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Effect of gender on Basic Science students' academic achievement in secondary schools in Enugu Education Zone, Enugu State, Nigeria

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Junior secondary schools' achievement in Basic Science continues to fall below expectations, despite several interventions by multiple stakeholders. Hence, there is need to research more on gender effects on the delivery of Basic Science curricula content. This study, therefore, examined the effect of gender on Basic Science students' academic achievement in secondary school. A pre-test, post-test, non-equivalent, control group, quasi experimental research design was adopted. Two intact classes of seventy-two (72) JSS 2 students (30 males and 42 females) were randomly selected from public secondary schools for the study State Nigeria. The selected classes were randomly assigned to experimental and control groups. A 25-item validated instrument titled Basic Science Achievement Test (BSAT) designed by the researchers was used for data collection. The reliability coefficient of the BSAT was 0.81 using Kuder-Richardson's formula 20 (K-R 20). Data collected were analyzed using Means, Standard deviation and Analysis of covariance (ANCOVA). The findings of the study revealed that gender (male/female) had no significant effect on students' achievement in Basic Science and finally, result showed that there was significant interaction effect of treatment and gender on students' academic performance in Basic Science. Therefore, it was recommended that students should be given equal opportunity and the same level of encouragement irrespective of their level and gender.

Key words: Academic achievement, basic science, gender, secondary school.

INTRODUCTION

Integrated science, now Basic Science is the first form of science a learner 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. Basic Science is therefore a subject which embraces some core science subjects, namely: biology, chemistry, physics and mathematics. Basic Science is a subject that cut across the school curriculum and needed in all branches of science, applied science and social sciences. Therefore, students have to be well grounded in Basic Science at the junior secondary

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level to enable them study single science subjects at the senior secondary school level successfully. Basic Science is given great emphasis in the junior secondary school curriculum (Okolo, 2018). The objectives of Basic Science teaching in Nigeria secondary schools are as follows:

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, 2004).

Researchers (Opara, 2011; Olarewaju, 1994; Adewumi 1982), were all in agreement with the reasons for teaching Basic Science in Nigeria. Basic Science is teaching science in such a way as to present scientific ideas as a unified whole. It is devised and presented in such a way that students appreciate the concept of the fundamental unity of science, the commonality of approach to problems of scientific nature, and are helped to gain an understanding of the role and function of science in everyday life and the world in which they live (Arbon as citied in Opara, 2011). Arbon added that, the integrating principles are intended to produce a course which is relevant to student's needs and experiences, stresses to fundamental unity of science, lays adequate foundations for subsequent specialist study and adds a cultural dimension to science education (Opara, 2011). The integration of Basic Science minimizes fragmentation of learning and links together basic scientific information. Basic Science teaching also ensures academic teaching experience in science in which the subject matter boundaries between various scientific disciplines (Biology, Chemistry, and Physics) are dissolved in favour of broad ideas that transcend all the Basic sciences (NOUN, 2006). This implies that the teaching of Basic Science as a unified course eliminates the repetition of subject matter from the various sciences and does not recognize the traditional subject boundaries when presenting topics or theme.

Producing scientists for national development is one of the goals of Basic Science education but some Basic Science teachers do not even think about the goals, and may even not know what the policy demands from their work (Okolo, 2018). It is important that Basic Science teachers be trained and retrained on the goals of teaching Basic Science to enable the teacher to select the content to be learnt by the learners, and to determine the appropriate methods and materials to be used during teaching in order to achieve the stated goals. This implies that the gender of the learners, methods and materials will be considered to help in effective delivery so as to help achieve the goals.

Gender sensitivity has been observed in the area of Basic Science as one of the factors that affect the performance of students in Basic Science. Most male students out-performed female students in science related subjects due to the psychological ability of the male students to with stand difficult tasks compared to their female counterparts who go for easy ways of life or less boredom tasks (Bichi, 2002). Aniugwu as cited in Okolo (2018) asserted that gender issues in Basic Science have a source of aversion and that Science related subjects has been male stereotyped since it was regarded as abstract and difficult subject as well as has attributes which boys were attracted to. Ani et al. (2020) in the study conducted, observed that male students performed better than their female counterparts when taught Basic Science. In view of the fact that gender of participants may have impact on the students' academic performance, this study will use gender as moderator variable.

