Effect of Gender-Role Stereotyping and Process Skills Acquisition Strategy on Upper Basic Iii Science Students' Achievement and Retention in Katsina State, Nigeria.

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Abstract

This study was designed to determine the effect of gender-role stereotyping on Basic Science students' achievement and retention exposed to process skills acquisition strategy. The pre-test, post-test, non-equivalent control group, the quasi-experimental research design was employed for the study. The sample for the study comprised ninety-five students selected from the Katsina Central Senatorial District of Katsina State, Nigeria. Two research questions guided the study, and two null hypotheses were tested at 0.05 level of significance. The instrument for data collection was the Science Process Skills Acquisition Test (SPSAT). The reliability of SPSAT was determined using Split half and the coefficient obtained was 0.76 implying that the instrument was reliable for the study. Descriptive statistic of the mean was used to answer the research questions, while ANCOVA was employed to test the hypotheses. The findings of the study indicate that there was a significant difference in the achievement and retention of male and female students in Basic Science using Process Skills Acquisition technique. The difference in achievement and retention were in favour of male students. Based on the findings, it is recommended that Basic Science teachers should be encouraged to adopt the use of the Process Skills Acquisition Strategy in teaching the subject.

Keywords: *Achievement; Basic Science; Gender-role Stereotyping; Process Skills Acquisition; Retention.*

Introduction

The term gender is socio-cultural and is based on biological expectations of the individual on the basis of being a male or female Jamabo, Enebeli, and Ester (2012). Gender also has a sound psychological background and is used to refer to specific cultural patterns of behaviour that are attributed to human sexes. It then refers to a set of assumptions about the nature and character of biological differences between males and females, assumptions that manifest in a number of ideas and practices that have a determinant influence on identity, social opportunities and life experiences of human actors (Berenbaum & Beltz, 2011). The assumptions tend to define the task and roles of a particular sex, thus enhancing role and behavioural identity for the individual. It determines what an individual is expected to do or not.

Kay, Matuszek, and Munson (2015) refer to stereotyping as a belief that individuals in a group such as gender, occupation, race, and religion generally have one or more peculiar traits or behaviours. This provides the leeway for people to make use of stereotyping to explain their own or others' behaviours to justify actions or decide how to act and to define boundaries. Similarly, Fapohunda (2012) observes that stereotyping expectations about individuals' behaviour can lead them to behave in a way that gives self-fulfilling prophecy and expectations about their own abilities which may influence their choices about interests they eventually want to pursue. A significant attachment of this assertion is its suitability to either males or females (gender stereotyping). In concurrence, Patmalniece (2011) adds that stereotyping affects both genders, but the element is more pronounced in females than in males, which implies a discrepancy between the number of female and female students studying certain subjects in schools. This further explains the existing inequalities between the genders. There are, however, noticeable differences between male students and female students, which have biological and genetic influences through dressing, provision of toys for play and rewarding of activities that are gender appropriate. Through this, children acquire an awareness of their gender roles, after which they begin to behave in ways commensurate with the acquired gender traits.

Isaac and AyokaMopelola (2014) demonstrate that gender-role stereotyping is the inclination towards certain interests based on male or female characteristics, which are inherent especially, where the majority of the tasks are physically laborious. For instance, while males are generally, stronger, taller and heavier than females, they invariably, tend to occupy positions requiring physical strength. This is true of the military or construction

careers. These generalisations do not hold water because some women are found to partake in those careers these days in a gender-reversal manner (Pattern and Parker, 2012). For instance, it is not uncommon to find women flying military fighter jets hitherto designated as males' domains.

Studies have indicated various results on gender role stereotyping, which begins at home from birth. Bills (2012) asserts that stereotyping has historically worked against women, and women's participation in formal education is influenced by cultural expectations and values. These effects are even felt in a religion where the importance of women education is recommended, and gender role expectations are still strong despite decades of societal changes (Schoon & Eccles, 2014). Gradual improvements have, however, been recorded in recent years where females occupy strategic positions in careers formerly designated for males (Kemi & Jenyo, 2016; Pattern and Parker 2012). Fapohunda (2012) admits that these changes in traditional gender-role patterns and standards have gathered more impetus into the traditionally male-dominated positions. Hoffmam, Gneezy, and List (2011) also agree that behavioural differences, however, avail where the reverse is the case regarding gender role stereotyping, where they discover that male students out-perform their female counterparts in visual-spatial ability, they are physically more aggressive than females, and they demonstrate a greater ability in mathematics abilities. It is, therefore, noticeable that these differences might not be generalised due to their short-comings.

