosho (2005) reiterated that past studies on gender and science have provided encouragement for females to offer science based studies. At the secondary school level, as earlier mentioned, the factors are biological, social and psychological. The biological refers to the constitutional make-up of females regarding the analytical, visual and spatial skills which are required need for abstract reasoning in science. The social- learning theory views the factors preventing females from studying sciences in different perspectives. It assumes that the child is being moulded by external forces to conform to an image through gender role socialization (Kelly, 2014). Children are socialized into assigned roles, right from infancy. No wonder females are found in domestic chores at home. At the school level, females are expected and encouraged to study feminine subjects such as languages, home economics and literature, which prepare them for expected adult role.

While males are oriented towards more challenging subjects like scientific related subjects.

Aremu (2010) reviewed a five - year (1980-1985) students' results in WASCE Agricultural Science, Biology, Chemistry and Physics and observed a low rate of performance. This made Aremu (2010) to identify factors militating against students' performance in school subjects especially female students. Such factors are categorized into external and internal factors. The external factors are those that are inherent in the child's home, school and the larger society. That is, the experience brought to school from home creates a wrong perception of certain natural phenomena that could be given scientific explanation. Pertinent and worthy of serious focus are the factors which emanate from learners themselves. Many Nigerian youths according to Aremu (2010), do not show enough interest in study generally and dread science in particular.

Proffering solutions to these problems, Kelly (2014) called for urgent need to overhaul the deplorable situation in our schools (especially public schools). The interest of teachers' needs to be regarded and attitude to work must be changed or modified using various behaviour modification strategies, such as employment of contingency management and shaping, and cognitive restructuring. She concluded by enumerating the use of guidance and counseling to handle militating factors that lie with learners. Ladele (2007) in her study on female students' performance in senior school certificate revealed low enrolment of females in physics and she opined that female representation in science will continue to remain low, unless steps are taken to address the issue at the secondary level, particularly at the junior secondary level. It is a common knowledge today that secondary schools' enrolment in science appears to favour male over female. The following table captures the enrolment of both sexes.

Table 1: Enrolment of Males and Females in Science: 2000-2012 at secondary school level.

	SCIENCE	
	Males	Females
1999/2000	6800	3500
2000/2001	9460	3924
2001/2002	10450	3650
2002/2003	8355	6517
2003/2004	13635	11680
2004/2005	13207	11231
2005/2006	11768	9874
2006/2007	2376	1976
2007/2008	8684	8684
2008/2009	1418	1376
2009/2010	1017	935
2010/2011	1147	1119
2011/2012	1059	1047

Source: Federal Office of Statistics 2013 Abstracts

The enrolment for three academic sessions gives a clear picture of female participation in science subjects for the period. This situation tends to agree with the findings of Aguele and Uhumuavbi (2003) that significant differences exist between male and female enrolment in science, up to the university level. Aguele and Uhumuavbi (2003) observed that gender differences in enrolment and performance in higher education are invariably rooted in inequality at the primary and secondary school levels where the real sorting of university - bound students takes place. According to Coombs, female participation and interest in science diminish as they move up in the educational ladder towards the university levels, due to a variety of factors that are primarily rooted in the attitude of the students towards science. The issue of low female participation in science seems to be a global issue. Other studies appear to be supportive of this position . For example, Croxford (2002), in a study on participation in science, engineering and technology in Scotland following the introduction of a new programme titled 'Science strategy for Scotland; observed that after taking account of attainment and science qualifications, females were less likely than males to study science and one quarter of students with two or more sciences at higher grade were studying medicine and dentistry or subjects allied to medicine. The proportion for science-qualified female was 35%.

The data in table 2 show the relationship between the total number of students that sat for NECO examination in Ondo state and their performance by gender.

Table 2: Percentage of Students that Sat for NECO Examination and their Performance by Gender in Science Subjects

The findings that males perform better than females in science subjects can be seen on the data in table 2.

Year	Total Male	Total male examined	% Male	Total Female	Total female examined	% Female
2000	6364	6463	20.69	4583	4583	14.70
2001	7039	7039	20.28	5276	5276	15.20
2002	3583	3583	14.77	2719	2719	11.21
2003	3803	3803	12.68	2975	2975	9.92
2004	2782	2782	3.60	2395	2395	7.40
2005	577	577	1.79	498	498	1.54
2006	3972	3972	21.582	15147	15147	19.666
2007	4857	4857	26.291	16001	16001	23.461
2008	8684	8684	47.704	16123	16123	46.542
2009	1418	1376	36.77	1135	1106	35.71
2010	1017	935	34.43	999	968	36.26
2011	1147	1119	31.21	1052	1012	28.52
2012	1059	1047	49.10	1144	1134	45.10
2013	1317	1286	54.21	1219	1203	53.98

Source-Min. of Education

Students performance in science subjects in NECO from 2000 – 2013 by gender as represented in the table showed that 20.69% of male who wrote NECO had higher percentage score than the females with 14.70 in 2000 and 47.70 to 46.54 percentage of females in science subjects.

