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Effects of homogeneous and heterogeneous sex grouping on biology students' achievement and retention in Delta North Senatorial District, Delta State, Nigeria

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Abstract

The effects of homogeneous and heterogeneous sex groupings on biology students' achievement and retention in Delta North Senatorial Districts were the focus of this study. The pretest, posttest, non-equivalent quazi-experimental design was adopted for the study. The population consist of six thousand four hundred and fifty three (6.453) senior secondary school II Biology students in all the public mixed and single-sex senior secondary school. The simple random sampling technique was used to select a sample size of three hundred and twenty five (325) SSII Biology students from six (6) secondary schools. Research questions and hypotheses were formulated to guide the study. Research instrument used for the study was a Biology Achievement Retention Test (BART). The reliability coefficient of 0.82 was obtained using the Kuder-Richardson 21 formula. The single-sex schools served as the homogeneous group while the mixed-sex schools served as the heterogeneous group. Data was collected by administering the instrument (BART) as pretest and posttest. The data obtained were analyzed using mean, standard deviation and t-test analysis. Results showed a significant difference between mean achievement scores among students taught biology in homogeneous and heterogeneous sex classes in favour of students in the heterogeneous sex classes, and a significant difference between mean retention scores of students who were taught biology in homogeneous and heterogeneous sex classes in favour of students in the heterogeneous sex class. Based on the findings, it was concluded that heterogeneous sex grouping promotes students' academic achievement and retention in biology than homogeneous sex group.

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Introduction

The role of biology in the socio-economic development of any nation needs no debate. Student's knowledge in biology has been regarded widely as a means of enhancing economic development, poverty eradication and introducing social welfare (Nwagbo, 2005). It is one of the core subject taught in all secondary schools in Nigeria. According to Adegboye, Ganiyu and Abimbola (2017), biology is a unique branch of natural science. However, like other natural sciences, it is concerned with the search of in-depth understanding of natural phenomenon and events. Biology is an integral science subject which provides content in the training of students that wants to study Medicine, Nursing, Pharmacy, Fisheries and so on (Ifeobu 2004). The cordinal objectives of teaching biology at the secondary school level according to the Federal Ministry of Education, FME (2008) are to prepare students to acquire; adequate laboratory and few skills in biology; meaningful and relevant knowledge in biology; ability to apply scientific knowledge to everyday life in matters of personal and community health and reasonable and functional scientific attitude. To achieve the aforementioned objectives, formal education is provided to students in either homogeneous (single-sex) or heterogeneous (mixed-sex) classrooms.

Homogeneous sex (singled sex) education is the practice of conducting educational activities for males and females in separate classes (Hartman, 2014). The practice was common before the 20th century, particularly in secondary and higher education which was advocated in many culture based on tradition as well as religion (Swllivah *et al.,* 2011). Proponents of single sex education believed that separating boys and girls increase students' achievements and economic interest (Richard, Eric, Adrienne and Kathrin, 2015). Heterogeneous sex (mixed-sex) is a system of education where males and females are educated together in the same classrooms. According to Richard *et al* (2015), Heterogeneous education creates a feeling of companionship. They advocated teaching of both male and female in an integrated form in the same institution without showing any discrimination in imparting knowledge. According to Kommer (2006), there are distinct advantages to heterogeneous sex education in that each sex will see how the other thinks, feels, responds and react. Such understanding is in itself a major goal for sex-friendly classrooms. Creating a sex-friendly classroom does not mean that sex-specific activities should be created in the classroom divided or single classroom must exist.

Debatable questions many educators, parents and researchers have been asking is whether or not it is academically beneficial to teach boys and girls together or separately at school (Guest, 2014). While some argued that co-education (mixed-sex) has primarily social benefits, allowing males and females of all ages to become more prepared for real-world situations, others are of the opinion that students from single-sex setting could be less prepared, nervous or uneasy. However, certain authors argued that at certain age, students may be more distracted by the opposite sex in co-educational setting (Wikipedia, 2019).

This distraction may affect how often a student is willing to raise his or her hand in class and this could make students to be less focused. Boys and girls learn and behave differently because their brains are biologically wired differently.

These differences are profound and should be recognized and used to provide a more effective and efficient secondary school education for both boys and girls. Based on the foregoing, the statement of the problem therefore is: Will homogeneous (single-sex) grouping improve students' achievement and retention in Biology more than heterogeneous (Mixed-sex) grouping?

In the Nigerian educational setting, the practice of homogeneous (single-sex) and heterogeneous (mixed-sex) sex grouping is still in existence. However, from the few numbers of single-sex schools compared to mixed-sex schools in Nigeria, one can vividly say that single-sex schools are gradually fading away.

