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Effect of Gender and Science Anxiety on Nigerian Junior Secondary Students' Academic Achievement in Basic Science

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Abstract
This study examined the effect of gender and science anxiety on students' academic achievement in basic science at the Junior Secondary School level. The study was a quasi-experimental study. The population for this study comprised the Junior Secondary III (JSIII) students in Ogun State Junior Secondary Schools. The sample was One hundred and twenty (120) intact class of students (mean age 13.4years, SD=1.57) drawn from three co-educational Junior Secondary Schools in three Local Government Areas of Ogun state. Achievement Test (Φ=0.81) for Basic Science Students, and Science Anxiety Scale (= 0.96) were the main instruments used to collect data. Descriptive statistics, and Univariate Analysis of Variance (ANOVA), were used to analyze the data collected. There was significant main effect of science anxiety on the students' academic achievement in basic science at o.o5 level of significance. There was no significant effect of gender on students'academic achievement in basic science. There was no significant interaction effect of gender and science anxiety on the academic achievement of students in Basic Science. Based on the findings, the authors proffered useful recommendations.
Keywords: science anxiety, basic science, gender, science anxiety, students' achievement.

1. Introduction

Science education plays a vital role in the lives of individuals and the development of a nation scientifically and technologically Alebiosu, & Ifamuyiwa, (2008). It is widely and generally acknowledged that the gateway to the survival of a nation scientifically and technologically is scientific literacy which can only be achieved through science education. Towards revolutionizing Nigerian educational system, the 1969 Conference gave birth to the National Policy on Education which brought about significant changes to the Nigerian educational system Alebiosu, & Ifamuyiwa, (2008). For instance, in Nigeria, the Federal Government of Nigeria National Policy on Education (2004) provided educational expenditure in science and technology. The Nigerian government, in a bid to enhance science and technological education, came up with 6-3-3-4 policy on education which stipulates that a child spends six years at the primary school level, three years at the Junior Secondary School level, three years at the Senior Secondary School level, and four years in Higher Institutions (Olanrewaju, 1994). All the afore-mentioned systems of education in Nigeria are designed with special provisions for science and technology learning in schools. Moreso, Nigerian government also came up with a policy that 60 percent of the students seeking admission into the nation's Universities, Polytechnics, and Colleges of Education should be admitted for science oriented courses, while 40 percent of the students should be considered for Arts and social science courses (Ajibola, 2008).

Basic science, formerly known as Integrated Science, is the first form of science a child comes across at the junior secondary school level; hence basic science prepares students at the Junior Secondary School level for the study of core science subjects at the Senior Secondary School level (Olanrewaju, 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. In an attempt to improve the standard of science teaching and learning, a lot of research studies had been carried out. Studies in Basic science education have reported that many students at the Junior Secondary School level have developed negative attitudes towards the subject (Akpan, 1996). Many of the students at this level, because of their dismal performance in the subject, are not benefiting much from the basic science curriculum { Balogun, (1992); Olagunju, (1995); Olanrewaju, (1999); Odetoyinbo, (2004); Afuwape, and Olatoye. (2004)}. This, according to Afuwape and Olatoye. (2004)), has prevented many of them from offering core science subjects or performing better in the core science subjects at the Senior Secondary School level. Many research studies had been carried out on the effective teaching and learning of basic science. Many of those studies found, among other things, that lack of qualified basic science teachers; poor methods of teaching; lack of instructional materials; inadequate exposure to practical work, etc. are the logics behind students' dismal academic achievement in Basic Science. Many of the aforementioned studies did not include in their findings the possible effect of both science anxiety

and gender on students' academic achievement in basic Science. Some studies have considered its predictive value in some science subjects but there's a dearth of evidence on its predictability on basic science achievement. Anxiety, according to Oludipe, (2014) can be inimical to Schools' achievement in Science and her study confirmed this. However, studies in this area haven't learnt themselves to simple summary. Conducting this present study would, therefore, not only be appropriate but indeed worthwhile. It is against this background that the present research work examined the effect of science anxiety and gender on students' academic achievement in Basic Science.