It can be observed that in year 2000, 20.69% of males who wrote NECO had 5 credits and above, while fourteen point seven (14.70%) of females had 5 credits and above. From 2001-2005 the percentage performances of male candidates were higher than that of female candidates. The gap or variation in the performance of male and female students in year 2000 result is wide compared to the performance by gender in 2005 NECO result, which has little variation or differences in 2005, the percentages of males and females that passed were 1.79% and 1.54% respectively. In 2006, the percentages of males and females that passed were 21.58% and 19.67% respectively.

Despite recent remarkable progress in female performance in science owing to positive actions and sensitization campaigns (nationwide and in various institutions of learning), gender disparities still exist and are quite striking in some disciplines. When we look at 2006-2008 enrolment of male and female students in science subjects in table 4, the participation and performance of females in core science subjects really improved. This must be shown within the context of a better knowledge. The constraints and difficulties faced by females in science subjects can be removed. In Nigeria, considerable efforts have been expended on trying to see how gender effects can be implicated in the seemingly poor performance of females. Until a composite figure of the gender differences' effect size is determined, all attempts to make responsible decisions about gender in core science subjects will be thwarted. However, it is clear also that the researcher was concerned about the existing gender imbalances in most of the single sex and co-educational schools, and she was willing that necessary actions be taken to bridge the gender gap.

In addition, evidence abounds to show that students' performance in science subjects such as physics and chemistry do not compare favourably with the performance in biology. A more disturbing picture also emerges when one considers the performance figures in technical subjects like applied electricity, auto mechanics, building construction, metal work, wood work and electronics (WAEC, 2004). One then wonders how the country is going to develop scientifically when a good number of her secondary school students appears aversive to the pursuit of science related subjects. Another worrisome dimension to this dwindling performance in some science subjects emerges when we consider gender, school types and teachers' variables as factors students' performance. The trend in female performance in Nigerian secondary schools generally in science subjects during the June/ July SSCE year 2005 is presented in Table 5 below.

Table 3: Analysis of NECO SSCE result from year 2000-2013 in Ondo State

Year	No of Candidates that sat for the NECO exam	No of Candidates with 5 credits and above	% Pass	No of Candidates with 4 credits & above	% pass
2000	30912	10947	35.41	11306	36.58
2001	34703	12315	35.49	12904	37.18
2002	24252	6302	25.99	6387	26.34
2003	29975	6778	22.61	7144	23.83
2004	32338	5177	16	5907	18.27
2005	32202	1705	3.34	1267	3.93
2006	33384	7778	23.30	NA	NA
2007	20858	8978	26.29	14076	28.76
2008	24807	8654	34.88	12200	49.17
2009	2553	1200	47.00	1557	60.98
2010	2016	980	48.61	1365	67.70
2011	2199	1243	56.52	1430	65.02
2012	2203	1256	57.01	1430	64.91
2013	2536	1546	60.96	1760	69.40

NA= Not available Source= PRS Department Min. of Education.(2013)

The data in table 3 revealed that 35.41%, 35.495%, 25.99%, 22.61%, 16.00% and 3.34% passed NECO SSCE at 5 credits and above including English and Mathematics from 2000 to 2005. These values indicate the percentages of the students that were qualified or eligible for University admission that year. A closer look at the data revealed that the students performed better in the examination in the previous year than the years under review.

The percentages dropped continually from 35.49% in 2001 to 25.99%, 26.61% and 16.00% in year 2002, 2003, and 2004 respectively. There was a pronounced sharp drop in the candidates' performance in 2005. Only 3.34% of the candidate had 5 credits. The same trend of performance was observed for candidate with 4 credits and above. Many factors were thought to be responsible for this. The most obvious of them is the constitution of Examination Malpractices Ethics and Disciplinary Committee in Ondo State, the passage of the ethics into law in 2005 and its strict enforcement by the State Ministry of Education.