Therefore does the dominant of mixed-sex schools over single-sex schools enhance students' achievement and retention more than single-sex school? This is the major rationale of this study. Hypotheses formulated to guide the study were tested at 0.05 level of significance to determine if there is a significant or no difference in mean achievement scores of students taught Biology in Homogeneous sex and heterogeneous sex classes in relation to mean retention score. The objective of this study is therefore to examine the effects of homogeneous and heterogeneous sex grouping on Biology students' achievement and retention.

Materials and methodology

The study examined the effects of homogeneous and heterogeneous sex groupings on biology students' achievement and retention in Delta North Senatorial District. Four research questions and four research hypotheses were raised and formulated to guide the study.

The pretest, posttest non-equivalent quazi-experimental design was adopted for the study. The population consists of 6,453 SSII Biology students in all the public mixed and single-sex senior secondary schools in Delta North Senatorial District. A sample of 325 SSII biology students from six secondary schools was used. The simple random sampling technique was employed to select the sample for the study.

Instrumentation

The research instrument used for the study was a Biology Achievement Retention Test (BART), containing 50 multiple choice items. The face and content validity of BART was determined by panel of three experts from Science Education and Measurement and Evaluation.

The reliability of BART was established using the Kuder-Richardson formula 21 approach. The instrument was administered to 30 biology students outside the area of coverage of the study. On analysis, a reliability coefficient value of 0.82 was obtained.

Treatment procedure

The researcher sought the approval of the school heads in order to use the teachers and students in the school for the study. Orientation was given on the purpose of the study. Two single-sex boys and single-sex girls' school served as the homogeneous group, while the mixed-sex schools served as the heterogeneous group.

The homogeneous and heterogeneous groups were taught the same biology concepts using the lecture method. The biology teachers in the selected schools served as research assistants. Students were taught in their various schools for a period of six weeks on the selected biology concepts with the instructional package provided by the researcher.

The BART instrument was administered as protest a day to the commencement of the six weeks treatment in order to determine the equivalence of the group before treatment. At the end of the treatment, the BART instrument was reshuffled and administered again as a posttest. Four weeks after treatment, BART was further administered as follow-up test (retention test). The protest, posttest and follow-up test scores for each group were collected and subjected to analysis.

Data analysis

Microsoft Excel software, Version 2010 was used to analyze the data. All research questions were answered using mean and standard deviation while hypotheses were tested using t-test at 0.05 level of significance.

Results

Table 1 indicates that students in the homogeneous sex class had a mean ($\bar{x}$) achievement score of 57.69 with a standard deviation (SD) of 6.16 while their counterparts in the heterogeneous sex class had a mean ($\bar{x}$) achievement score of 61.28 with a standard deviation (SD) of 10.76. This implies that there s a differences between the mean achievement scores of students taught Biology in Homogeneous and Heterogeneous sex classes.

Table 1. Mean and Standard Deviation of Post-test Achievement scores of students taught biology in Homogeneous and Heterogeneous sex classes.

Group	N	$\bar{x}$	SD	Mean difference
Homogeneous	213	57.69	6.16	
Heterogeneous	112	61.28	10.76	3.59

Table 2. Mean and Standard Deviation of Post-test Achievement scores of male and female students taught Biology in Homogeneous sex classes.

Sex	N	$\bar{x}$	SD	Mean difference
Male	113	57.46	6.26	0.5

Table 2 indicates that male students in the homogeneous sex class had a mean ($\bar{x}$) achievement score of 57.46 with a standard deviation (SD) of 6.26 while their female counterparts had a mean ($\bar{x}$) achievement score of 57.96 with a standard deviation (SD) of 6.66. This implies that there is no differences between the mean achievement scores of male and female students taught Biology in Homogeneous sex classes.

Table 3. Mean and Standard Deviation of Post-test Achievement scores of male and female students taught biology in Heterogeneous sex classes.

Sex	N	$\bar{x}$	SD	Mean difference
Male	58	61.47	10.91	
Female	54	61.07	10.71	0.4

Table 3 indicates that male students in the heterogeneous sex class had a mean ($\bar{x}$) achievement score of 61.47 with a standard deviation (SD) of 10.91 while their female counterparts had a mean ($\bar{x}$) achievement score of 61.07 with a standard deviation (SD) of 10.71. This implies that there is no differences between the mean achievement scores of male and female students taught Biology in Heterogeneous sex classes.

Table 4. Mean and Standard Deviation of Post-test Retention scores of students taught Biology in Homogeneous and Heterogeneous sex classes.