2. Hypotheses

The following null hypotheses were formulated and tested for this study:

Ho_1: There is no significant influence of science anxiety on academic achievement of students in basic science.

Ho_2: There is no significant influence of gender on academic achievement of students in basic science.

Ho_3: There is no significant interaction effect of gender and science anxiety on students' academic achievement in basic science.

3. Methodology

Sample

This study is a quasi experimental study. 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. The sample was made up of One hundred and twenty (120) intact class of students drawn from three co-educational Junior Secondary Schools in three Local Government Areas of Ogun state. Stratified random sampling was used to select three co-educational Junior Secondary Schools from the total number of co-educational Junior Secondary Schools in the aforementioned local government areas.

Instruments

Achievement Test for Basic Science Students (ATBSS) and Science Anxiety Scale (SAS) were the main instruments used for data gathering. The ATBSS was a test of students' achievement in basic science. The concepts examined were based on the five topics in basic science scheme of works for third term. 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. Copies of the Achievement Test for Basic Science Students (ATBSS) were given to specialists in the field of science education to establish the content and face validity. Spearman - Brown co-efficient was used to determine the reliability co-efficient of ATBSS, which was found to be 0.81.

The SAS instrument was the adapted 20-item science Anxiety Rating Scale by Murat BURSAL (2008). Two of the 20 items that were not relevant to basic science were discarded; hence the science rating scale contained 18 items. The instrument was to find students' level of science anxiety for learning science at the Junior Secondary School level in order to categorize them into low and high science anxiety levels respectively. There were two sections in the questionnaire; section A sought for demographic data of students, while section B consisted of 18 items which students responded to by expressing their level of agreement or otherwise on a 5-point Likert scale of 1 = No anxiety, 2 = slightly low anxiety, 3 = moderate anxiety, 4 = slightly high anxiety, and 5 = High anxiety. The reliability of the instrument was determined by using Cronbach coefficient alpha which was found to be 0.96.

Data Collection Procedure

There were three phases of data collection. These were the pretest – first one week, treatment – six weeks, and the posttest – one week–last one week of the eight weeks. Three periods of 40 minutes each were spent each week for the six weeks. There was no alteration on the time-table allocated for basic science by the school, i.e. the periods were in line with the schools' time-tables. Before exposing the selected students for the study to teaching, the students were given the questionnaire on science anxiety for their responses in other to categorize them into low and high anxiety levels respectively. The students were taught using the normal conventional lecture method. At the post-test level, the ATBSS was administered to the students one week after the completion of teaching. The data collected from the administration of the instruments were analyzed using the following statistical techniques: descriptive statistics, which involved the computation of the post-test mean scores; and standard deviation for the dependent variables. Univariate Analysis of Variance (ANOVA) computed for the dependent variable in order to test for possible post experimental differences in the dependent variables with respect to science anxiety, and gender. Computations for the afore-mentioned methods of data analysis were done using SPSS 15.00 Statistical Package.

Theoretical Framework

Identifying factors that influence student achievement and motivation to learn in the classroom continues to be a goal of education researchers Hancock. (2001). Classroom climate is sometimes referred to as the learning environment in which the students interact with one another Adelman, and Taylor (2002), and the classroom climate can affect a student's motivation, interest, and achievement. A lot of learning takes place in a stimulating environment when social relations are considered before any other factors. Everyone sometimes experiences anxiety in one form or another and in varying degrees. It involves a pattern of physiological and psychological reactions like feeling of stress and emotions. As such, anxiety can seriously inhibit the ability of concentration and dealing with things in a more positive way. It is considered as an unpleasant state evoking avoided behaviours and defenses. It can also be defined as a specific emotion necessary for an individual to prepare for potential and threatening situations. Many researchers found that anxiety is still unclear and not easy to define in simple sentences Brown, (2007). Science anxiety is described as involving feelings of tension and stress that interfere with construction of science knowledge, the development of science skills and abilities, and the use of science knowledge, skills, and abilities in a wide variety of ordinary life and academic situations Schonwetter (1995) and Udo, Ramsey and Mallow. (2004), and can negatively impact cognitive processing (Britner, 2010).