In the secondary school setting, WAEC conducted examination, until year 2000 had for a long time been the only means of summative evaluation used for the certification and this at the same time serves the only "yard stick" for assessing performance. In addition, it was first argued that lack of participation and poor attitudes of females in this important area of knowledge might result in negative consequences both for themselves and the nation. Secondly, females are disadvantaged when considering careers that in the physical sciences; thirdly, this lack of females in science subjects may contribute to the relative exclusion of females from scientific fields and can

affect the national economy. When female students decide not to enroll in science classes, they are seriously hindering their career opportunities and the nation's creative resources. Thus, with us in Nigeria, since few students in secondary school enrolled for science subjects, tertiary institutions such as the Colleges of Education and the Universities begin to suffer from lack of physics students. The enrolment of females for physics education is relatively low when compared to their enrolment in the humanity based subjects.

Report showed a wide gap between the number of females and males in scientific and technological careers. This can be bridged if a greater number of College and University graduates choose to specialize in scientific fields. Education especially in the area of Science is a key to acquisition of power and statues both within the society and domestic life. A female's educational level to a great extent affects her job opportunity or attainment of future professional ambitions (Aguele, 2004).

Despite the fact that the Nigerian National Policy on Education (2004) clearly stipulates equal educational opportunity for citizens without prejudice to birth circumstance of the child, existing literature shows inequality in the education of male and female from primary to post primary levels of education (Okeke, 2007 and Oboh, 2005). For example, Okeke (2007) reported that females have lower access to education than males; fewer females go to school than males; and the gap between male and female enrolment widens more at the higher level of education. Retention rates are lower for females than males, more female drop out from school than males before reaching a satisfactory level of education. That is, completion rates are lower for female than male. In the light of the above, for a child to be science inclined, the foundation has to be effectively laid at the basic education level (Ekpunobi, 2005).

Proponents of single-sex school-education believed that separating males and females, by classrooms or schools, increases students' performance. Actually, poor performance led to single sex schools (James, 2009). Notwithstanding, single sex schools should be available as an option for interested families. James (2009) believed that single sex schooling increases students' performance. He views that gender difference in psychological characteristics are relevant to learning and that biological and social psychological perspectives make single sex schooling particularly effective for low income Nigerians.

The negative stereotype, low expectations and relative lack of student and adult role - models in co - educational schools led to poor performance (Ogunleye, 2009). Comparing single sex schools with coeducational schooling for science performance, attitude to science and gender stereotyping caused discrepancies between the performance of females and the performance of males in the senior secondary schools.

This study looked at the performance of males versus that of females in science subjects (Chemistry, Biology, Physics). It also looked at the impact of school type (co-educational, females' only school and males' only school), gender on students' performance in science in senior secondary schools for a period of 2005 to 2014. This study is also designed to find out the reasons for under representation of females in

science subjects. The influence of type of school on students' performance of students in science was also examined in order to suggest ways of reducing gender gap in science subjects in schools.

Research Questions

1. Is there any difference in the performance of male and female students in senior secondary schools in science subjects?
2. Is the performance of students in science subjects the same in single sex and co-educational schools?

Research Hypothesis

1. School types will not significantly predict science students' performance in Secondary Schools.

Methodology

The research design employed in this study was the survey type using purposive and intact classes which were assigned to different instruments.. The populations for the study were made up of all the secondary schools science students in Ondo State. Target population was all the SSS3 science students. These students are final year students that must have covered the scheme of work in preparation for WASSCE (West African Senior School Certificate Examination). They have been exposed to the content of the core science subjects syllabus for three years needed for this study. They include all males and female science students.

One thousand and eighty (1080) science students formed the sample for the study. Twenty seven (27) schools were purposively selected from three (3) senatorial districts in Ondo State. Schools where science students in SSS3 classes measure up to forty (40) in a class with at least twenty (20) males and twenty (20) females in the co – educational school and forty (40) in single – sex were selected for the study.

Three research instruments were used for the collection of data. They are:

1. Students' Science Achievement Test (SSAT)

The Students' Science Achievement Test (SSAT) consists of twenty objective items on Physics, Biology, Chemistry from WAEC and NECO past questions.

Table 4: Table of specification of Science Students Achievement Test (SSAT)

Behavioural tendencies to learn science	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total
Practical	1	1	1		1	1	5
Physical	1	1			1		3
Chemical	1	1	1	1			4
Spring/chemical balance		1		1		1	3
Friction/motion		1	1		1		3
Calculations		1	1	1		1	4
Machines	1	1	1		1		4
Properties	1	1		1		1	4
Time			1	1	1		3
Acidity	1	1					2
Magnitude			1			1	2
Element	1			1		1	3
Energy		1		1	1		3
Temperature	1	1		1	1		4
Identification		1	1	1	1		4
Characteristics	1	1				1	4
Living Organisms		1		1	1		3
Adaptation	1						1
Growth							1
Total	10	14	8	11	9	8	60

The first drafts of the instruments were given to three academic staff in the Faculty of Education. They examined them for face, content and construct validity. The academic staff made useful input to the instruments. The final drafts which incorporated the inputs were used for the study.

