Gender Difference in Nigerian Junior Secondary Students' Academic Achievement in Basic Science

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Abstract *The main purpose of this study was to investigate the influence of gender on Junior Secondary students' academic achievement in basic science using cooperative learning teaching strategy. Total number of one hundred and twenty (120) students obtained from the intact classes of the three selected Junior Secondary Schools in the three selected Local Government Areas of Ogun State, South-west Nigeria, participated in the study. This study employed a quasi-experimental design. Lesson note based on the jigsaw II cooperative learning strategy and Achievement Test for Basic Science Students (ATBSS) were the instruments used to collect the relevant data. The data collected was analyzed using descriptive and independent samples t-test statistical methods. Findings of this study revealed that there was no significant difference in academic achievement of male and female students at the pretest, posttest, and delayed posttest levels respectively. This research suggested that in order to encourage more women into pure sciences, and science-oriented courses, interventions need to be designed that focus not only on the academic achievement of girls but also in how to make science-related occupations more interesting for young, high achieving girls.*

1. Introduction

Basic science, formerly known as Integrated Science, is the first form of science a child comes across at the secondary school level; hence basic science prepares students at the Junior Secondary School level for the study of core science subjects (physics, chemistry, biology) at the Senior Secondary School level (Olarewaju, 1994). This implies that for a student to be able to study single science subjects at the Senior Secondary School level successfully, such student had to be well grounded in basic science at the Junior Secondary School level. In view of this, basic science is given great emphasis in the Junior Secondary School curriculum. The principal reasons why Nigerian Government started Basic Science teaching in Nigerian secondary schools are as follow:

1. It provides students at the Junior Secondary School level a sound basis for continuing science education either in single science subjects or further integrated science;
2. It enhances the scientific literacy of the citizenry;
3. It allows students to understand their environment in its totality rather than in fragments;
4. It allows the students to have general view of the world of science;
5. The processes of science serve as unifying factor for the various science subjects. It is necessary for the learner to know these processes through integrated approach of learning science. (Federal Ministry of Education, 1981).

What has remained the main focus of great concern in the field of science education are the biases and misconceptions about women and science, i.e. Science is a male enterprise (Erinosho, 2005). Many researches had been carried out on gender issues in science education (Bilesanmi-Awoderu, 2002; Erinosho, 1997a, 1997b, & 1997c; Erinosho, 2005; Kennedy, 2000, etc.). Many researchers have provided reports that there are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender (Arigbabu & Mji 2004; Bilesanmi-Awoderu, 2006; David &

Stanley,2000; Din, Ming, & Esther, 2004; Freedman, 2002; Sungur & Tekkaya, 2003, etc.). However, Aguele & Uhumniah (2008); Billings (2000); Croxford (2002); Eccles, Lord, Roeser, Barber, & Jozefowicz (1997); Hyde & McKinley, (1997); Kolawole, (2007), etc., in their studies found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. There is a strong association between gender and response to science education. The likely influence of gender factors on students' academic achievement in basic science when they are taught using the cooperative learning and conventional methods was examined by this study.

The issue of gender is an important one in Science education especially with increasing emphasis on ways of boosting manpower for technological development as well as increasing the population of females in science and technology fields (Ogunkola &Bilesanmi-Awoderu, 2000). In Nigeria, and perhaps the whole of Africa, gender bias is still very prevalent (Arigbabu & Mji, 2004). This is a view to which Onyeizugbo (2003) has also alluded in pointing out that "sex roles are somewhat rigid in Africa particularly in Nigeria…gender differences are emphasized". It is common place to see gender stereotypes manifested in the day-to-day life of an average Nigerian.