There is high rate of poor academic achievement of students in Basic Science in Junior Secondary School Certificate Examination (JSSCE) over the years. This could be as of the teachers use ineffective methods, strategies and gender differences in science teaching which among other factors have contributed to the student's poor achievement in Basic Science at the junior secondary school. This poor achievement in Basic Science has necessitated the need for Basic Science in junior secondary school by the researchers. Beside this, inconsistent findings have been made on gender differences and academic achievement (Gimba, 2006; Nsofor, 2004; Akinsola, 2002; Okereke, 2011; Amosun, 2011; Asuai, 2013; Ugwuanyi, 2016). The researchers therefore proposed the need to find out if gender has effect on students' academic achievements in Basic Science.

The study aims to investigate the effect of gender on the academic achievement of students in Basic Science irrespective of gender. In specific terms, the study sort to investigate the gender effect on Basic Science students' academic achievement. The following research questions were raised to guide the study:

1) What is the influence of gender on academic achievement of Basic Science students in Enugu Education zone?
2) What are the mean post-test achievement scores of male and female Basic Science students exposed to treatment in Enugu Education zone?
3) What are the mean retention scores of male and female students exposed to experimental control in Enugu Education zone?

Table 1. Mean and standard deviation scores of students in BSAT for experimental and control groups before and after treatment achievement.

Gender	Pre-test			Post-test			Mean gain	Mean gain difference
	N	Mean	SD	N	Mean	SD		
Male	30	14.65	6.62	30	44.23	11.35	29.58	15.40
Female	42	11.28	5.77	42	25.46	9.83	14.18	
Total	72	12.97	12.39	72	34.85	21.18	21.88	

Hypotheses

The following null hypotheses tested at 0.05 level of significance guided the study:

Ho_1: There is no significant difference in the mean achievement scores of male and female students' academic achievement in Basic Science.
Ho_2: There is no significant difference in the mean achievement scores of male and female students exposed to treatment and their counterparts in the control group.
Ho_3: There is no significant difference in the mean retention scores of male and female students exposed to experimental control.

METHODS

The study adopted quasi-experimental design of pretest-posttest and post-posttest non-equivalent control group design. The choice of this design was made as none of the true experimental designs were possible. According to Anikweze (2015), this design is desirable for analyzing gain scores, that is, differences between posttest and pretest scores. This design was used because the researchers were interested in the study of cause and effect and in manipulating the independent variable (gender) in order to observe the effect on the dependent variable (academic achievement). The target population of the study was the entire JSS II students in the 31 public secondary schools in Enugu zone. A sample of 72 students consisted of 42 female and 30 males students participated in the study. Two (2) intact JSS II students were randomly picked from two (2) randomly selected public secondary schools in Enugu Education Zone of Enugu State, Nigeria. The two selected intact JSS II students were randomly assigned to experimental and control groups respectively. Three research questions and three null hypotheses were formulated to guide the study.

The instrument used for data collection was a 25-item Basic Science Achievement Test" (BSAT) designed by the researchers. Face and content validity of the instruments were carried out through test blue print by two experts in Basic Science and Measurement and Evaluation units of Alex Ekwueme Federal University Ndufu Alike Ikwo (AE-FUNAI), Ebonyi State, Nigeria. Trial testing of the instrument was carried out using Kuder-Richarderson Formula 20 (K-R 20) to determine the reliability coefficient index of 0.81 for the instrument. The researchers were introduced as the new Basic Science teachers in order to prevent students from thinking that they are being used for experiment. In order not to disrupt the school schedules, the school normal class time tables were used.