Many scholars such as Adodo and Gbore (2012) and Mustapha (2012) have researched gender differences in academic performance, especially in Basic Science. Basic Science subject serves as a good foundation for science and technology educations (Agu and Samuel, 2018). The teaching of the subject in most Nigerian secondary schools falls short of the standard expected of it and the teaching methods used have been described as inappropriate and uninspiring. Studies by Opara and Etukudo (2014); Osuolale (2014) have found that most teachers of Basic Science are not qualified. This, in turn, affects their students' academic performance. One major problem of the teachers is that of inability to use appropriate activity–based teaching strategy (Samuel, 2018). They often resort to the usual traditional lecture method that has been shown produce poor academic performance in Upper Basic secondary schools. Igboegwu (2012) agrees that there is no best method of teaching than scientific teaching which should be laboratory-centered and activity-oriented rather than textbook or lecture dominated methods.

Science Process Acquisition Skills as a set of broadly transferable abilities appropriate to science discipline and reflective of what scientists do. Safaah, Muslim and Liliawati (2017) have identified six Basic Science Process Acquisition Skills, namely:

i. Observing-This involves using all the five senses to gather information about an object or event. This is the fundamental Science Process Acquisition Skills where the ability to make a good observation is necessary to develop other skills like communicating, classifying, measuring, inferring and predicting;
ii. Communicating-This involves using written and spoken words, graphs, tables, diagrams, and other information presentations. Students need to have good communication skills in order to share their observations with one another in the class, so communication must be clear and effective using descriptive words;
iii. Classifying-This skill involves grouping or ordering objects or events into categories based on properties or criteria. It can be binary where a set of objects is divided into two subsets, or multistage system involves different layers or stages of classification;
iv. Measuring This involves using both a standard and a non-standard measurement to describe the dimension of an object or event;
v. Inferring-Drawing a conclusion about a specific event based on observations and data. This involves explanations or interpretations that result from observation;
vi. Predicting-Stating the outcome of a future event based on a graph. For the purpose of this write up, we intend to use four Basic Science Acquisistion Skills which are observing, communicating, inferring and predicting.

Based on the importance of science to human and national development, the emphasis is now placed on science instruction at all levels of the Nigerian education system especially at the upper levels of the Universal Basic Education (UBE). The Nigerian Educational Research and Development Council (NERDC, 2007) developed a curriculum on Basic Science and stressed on the theme "Science and Development." The most important aspect of studying science is by developing in the learner the skills needed for acquiring scientific attitudes, which are the Science Process Acquisition Skills. Agu and Samuel (2018) see these process skills as tools which scientists use for science and that if children are properly introduced early to science through Process skills acquisition, they will find the skills useful throughout their lives. They add that it is possible to easily forget science content(s) learned but Process acquisition skills remain with individuals permanently. Safaah, Muslm, and Liliawati (2017) opined that Science Process Acquisition Skills had added value to students' abilities to explore their environment, answer questions and solve challenging problems individually due to its applicability. It is possible that interaction between male and female students in the classroom may enhance acquisition of Science Process Skills leading to science learning among them.

Statement of the Problem

Research by Agu and Samuel (2018) have shown that the problem of teaching and learning Basic Science at the Upper Basic School levels still persists, and students continue to perform poorly in terminal examinations, despite the existence of effective activity based teaching strategy. This has been attributed to the constant use of lecture method and negative attitude towards Basic Science teaching (Eriba & Samuel, 2018). The present study is aimed at investigating the effect of gender-role stereotyping on Basic Science students' achievement and retention using process skills acquisition strategy. The researchers were moved to conduct this research by the dwindling poor performance of students in Basic Science examinations as confirmed by the Basic Education Certificate Examination (BECE 2009-2013) reports. The students' performance in BECE (Basic Science) examinations in Katsina State over the years indicated a failure rate which was attributed to the complex nature of Basic Science concepts. This has led to the development of negative interest towards the subject by the students. Gender plays a major role in achievement, and it may be possible that gender disparities could affect the acquisition of Science Process Skills among students especially in the Upper Basic Level.