Certain vocations and professions have traditionally been regarded as men's (medicine, engineering, architecture) and others as women's (nursing, catering, typing, arts). Typically, parents call boys to wash cars, cut grass, fix bulbs, or climb ladders to fix or remove things. On the other hand, chores such as washing dishes, cooking, cleaning and so on, are reserved for the girls. In a nutshell, what are regarded as complex and difficult tasks are allocated to boys, whereas girls are expected to handle the relatively easy and less demanding tasks. As a result of this way of thinking, the larger society has tended to see girls as the "weaker sex". Consequently, an average Nigerian child goes to school with these fixed stereotypes. Gender issues, both on the part of the teachers and students, have been documented to affect achievement generally (Erinosho, 2005; Kennedy, 2000; Ogunkola, 1999, etc.). Conflicting results in gender-related research should, however, be expected as studies vary in their learning contexts. These include the methodology, populations, geography, research tasks, and classroom settings.

There are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender (Arigbabu & Mji 2004; Bilesanmi-Awoderu 2001, 2002, 2004, 2006; David & Stanley 2000; Din, Ming, & Esther, 2004; Freedman, 2002; Sungur & Tekkaya 2003, etc.). Girls are being encouraged and sensitized into developing positive attitudes towards science. However, some researchers still found that there are still significant differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender (Aguele & Uhumniah (2008); Billings (2000); Croxford (2002); Eccles, Lord, Roeser, Barber, & Jozefowicz, 1997; Hyde & McKinley, 1997; Kolawole, 2007, etc.).

Chi-chau (1997) investigated the effect of classroom goal structures on children's goal orientation, mathematics achievement and intrinsic motivation. He also assessed gender effects, and the interaction effects between goal structure and gender in these learning situations on the variables related to mathematics learning. The results showed no significant gender effects on the variables of goal orientation, mathematics achievement, intrinsic motivation, and beliefs about failure.

Drzewiecki & Westberg (1997) carried out a survey on high school students to better understand how students' attitudes toward mathematics differ by gender and by grouping technique used for mathematics instruction. More specifically, the survey examined the impact of cooperative grouping as an alternative to traditional mathematics instruction for improving females' attitude toward mathematics. A 2x2 analysis of variance indicated that there were no significant main effect for gender and instructional methods.

Ogunkola & Bilesanmi-Awoderu (2000) carried out a research on the effectiveness of laboratory-based and lecture methods on students' achievement in Biology and employed a 2x2x2 non randomized control group pretest-posttest quasi-experimental factorial design, using Analysis of covariance (ANCOVA) to analyze the data collected; they found that students' achievement in Biology was not sensitive to the sex of students.

Bilesanmi-Awoderu (2002) carried out a study on the concept-mapping, students' locus of control, and gender as determinants of Nigerian high school students' achievement in Biology using Analysis of Covariance to analyze the data collected; she found that there was no significant main effect of gender on students' achievement in Biology.

Viann (2002) investigated differences and the effects of cooperative learning in mathematics classroom setting. The researcher used quasi-experimental design to compare a control section using individualized learning method with three treatment sections using cooperative learning strategy based on the Learning Together model of Johnson and Johnson (1991). The results revealed no significant gender-related differences, but females achieved slightly higher grades than males.

Pandian (2004) investigated the effects of cooperative computer-assisted learning method on male and female students' achievement in biology. The students were randomly grouped into cooperative computer-assisted learning and traditional method groups. The analysis of results indicated that gender did not express any significant influence on biology achievement. However, male and female students in the cooperative computer-assisted instruction group showed remarkable post-test mean differences over their respective counterparts who learned the same biology concepts through traditional method.

Samuel & John (2004) examined how the cooperative class experiment (CCE) teaching methods affect students' achievement in Chemistry. They found that there was no significant difference in gender achievement between the experimental and control groups, but girls had a slightly higher mean score than boys did. Moreso, the girls taught through CCE method performed better than girls taught through the conventional teaching method in the post-test scores. Similarly, boys who were taught using CCE method performed significantly better than the boys in the control groups in the post-test scores. The researchers also pointed out that there was no significant difference in achievement between boys and girls exposed to CCE method, both performed significantly better than those taught through conventional lecture method.