The reliability of the instrument was established through test and retest method. The instrument was administered twice on 30 science students at interval of two weeks. The scores obtained from the successive administrations were subjected to Pearson Product Moment Correlation at 0.05 levels of significance. Reliability coefficient of 0.68, 0.71 and 0.73 were obtained. Hence the instruments were adjusted reliable.

The researcher personally went to the schools to administer the questionnaire on the respondents. The respondents filled copies of the questionnaire individually. Efforts were made to ensure that all items in the questionnaire were responded to. Completed copies of the test were collected on the spot. WAEC and NECO offices were also

contacted to collect the SSCE results of Biology, Physics and Chemistry from 2005-2010 for the schools involved in the study.

Descriptive statistics was used to analyze the four research questions while t- test and Multiple Regression statistics were used to analyze the eleven hypotheses at 0.05 levels of significance.

The research questions were answered using the data analyzed through the use of mean, standard deviation and bar chart. The hypothesis was subjected to regression analysis and was tested at 0.05 levels of significance.

Results

Research Question 1: Is there any difference in the performance of male and female students in science subjects in senior secondary schools?

Table 5: Performance of Male and Female Students in Science Subjects

Science subject	Gender	N	Mean	SD
Physics	Male	540	9.76	4.16
	Female	540	8.67	3.31
Biology	Male	540	10.06	4.47
	Female	540	10.03	4.51
Chemistry	Male	540	7.09	4.36
	Female	540	5.22	3.44
Overall performance	Male	540	8.97	3.78
	Female	540	7.98	3.01

Source: Result from the researcher's Fieldwork.

Table 5 shows that the male students performed better than their female counterparts in science subjects. The standard deviation for males in physics is 4.16 and the standard deviation for females is 3.31. In chemistry, the standard deviation for males is 4.36 and that of females is 3.44 except in Biology where there is very little difference in their mean scores, male = 10.06 and female = 10.03. The highest difference is in chemistry in which the mean scores are 7.09 for males and 5.22 for females. This is followed by physics, where the mean scores are 9.76 and 8.67 for males and females respectively.

The performances in the tests were used as the indices

+ for answering this question.

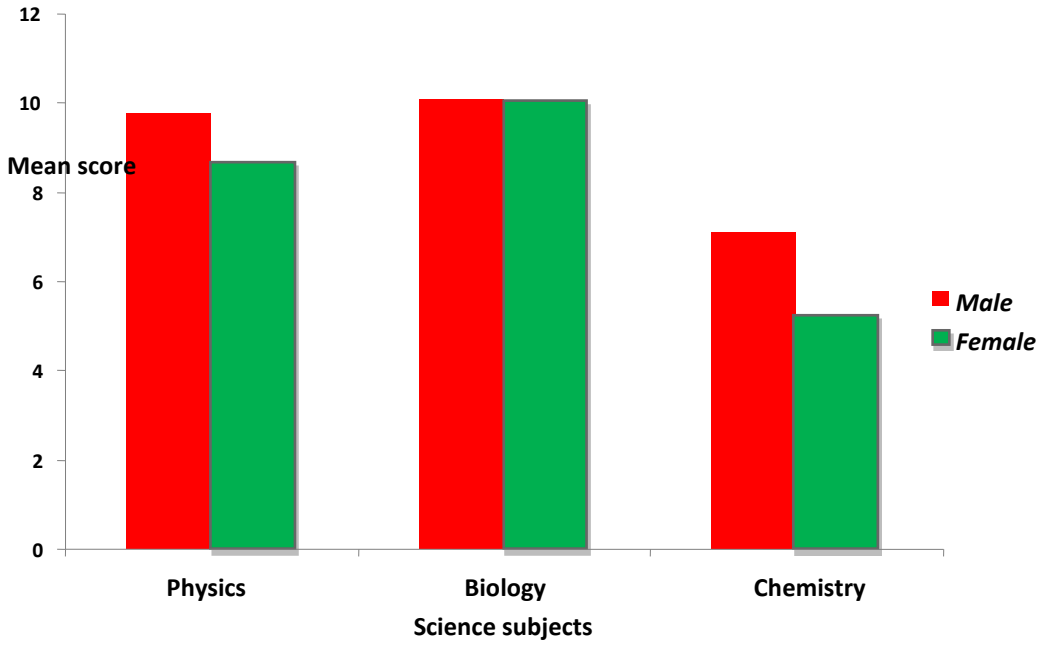

Figure 1: Bar charts showing the performance mean scores of students in Science subjects by gender

From figure 1, the mean score of males in physics is higher than that of the female scores in physics. Males are more interested in physical sciences, most especially in Physics than their female counterparts. In Biology, the mean scores of males are very close to that of females while the mean score of males in chemistry is higher than their female counterparts.