The researchers used lesson notes with infused instructional modes and normal lesson notes in teaching the students in experimental and controlled group respectively the content areas for six weeks. Pre-test was administered by the researchers on the two groups before teaching to determine the equivalence and ability level of the students' knowledge in the two groups. Post-test was administered on the two groups at the end of the six (6) weeks of teaching. The BSAT was reshuffled and administered 2 weeks later after the post-test as post-posttest to determine the students; retention. The data were collected and analyzed using mean and standard deviation to answer the research questions while ANCOVA was used to test the null hypotheses at 0.05 level of significance.

RESULTS

The following results were obtained from the data analysis

Research Question 1: What is the influence of gender on academic achievement of students in secondary school Basic Science students in Enugu Education zone? The results in Table 1 shows that at pre-test, the achievement mean scores for males and females were 14.65 and 11.28 2 respectively. Similarly the standard deviations were 6.62 for the males and 5.77 for the females. After post-test, it was observed that for the males, mean achievement score was 44.23 with a standard deviation of 11.35 while for the females, the mean achievement scores and standard deviations were 25.46 and 9.83 respectively. This implies that males achieved higher than females. The null hypothesis one tested at 0.05 level revealed that the mean achievement scores of Basic Science male students differ significantly with their female counterparts.

Research Question 2: What are the mean posttest achievement scores of male and female Basic Science students exposed to treatment in Enugu Education Zone? Data in Table 2 shows the mean scores and standard deviation of male and female students exposed to treatment. The difference in the post-test mean scores between male and female students was mean difference of 2.17 in favour of the male students. This implies that the male students retained what they had learned more their female counterparts.

Table 2. Mean scores and standard deviation of male and female students achievement exposed to treatment.

Gender	Type of test	N	Mean	SD	Mean Diff
Male	Treatment	12	21.74	5.27	
					2.17
Female	Treatment	18	19.57	3.79	

Research Question 3: What are the mean retention scores of male and female students exposed to experimental control?

Data in Table 3 shows the mean retention score and standard deviation of male and female students exposed to experimental control group. The difference in the post-test mean retention scores between male and female students was mean difference of 8.15 in favour of the male students. This implies that the male students retained what they had learned more than female students.

Hypotheses

Ho_1: There is no significant difference in the mean scores of male and female students' academic achievement in Basic Science.

Table 4 shows that gender is not significant on students' achievement in Basic Science. The Table shows that, F = 9.439, 1/70 df, P <0.005 (8.49) - this means that statistically significant differences were noted by gender and "P < 0.005" means that there are less than 5 chances out of 1,000 occurrences that this finding happened by chance alone.

Ho_2: There is no significant difference in the mean achievement scores of male and female students exposed to treatment and their counterparts in the control group in Enugu Education Zone.

Table 5 however shows summary of ACOVA test of male and female students' academic achievement in Basic Science. The result revealed that the observed difference between the mean scores of male and female students was significant at 0.05 alpha levels. This was as a result that P>0.05 was not rejected since F = 1.896, 1/70 df, P > 0.05 (4.00) --- this means that statistically significant differences were not found at the 0.05 level.

Ho_3: There is no significant difference in the mean retention scores of male and female students exposed to experimental control.

Table 6 shows summary of ACOVA test of retention of male and female students' academic achievement in Basic Science. The result revealed that the observed difference between the mean scores of male and female students was significant at 0.05 alpha levels. This was as a result that P>0.05 was not rejected since F = 1.696, 1/70 df, P > 0.05 (4.00)- this means that statistically significant differences were not found at the 0.05 level.

DISCUSSION

Based on the above findings, students exposed to treatment had higher performance compared to their counterparts. However, hypothesis testing revealed that this means that statistically significant differences were noted by Gender and "P < 0.005" means that there are less than 5 chances out of 1,000 occurrences that this finding happened by chance alone. This finding was not is in agreement with Asuai (2013) who found that there was a significant difference in the achievement of students who were exposed to experimental treatment. The study also agrees with the assertions that gender difference may exist but a good method should be capable of neutralizing the difference (Akinsola, 2002). Hence, in the pre-test there existed some gender difference between the sexes in both the experimental and control groups. The difference that existed within the experimental groups reduced drastically after treatment.