Other research has also shown a decline in the differences between the genders in the past few decades on standardized test, suggesting that the more exposure that women are getting to math and science classes, the better their scores (Hyde & McKinley, 1997). Kolawole (2007) found that boys performed better than girls in both cooperative and competitive learning strategies when he conducted a research on the effects of competitive and cooperative learning strategies on Nigerian students' academic performance in mathematics. Work by Eccles, Lord, Roeser, Barber, and Jozefowicz (1997) found that gender differences in enrollment in advanced mathematics courses in high school are mediated by gender differences in expectations for success in math and physics and perceived value of competence in math. Aguele & Uhumniah (2008); Billings (2000); Croxford (2002), etc., found, in their studies at various times, that male students achieved significantly better than female students in science education.

2. Methodology

This study employed quasi-experimental design, the design included Jigsaw II method of cooperative learning, while the gender was at two levels (male and female). The target population for this study was the Junior Secondary III (J.S.III) students in Ijebu-Ode, Ijebu North – East, and Odogbolu Local Government areas of Ogun State, south-west, Nigeria, respectively. The sample for this study was the total number of students in the intact classes used in the selected co-educational Junior Secondary Schools. Three co-educational Junior Secondary Schools were randomly picked from the total number of co-educational Junior Secondary Schools in the aforementioned local government areas which met the laid down criteria set by the researcher. Intact class was used in each of the selected schools because most of the school principals did not want distortion in their normal school arrangement. The main instruments for data gathering were the lesson note used to teach the students basic science concepts (energy and force) and Achievement Test for Basic Science Students (ATBSS). The students were taught using Jigsaw II teaching strategy of cooperative learning. The test items of forty multiple choice

questions were adopted from the past questions of Junior Secondary School Certificate Examination (JSSCE) in basic science in Ogun state. The JSSCE questions are standardized in nature because it has been field-validated by the experienced test and measurement experts in the state ministry of education. Moderating Committee edited and selected good items. To determine the reliability of ATBSS, the achievement test was trial tested by administering it to forty students from an intact class of a co-educational Junior Secondary School different from the selected schools for the main study. Spearman - Brown co-efficient statistical method was used to determine the reliability co-efficient of the instrument, which was found to be 0.751. The data collected from the administration of the instrument were analyzed using descriptive and independent samples t-test methods of data analysis. The analysis was computed using SPSS 15.00 package.

There were three phases of data collection; these were the pretest – first one week, treatment – six weeks, the posttest – one week, delayed posttest – the last two weeks. Before exposing students to teaching, the forty multiple choice test was administered to students as pretest. The posttest was administered a day after the completion of the treatments, this was to minimize maturation effect, by giving the students the same forty – items - multiple choice test that was used for the pretests, the delayed posttest was administered two weeks after.

3. Results

Table 1. Descriptive Statistics

	gender	N	Mean	Std. Deviation	Std. Error Mean
pretest	male	67	7.81	1.480	.181
	female	53	7.91	1.535	.211
posttest	male	67	23.66	8.149	.996
	female	53	24.89	7.213	.991
Dposttest	male	67	22.28	10.292	1.257
	female	53	24.23	9.312	1.279

N: Number; Std: standard

In table 1, it is revealed that 53 female students who participated in the study had pretest, posttest, & delayed-posttest achievements mean scores of 7.91, 24.89, & 24.23 respectively and standard deviations of 1.535, 7.213, & 9.312 respectively; while the 67 male students had pretest, posttest, & delayed-posttest achievements mean scores of 7.81,23.66, & 22.28 respectively and standard deviations of 1.480, 8.149, & 10.292 respectively.