Group	N	$\bar{x}$	SD	Mean difference
Homogeneous	213	52.62	6.91	4.66

Table 4 indicates that students in the homogeneous sex class had a mean ($\bar{x}$) retention score of 52.62 with a standard deviation (SD) of 6.91 while their counterparts in the heterogeneous sex class had a mean ($\bar{x}$) achievement score of 57.28 with a standard deviation (SD) of 8.37. This implies that there s a differences between the mean retention scores of students taught Biology in Homogeneous and Heterogeneous sex classes. Table 5 indicates that there is a significant difference between the post-test mean achievement scores of students taught Biology in Homogeneous and Heterogeneous sex class in favour of students in the heterogeneous sex classes. Thus, the null hypothesis is rejected. Table 6 indicates that there is no significant difference between the post-test mean achievement scores of male and female students taught Biology in Homogeneous sex classes. Thus, the null hypothesis is accepted.

Table 5. Summary table of t-test comparison of posttest achievement scores of students taught Biology in Homogeneous and Heterogeneous sex classes.

Group	N	$\bar{x}$	SD	df	t-cal	Sig(2-tailed	Decision
Homogeneous	213	57.69	6.16			0.000	rejected
Heterogeneous	112	61.28	10.76	323	3.816		

Table 7 indicates that there is no significant difference between the post-test mean achievement scores of male and female students taught Biology in Heterogeneous sex classes. Thus, the null hypothesis is accepted. Table 8 indicates that there is a significant difference between the post-test mean retention scores of students taught Biology in Homogeneous and Heterogeneous sex class in favour of students in the heterogeneous sex classes. Thus, the null hypothesis is rejected.

Table 6. Summary table of t-test comparison of posttest achievement scores of male and female students taught Biology in Homogeneous sex classes.

Group	N	$\bar{x}$	SD	df	t-cal	Sig(2-tailed	Decision
Male	113	57.46	6.24	211	0.551	0.590	Accepted
Female	100	57.96	6.66				

Table 6 indicates that there is no significant difference between the post-test mean achievement scores of male and female students taught Biology in Homogeneous sex classes. Thus, the null hypothesis is accepted.

Discussion

From analysis of results as presented, the study showed a significant difference in mean achievement scores of students who were taught Biology in homogeneous and heterogeneous sex classes in favour of students in the heterogeneous sex. This implies that students taught Biology in heterogeneous sex (mixed-sex) schools out-performed their counterparts in homogeneous sex (single-sex) schools. The implication therefore is that interaction with the opposite sex provides variety of information for students in the heterogeneous sex school. Heterogeneous sex schools also promote competition between male and female students. Such competitions between sexes are not found in homogeneous sex (single-sex) schools.

Table 7. Summary table of t-test comparison of posttest achievement scores of male and female students taught Biology in Heterogeneous sex classes.

Group	N	$\bar{x}$	SD	df	t-cal	Sig(2-tailed	Decision
Male	58	61.47	10.91	110	0.191	0.848	Accepted

The finding corroborates that of Singh *et al.*, 2001). They reported that students in coeducation (heterogeneous) classes outperformed students in single-sex (homogeneous) classes in science achievement. The findings from the study also revealed a significant difference between the mean retention scores of students taught biology in homogeneous and heterogeneous sex classes. This implies that students in heterogeneous sex classes retain the knowledge of the biology concepts taught more than their counterparts in homogeneous sex classes. Brunner (1961) noted that what is crucial in learning are storage of knowledge and retrieval.

The study also revealed that there is no significant difference in the mean achievement scores of male and female students taught biology in homogeneous sex classes. This implies that performance in biology by male students in homogeneous sex (single-boy) classes did not differ from that of female students in

homogeneous sex (single-girls) classes. Ogden (2011) reported insignificant difference in mean achievement score of male and female students. There was also a non-significant difference in the mean achievement score of male and female students taught biology in heterogeneous sex classes.

Table 8. Summary table of t-test comparison of posttest achievement scores of students taught Biology in Homogeneous and Heterogeneous sex classes.

Group	N	$\bar{x}$	SD	df	t-cal	Sig(2-tailed	Decision
Homogeneous	213	52.62	6.91				
Heterogeneous	112	57.28	8.37	323	5.323	0.000	Rejected

This implies that female students in heterogeneous sex classes performed just well as their male counterparts in heterogeneous classes. The findings correlates with that of Gwarjixo (2015) stating a non-significant difference between the performance of male and female students in mixed gender streaming on English language.

Conclusion

Based on the major findings of the study, it can be concluded hat heterogeneous sex grouping promotes students' academic achievement and retention in biology than homogenous sex grouping. So, the recommendations were proffered as first, heterogeneous sex grouping should be upheld in Nigerian schools; Second, Policy makers in the Ministries of Education and principal of secondary schools should lend full support to heterogeneous sex grouping; third, since heterogeneous sex grouping has proved effective, biology teachers should taken cognizance of it not to create gender biasness is class.

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