Research Question 2: Is the performance of students in science subjects the same in single sex and co-educational schools?

Table 6: Result of Male and Female Students Performance in Single-sex and Co-educational Schools

Science subjects	Single –Sex				Coeducational			
	Male N=180		Female N=180		Male 180		Female 180	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Physics	9.61	3.98	8.82	3.06	9.84	4.26	8.61	3.42
Biology	10.44	4.80	10.37	4.17	9.84	4.25	9.89	4.64
Chemistry	7.94	4.44	5.12	3.71	6.60	4.24	5.27	3.33
Overall Performance	9.33	3.69	8.10	2.91	8.76	3.81	7.92	3.05

Table 6 reveals that schools. For instance male students in single-sex schools had higher overall performance mean scores than male students in co-educational, males' single sex mean score is 9.33, while male mean score in co-educational school is 8.76. Also, female students in single sex schools performed better than their counterparts from co-educational schools (i.e. the overall mean scores for male was 8.10 while the scores for female in co-educational schools were 7.92).

Hypotheses 1: School types will not significantly predict science students' performance in secondary schools.

Table 7: Regression Result of School Type as Predictor of Students' performance in Science Subjects

Science Subjects	Model	B	Std. error	Beta	T	P	R^2	F
Physics	Constant	8.014	1.298	.161	6.176	.000	.026	1.299
	school type	.686	.602		1.140	.260		
Chemistry	Constant	3.911	1.325		2.951	.005		
	school type	1.055	.615	.238	1.175	.093	.257	2.943
Biology	Constant	10.375	1.503		6.904	.000		
	School type	-.189	.697	-.039	-.272	.787	.002	.074
Overall performance	Constant	7.433	1.141		6.515	.000		
	School type	.517	.529	.138	.977	.333	.019	.955

Table 7 presents the extent to which school type predict students' performance in science subjects. The B value weight is .517. It implies that school type is a good predictor of students' performance in science subjects. School type has the most profound predictive strength on students' performance in Chemistry (B = 1.055). This is closely followed by Physics (B = .686); while the predictive strength of school type on students' performance in Biology is the least predictor. (B = -.189).

Discussion of Findings

The result indicated that male students performed better than their female counterparts in science subjects. This finding however differs from other gender-related research findings of that gender has no significant effects on students' achievement scores, Ojo (2009)) that gender has no effect on subjects' students' achievement scores in Biology. Duyilemi, (2005) corroborates the finding of this research that female had low achievement score in science subjects and confirm that female representative in science disciplines is generally low in access, participation and performance at the secondary school level, the factors are biological, social and psychological. In support of these contributory factors to female under achievement, Aremu (2010) also identifies some factors which are categorized into external and internal factors, the external factors include class size, school location and availability of instructional materials to teach

science subjects. The internal factors include the self-esteem and self-efficacy which are regarded as too low in female science students. According to Ogunleye (2009) Females view some subjects such as Physics, Chemistry as masculine and very few show interest in them. According to Yoloye (2011) the low performance of female students in science subjects is found to be pronounced in co-educational schools where science students in that environment are more likely to acquire a perceived gender role than in single sex schools. Aremu (2010) to identify factors militating against students' performance in school subjects especially female students. Such factors are categorized into external and internal factors.

Conclusion

The study revealed that male students performed better than their female counterparts in science subjects. The female students should be encouraged to believe and accept that science could be studied and passed just like other subjects and that science is an essential tool, a prerequisite for further education in many vocations. Science teaching and evaluation strategies should be free from gender bias. This way, males and females will tend to see themselves as equal and capable of competing and collaborating in classroom activities. It can therefore be concluded that there is need for improvement in female education and that females could be encouraged to participate actively in science classes if science teachers, schools (single or co-educational), heads of science subject areas, textbook developers, curriculum developers, educational planners and public examination bodies, such as WAEC and NECO, collaborate in unison towards this end.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. School authorities at the secondary level should encourage teachers to give more time to teaching and motivation of female students in Physics and Chemistry classes.
2. Female and male students in all secondary schools should have equal exposure to the teaching of science subjects and sex-typing of school subjects especially in sciences should be discouraged.
3. Finally, the male folk should actively learn to appreciate and respect the dignity and worth of female scientists and willingly cooperate with, rather than discriminate against them.

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