Table 2. Independent Samples Test

	t	df	Sig (2-tailed)	Mean difference	Std error Difference
Pretest	-.361	118	.719	-.100	.277
Posttest	-.863	118	.390	-1.230	1.425
DPosttest	-1.071	118	.287	-1.943	1.815

Dposttest: Delayed posttest, df: degree of freedom, std: standard

Hypothesis (Ho₁)

There is no significant difference in the pretest academic achievement mean scores of male and female students in basic science.

The result, as revealed in table 2, indicates that there was no significant difference in the pretest academic achievement mean scores of male and female students in basic science ($t_{(1,118)}$ = .719,statistically not significant). This implies that there was no significant gender differences in the students′ pretest academic achievement mean scores in basic science. As a result, the null hypothesis 1 was not rejected.

Hypothesis (Ho₂)

There is no significant difference in the posttest academic achievement mean scores of male and female students in basic science.

The result in table 2 also revealed no statistically significant difference in the posttest academic achievement mean scores of male and female students in basic science (t $_{(1,118)}$ = .390, statistically not significant). This implies that there was no significant gender differences in the students′ posttest academic achievement mean scores in basic science. As a result, the null hypothesis 2 was not rejected.

Hypothesis (Ho₃)

There is no significant difference in the delayed posttest academic achievement mean scores of male and female students in basic science.

Talking of the main effect of gender on students′ retention of basic science concepts taught, table 2 also reveals that there was no significant difference in the delayed posttest academic achievement mean scores of male and female students in basic science (t $_{(1,118)}$ = .287, statistically not significant). This implies that there was no significant gender differences in the students′ retention of basic science concepts taught. As a result, the null hypothesis 3 was also not rejected.

3. Discussion of Result

This study was conducted to establish gender difference in students′ academic achievement in basic science. Examining the main effect of gender on students′ academic achievement at the pretest, posttest, and delayed

- posttest levels respectively, result from table 2 reveals that there were no statistically significant differences in the pretest, posttest, and delayed – posttest academic achievement mean scores of male and female students, though the female students' academic achievement mean scores at dependent measures level were a little bit higher than those of the male students, the differences were not significant. This research would suggest that in order to encourage more women into pure sciences, and science-oriented courses, interventions need to be designed that focus not only on the academic achievement of girls but also in how to make science-related occupations more interesting for young, high achieving girls. This type of intervention should start early in the academic careers for these young girls; our results suggest that lack of interest in basic science at the Junior Secondary School level is the main reason why many of these promising girls do not show interest in single science subjects at the Senior Secondary School level and science-oriented courses at the nation's tertiary institutions respectively.

This result is in line with some of the research findings which were of the opinion that gender difference in science achievement has disappeared (e.g. Arigbabu & Mji, 2004; Bilesanmi-Awoderu, 2006; Chi-chau, 1997; Din, Ming, & Esther, 2004; Drzewiecki & Westberg 1997; Erinoso, 2005; Freedman, 2002; Pandian, 2004; Samuel & John, 2004; Viann, 2002; etc.). However, the findings of this study contradict the findings of Aguele & Uhumniah (2008); Billings (2000); Eccles, Lord, Roeser, Barber, & Jozefowicz, (1997); Hyde & McKinley, (1997); Kolawole, (2007), etc., who found in their studies, at various times, that male students achieved significantly better than female students in science subjects.

4. Conclusion

Based upon the finding of this study, i hereby conclude that there is no significant gender difference in students' academic achievement and retention in basic science. This implies that there are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender. Female achievement scores in basic science at the pretest, posttest, and delayed-posttest levels were slightly better than those of their male colleagues; girls are being encouraged and sensitized into developing positive attitudes towards science. The implication of this is that since basic science prepares students for the study of science subjects at the Senior Secondary School level, more female students would offer single science subjects (Biology, Chemistry, and Physics) at the Senior Secondary School level, these single science subjects are the prerequisites for studying science-oriented courses at the Nation's tertiary institutions. Hence, courses such as engineering, medicine, pure sciences, computer science, physical sciences, which were exclusively meant for men, would also involve more women.

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