Different sources contributing to science anxiety such as gender stereotyping, misconceptions about the scientific method, and associating science with technology have been identified Udo, Ramsey and Mallow (2004). Science anxiety in students can be strongly influenced by science anxiety in teacher. Disappointingly, this may be contributing to intergenerational cycle of fear surrounding learning about science. Science anxiety in high school students is inversely correlated with self-efficacy, science enjoyment, and achievement Britner, (2008), Napier and Riley. (1985), Wynstra and Cummings (1993).Science anxiety can also be described as a state of discomfort which occurs in response to situations involving scientific tasks which are perceived as threatening to self-esteem. Such feelings are shown to lead to panic, tension, helplessness, fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty in breathing, and loss of ability to concentrate which hamper science achievement Walkman, Walker and Rossenhan (2001). If a student feels that he/she will be penalized for failure, frightened or rejected, such student will find it difficult to concentrate on learning. For optimal learning to take place, classroom climate should be positive and supportive and the behaviour of the teacher, more than any other individual, sets the climate of the class. Teachers can most readily influence climate by focusing on two complementary aspects of classroom interaction – the rapport between teacher and students and the rapport among the students.

Anxiety and Achievement

Research findings have revealed anxiety as one of the variables that affect science achievement {Julkunen (1992), Schonwetter.(1995), Zanakis, and Valenzi. (1997), Oludipe, (2010)}. Some of these studies have associated high anxiety with low achievement Teresa, (2004) investigated the effects of mathematics anxiety levels on students' achievement in mathematics. The researcher used Pearson product moment correlation statistical analysis to analyze data collected to determine if there were any relationships between anxiety levels of the students and their achievement scores. The analysis indicated that as mathematics anxiety scores increased, achievement scores decreased. Albero, Brown, Eliason, and Wind (1997*)* found that children with high anxiety had significantly lower scores. Similarly, Schonwetter (1995) found that anxiety yielded differences in students' learning outcomes.

Gender and Achievement

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 [Erinosho. (1997a), Erinosho (1997b), Erinosho, (1997c), Kennedy, (2000), Bilesanmi-Awoderu, (2002) and Erinosho. (2005). 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 [David, Kumar and Stanley, Helgeson, (2000), Freedman, (2002), Abayomi, Arigbabu, and Mji, (2004), Bilesanmi-Awoderu, (2006). However, Hyde and McKinley, (1997), Billings, (2000) and Kolawole. (2007) in their studies found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements.

Results

Gender	Anxiety level	Mean	Std. Deviation	N
Male	low	27.97	4.706	36
	high	18.65	8.484	31
	Total	23.66	8.149	67
Female	low	26.97	5.591	32
	high	21.71	8.326	21
	Total	24.89	7.213	53
Total	low	27.50	5.127	68
	high	19.88	8.475	52
	Total	24.20	7.742	120

Table 1. Descriptive statistics of students' posttest academic achievement mean scores according to anxiety and gender

In table 1, it is revealed that low anxiety students had the higher posttest (27.50) mean score than their colleagues in the high anxiety group whose posttest mean score was 19.88 (high anxiety implies low mean scores, while low anxiety implies high mean scores). It is also revealed in table 1 that there was slight difference in the post-test mean scores of male (23.66) and female (24.89) students, but the difference was not significant.

Table 2. Summary of Univariate Analysis of Variance of Students' Post-test Academic Achievement Scores According to Science Anxiety and Gender

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1843.877(a)	3	614.626	13.479	.000	.258
Intercept	65384.091	1	65384.091	1433.937	.000	.925
gender	30.718	1	30.718	.674	.413	.006
Anxiety level	1530.694	1	1530.694	33.570	.000	.224
gender * anxiety level	119.406	1	119.406	2.619	.108	.022
Error	5289.323	116	45.598			
Total	77410.000	120				
Corrected Total	7133.200	119				

a R Squared = .258 (Adjusted R Squared = .239)

Ho_1: There is no significant main effect of science anxiety on academic achievement of students in basic science.