Research Questions

The following research questions guided the study:

i. What is the effect of gender on the mean achievement scores of students taught Basic Science using Process Skills Acquisition Strategy?

ii. What is the effect of gender on the mean retention scores of students taught Basic Science with Process Skills Acquisition Strategy?

Research Hypotheses

This study tested the following hypotheses at 0.05 level of significance:

H_{O1}: There is no significant gender difference in the mean achievement scores of students taught Basic Science with Process Skills Acquisition Strategy.

Ho_2: There is no significant gender difference in the mean retention scores of students taught Basic Science with Process Skills Acquisition Strategy.

Methodology

The study was a quasi-experimental research design. The research makes use of pre-test, post-test non-equivalent control group design. The researchers randomly assigned intact classes to treatment and control group with a population for the study comprising all Upper Basic three students in the Katsina Central Senatorial District of Katsina State using random sampling techniques. The sample size was made up of ninety-five Upper Basic three students (forty-six for the experimental group and forty-nine for the control group). The instrument used for data collection was the Science Process Skills Acquisition Test (SPSAT). It consisted of two sections as follows: Section A: Students' Biodata; Section B: Consisted of standardized multiple choice test items adapted from the Basic Education Certificate Examination (BECE) questions. The research instrument received a face and content validation from experts in the Faculty of Education, Nasarawa State University, Keffi, Nigeria. Ten days' intensive training programme was organized for the teachers that were involved in the

study. The training exercise was based on the purpose of the study; the topics are to teach, the use of the lesson plans, the use of the instrument and general conduct of the study. The conduct of the study took place during the normal school lesson periods. On the first day, before the lesson commenced, SPSAT was administered as a pre-test to both the experimental and control groups after which proper teaching commenced by using the prepared lesson plans. The experimental group was taught with process skills acquisition lesson plans while the control group was taught with the conventional lesson plans. Each lesson lasted for 40 minutes, and the treatment lasted for 10 weeks. At the end of the treatment, a posttest was administered on both groups with the; the scores obtained from both groups were compared to determine if there is any significant difference in the performance of the two groups. Data collected were analyzed using descriptive to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 level of significance.

Results

Research Question One: What is the effect of gender on the mean achievement scores of students taught Basic Science with Process Skills Acquisition Strategy?

The result to answer this research question is presented in Table 1.

Table 1 - Mean Achievement Scores of Male and Female Students Taught Basic Science Using Process Skills Acquisition Technique

Gender	Process Skills Acquisition Strategy				Conventional Method			
	N	Pretest	Posttest	Mean Gain	N	Pretest	Posttest	Mean Gain
Male	22	17.43	42.55	25.12	27	17.23	32.67	15.44
Female	24	17.72	41.57	23.85	22	17.36	29.94	12.58

The data presented in Table 1 show that male students taught Basic Science using Process Skills Acquisition Strategy had higher mean scores than female students in the Achievement Test. Thus, there is an effect attributable to gender on the achievement of students taught Basic Science.

Research Question Two: What is the effect of gender on the mean retention scores of students taught Basic Science with Process Skills Acquisition Strategy?

The result of the data in respect of this research question is presented in Table 2.

Table 2- Mean Retention Scores of Male and Female Students Taught Basic Science Using Process Skills Acquisition Strategy

Gender	Process Skills Acquisition Strategy				Conventional Method			
	N	Posttest	Post-posttest	Mean Loss	N	Posttest	Post-posttest	Mean Loss
Male	22	42.55	29.15	13.40	27	32.67	17.56	15.11
Female	24	41.57	21.07	20.50	22	29.94	12.78	17.16

The data presented in Table 2 shows that the male students retained concepts Basic Science taught better than female students in the test for retention of learning did.

Hypothesis One: There is no significant gender difference in the mean achievement scores of students taught Basic Science with Process Skills Acquisition Strategy.

The data to test this hypothesis is presented in Table 3.