The findings of the study revealed in Table 2 that the mean difference was in favour of the male students while the null hypothesis 2 tested revealed that the observed difference between the mean scores of male and female students is no significant at 0.05 alpha levels. This was as a result that P>0.05 was not rejected since F = 1.896, 1/70 df, P > 0.05 (4.00) --- this means that statistically significant differences were not found at the 0.05 level. Hence, the findings revealed that there was no significant difference in academic achievement gained by both male and female students in the experimental group. This study therefore asserts that students' academic achievement is not a function of gender. This was not in agreement with the study conducted by Ani et al., (2020) whose findings revealed that the mean achievement scores of students who received geometry instruction using analogical teaching approach did differed significantly.

Table 3 showed that male students had higher mean retention scores that their female counterparts. The male difference was in favour of the male students. Hypothesis three tested, revealed that statistically significant differences were not found at the 05 level, This is as a result that P>0.05 was not rejected since F = 1.696, 1/70 df, P > 0.05 (4.00) --- this means there was significant

Table 3. Mean retention and standard deviation of male and female students achievement exposed to experimental control.

Gender	Type of test	N	Mean	SD	Mean Diff
Male	Retention	10	25.61	7.11	
					8.15
Female	Retention	20	17.46	4.46	

Table 4. Analysis of Covariance (ANCOVA) Result for Male and Female Students' Achievement Scores.

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected Model	645.023 [a]	2	204/770	4.688	0.005
Intercept	15874.648	1	15784.648	235.567	0.000
Pretest	64.769	1	64.769	0.213	0.304
Gender	16.872	1	16.872	9.439	0.000
Error	10329.734	70	62.864		
Total	234370.000	72			

S = Significant at P< 0.05; df = 1, 70.

Table 5. Analysis of Covariance (ANCOVA) Result for Male and Female Students exposed to Treatment.

Source	Type III sum of squares	Df	Mean square	F	Sig.
Corrected Model	162.142[a]	2	86.121	1.643	0.002
Intercept	1782.566	1	1782.566	44.768	0.000
Posttest	88.658	1	88.6658	1.784	0.256
Gender	90.312	1	90.312	1.896	0.002
Error	2091.241	70	46.761		
Total	115083.247	72			
Corrected total	2146.400	71			

Table 6. Analysis of Covariance (ANCOVA) Result for Male and Female Students' Retention Exposed to Treatment.

Source	Type III sum of squares	Df	Mean square	F	Sig.
Corrected Model	752.121[a]	2	76.121	1.643	0.001
Intercept	182.546	1	1682.496	43.77	0.000
Posttest	84.653	1	68.645	1.864	0.276
Gender	91.312	1	10.313	1.696	0.000
Error	2291.143	70	56.682		
Total	135083.244	72			
Corrected Total	2245.401	71			

difference in academic achievement of male and female students' retention when exposed to treatment. This finding is in agreement with Ugwuanyi (2016) whose findings revealed that students who were taught algebra using algebraic fraction game retained more of the concepts taught than those taught with conventional approach.

Conclusion

Based on the results and discussions of the findings of

the study, the researchers pertinent that students' academic achievements in secondary school Basic Science are not influenced by gender. The study has shown that gender had no significant effect on students' achievement in Basic Science. It can therefore be asserted that gender of students whether male or female, does not seem to have any influence on the effectiveness of any of the treatment employed in the study. This is an indication that if both treatments are used effectively for male and female they are likely to produce the same result.

Recommendations

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

1) Students should be given equal opportunity and the same level of encouragement irrespective of their level and gender.
2) Teachers should show and factored equal treatment of male and female in Basic Science instructional curriculum and school policy formulation.
3) Scholarship opportunities should be made available by the government and other institutions to enhance the scientific literacy of the Nigerian citizens.

CONFLICT OF INTERESTS

The authors have not declared any conflicts of interests.

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