It is revealed in table 2 that there was significant difference in the posttest mean scores of low and high science anxiety students ($F_{(1,119)} = .000$, statistically significant). Hence hypothesis 1 is not accepted.

Ho_2: There is no significant main effect of gender on academic achievement of students in basic science.

It is also revealed in table 2 that there was no significant difference in the posttest mean scores of male and female students ($F_{(1,119)} = .413$, statistically not significant). Hence hypothesis 2 is accepted.

Ho_3: There is no significant interaction effect of gender and science anxiety level on students' academic achievement in basic science

Talking about the interaction effects of anxiety and gender, it is revealed in table 2 that there was no significant interaction effect of gender and anxiety on students' academic achievement (F (1,119) = 108, statistically not significant.

6. Discussion

This study was conducted to examine the extent to which gender and science anxiety affects students' academic

achievement in basic science at the Junior Secondary school level. Results in tables 1 & 2 indicated that there were differences in the academic achievement mean scores of low science anxiety students and high science anxiety students. This implied that anxiety did affect students' academic achievement in basic science. As level of science anxiety decreased; achievement scores increased; high science anxiety led to decrease in academic achievement scores. This result is in line with the findings of Albero, Brown, Eliason and Wind, (1997*)*; Erinosho (1997a); Diaz, Glass, Arnkoof and Tanosfky-Kraff (2001); Erinosho. (2005). Tables 1 & 2 also revealed that students' academic achievement in basic science was gender invariant. Though there was slight difference in the post-test mean scores of female (24.89) and male (23.66) students, the difference was not significant. This result is also in line [David, Kumar and Stanley, Helgeson (2000), Walkman, Walker and Rossenhan (2001), Freedman (2002), Abayomi, Arigbabu and Mji (2004), Bilesanmi-Awoderu, (2006)] who provided reports that there are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender. The low science anxiety male students had higher post-test mean scores (27.97) than their high science anxiety male colleagues (18.65). Similarly, the low science anxiety female students had higher post-test mean scores (26.97) than their high science anxiety female colleagues (21.71). This implies that students with low science anxiety generally understood and improved in their academic achievement in basic science, while reverse was the case with their colleagues with high science anxiety. With respect to the interaction effects of gender and science anxiety, tables 1 & 2 revealed that there was no significant interaction effect of gender and science anxiety on students' academic achievement. This implies that the effect of anxiety on the students' academic achievement in basic science was insensitive to their gender. The mean scores of the male – low science anxiety and male – high science anxiety were not significantly different from one another; similarly, the mean scores of the female – low science anxiety and female – high science anxiety students were not significantly different from one another.

Implications and Recommendations

This study has very important contributions and high implication for the educational practices in Nigeria. This study revealed that low science anxiety students had higher academic achievement mean scores than the high science anxiety students. Therefore, basic science teachers should strive to understand science anxiety and implement appropriate teaching and learning strategies which can help the students overcome their science anxiety. This implies that if many of the basic science / science teachers do not make their lessons friendly with the students or are fond of using teaching methods that do not actively involve students in the teaching and learning basic science/science subjects, such sets of students would be afraid to attend such classes; and when they do, they would not concentrate on what their teachers are teaching them. This study also found that gender-related factors do not influence anxiety and academic achievement in Basic science.

Based on the findings of this study, the following recommendations were made:

- Basic science/science teachers should stop going to the class with cane in hand and establish good rapport with their students. This would enhance students' interest in the subject and lead to students having positive attitude towards basic science/science subject.
- When friendliness is established, students are motivated to learn and are more confident to ask questions from one another for better understanding of the tasks being learnt. Hence basic science/science teachers should adopt teaching method(s) that would actively involve students in the teaching and learning process (e.g. cooperative learning strategy, etc).
- Science/Basic science teachers should demonstrate their own interest in science/basic science in order to raise students' motivation in science/basic science as a means of helping students reduce their science anxiety.
- Science/basic science teachers should take into account the science anxiety levels of their students before determining effective and appropriate teaching strategies.

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