Table 3

Summary of Analysis of Covariance (ANCOVA) for Test of Significance Between the Mean Scores of Experimental and Control groups in the Achievement Test

Source	Sum of squares	Df	Mean square	F	Sig.
Corrected Model	1686.9287	1	421.7326	81.3807	-000
Intercept	2900.2102	1	2900.2102	559.6451	.000
Pretest	5.9126	1	5.9126	1.1407	.415
Group	1332.256	1	1332.256	257.083	.000
Gender	42.6003	1	42.6003	8.220	.030
Group*Gender	8.8434	1	8.8434	1.7068	.319
Error	880.9791	89	8.8094		
Total	83298.3	95			
Corrected Total	2567.9401	94			

The data presented in Table 3 shows F-calculated values for mean scores of experimental and control groups in the achievement test, gender and interaction effect of treatments and gender on students' achievement in Basic Science. The F-calculated value for Group is 257.083 with a significance of P at .000 which is less than .05. The F-calculated value for gender is 8.220 with a significance of P at .030 which is less than .05. The null hypothesis was, therefore, rejected at .05 level of significance. This means that there was a significant difference between the effects of gender on students' achievement in Basic Science. With this result, there is a significant difference between the mean achievement and retention scores of male, female students taught Basic Science with Process Skills Acquisition Strategy, and those taught with Conventional Method.

Hypothesis Two: There is no significant gender difference in the mean retention scores of students taught Basic Science with Process Skills Acquisition Strategy.

The data to test this hypothesis is presented in Table 4.

Table 4.

Summary of Analysis of Covariance (ANCOVA) Test of Significance between the Mean Scores of Experimental and Control groups in the Retention Test

Source of variance	Sum of squares	Df	Mean squares	F	Sig. of P
Covariances	40.671	1	40.671	4.7209	.097
Post-test	40.671	1	40.671	4.7209	.097
Main effects	96949.295	1	96949.295	1125.381	.000
Group	96949.295	1	96949.295	112.381	.000
Explained	96953.644	2	48476.822	566.422	.000*
Residual	4936.044	89	14.647		
Total	101889.3198	95	300.559		

Table 4 shows that the F-value for the group is 112.381 with significant of P at .000, which is less than .05. The null hypothesis was, therefore, rejected at .05 level of significance. With this result, there was a significant difference between the mean scores of students taught Basic Science with Process Skills Acquisition Strategy and those taught using conventional teaching method in the test for retention.

Discussion

The finding of this study shows that male students taught Basic Science had higher mean scores than female students in the Achievement Test. Thus, there is an effect attributable to gender on the achievement of students taught Basic Science. Similarly, the result indicates that the female students performed better than male students in the test for retention of learning did. These findings have revealed that male students had a higher mean score in the basic Science achievement test than that of female students. At the same time, analysis of covariance was employed to test the second hypothesis, where the findings show that there was a significant difference between the main effects of gender on students' achievement in Basic Science which confirmed that the difference between the achievement of male and female students in Basic Science was statistically significant in favour of male students (Oludipe, 2012). The obvious implication of this finding is that there was an effect attributable to gender on the achievement of students in Basic Science (Mayange & Umar, 2018). This finding is similar to findings of (Udousoro, 2011) that were conducted on gender effects on achievement of male and female students in mathematics, sciences and technology fields which indicated that significant gender differences in favour of male students. These findings revealed that students taught with Process Skills Acquisition Strategy had a higher mean score than those taught with the conventional teaching method in the test for retention of learning, where the analysis of covariance of the retention test confirmed that the difference in the mean score of the students taught with the Process Skills Acquisition Strategy and those taught with conventional teaching method is significant Samuel and Peter (2013). This implies that the Process Skills Acquisition strategy has a positive effect on the students' retention of learning in Basic Science. This can be explained as a result of the relevant learning approach which facilitates knowledge construction, develops higher order thinking skills, improves memory and enhances transfer of learning (Ekon & Ekon, 2015: Amanso & Bassey, 2017). This finding is in support of Rusman, Wolde, Euser & Ploeg (2018) and Taylor-Smith, Tweya, Harries, Schoutene and Jahn (2010) who fund that retention of learning is not affected by gender but by the degree of original

learning, time at which retention is measured and the individual's working memory capacity among other factors.

Conclusion

The study revealed that there was a significant difference in the achievement and retention of male and female students in Basic Science when taught using Process Skills Acquisition Strategy. The difference in achievement was in favour of male students while the difference in retention was in favour of female students.

Recommendations

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

i. Teachers should adopt the use of the Process Skills Acquisition Strategy in the teaching of Basic Science;
ii. Ministry of education and administrators of Upper Basic Levels should always organize seminars, conferences and workshops to sensitize teachers on the use of Process Skills Acquisition technique.

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