GENDER INFLUENCE ON ACADEMIC PERFORMANCE IN BASIC SCIENCE IN TWO INSTRUCTIONAL SETTINGS: THE CASE OF COMPUTER -ASSISTED INSTRUCTIONAL PACKAGE IN NIGERIA

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Abstract
In heterogeneous schools, students are subjected to same treatment irrespective of differences in gender. Performance in this setting does not always reflect gender disparity except when teachers discriminate. In Computer-assisted setting, students' performance may not necessarily follow the pattern of brick and mortal classroom because some learn well as individual while others learn faster amidst their peers in form of group work. This study examined performance based on gender within and between two instructional settings when taught using Computer Assisted Instructional Package (CAIP). Quasi-experimental pre-test- post-test research design was used. Five Null hypotheses were generated; the target population was all JSS 3 students in Ondo State; 120 samples were selected from three schools (40 samples from each) and assigned to Experimental groups 1 and 2 in equal numbers according to gender. The third school served as control and taught conventionally. Students in Experimental group 1 were exposed to CAIP individually, Experimental group II in Cooperative groups. Basic Science Achievement Test (BSAT) was used in collecting data. Test-retest method was used in finding the reliability of BSAT which yielded reliability coefficient of 0.78. BSAT was analysed using Analysis of Covariance and Multiple Classification Analysis. Results indicated that Male students exposed to CAIP in cooperative setting performed better than male subjects in individualised setting, while female students I n the Cooperative setting performed better than their female counterparts in individualised instructional settings. Also, it was detected that there was no significant difference between male and female subjects within the two instructional settings. Consequently, the paper recommends cooperative instructional setting devoid of gender discrimination in learning Basic science in secondary schools.

Keywords: CAIP, gender, individualized instructional setting, cooperative instructional setting; and BSAT

Introduction

Basic Science, one of the subjects offered at the junior secondary classes, introduce students to the main science subjects offered at the senior secondary classes. With the aim of enhancing students' science cognition as well as the fundamental nature of science, Basic science learning promises to inculcate basic scientific skills and attitude in students. This importance necessitated a need for a viable instructional tool for learning. Also, with the emergent of the new reality of COVID 19 which featured social distancing as a preventive measure, an instruction exhibiting such nature is of great need in the educational enterprise. Furthermore, the stereotypic bias that science is a male enterprise is of a great concern thereby a mode of instruction that will give both gender an equal recognition becomes essential.

A Computer -Assisted Instructional Package was developed and Validated by Laleye in 2016. The Package was tested for efficacy in two instructional settings- individualised and cooperative. It was detected that that the package enhanced students' learning outcome in

Basic science; also, students in the cooperative group performed better than students that accessed the package individually (Laleye, 2019a, 2019b). This may be due to the interaction, cooperation and collaboration among the members of the group as each of the members of the group plays active roles when learning using the package. This helps their rate of understanding and knowledge of basic concepts of the content thereby improving their academic performance.

A Basic Science class in a heterogeneous school comprises of students of different gender with peculiar characteristics. Gender refers to the socio-cultural dimensions of being female or male. Gender is distinguished from sex, which involves the biological dimensions of being male or female. Gender roles are the social expectations that prescribe how males and females should think, act or feel. A child when born is either male or female but the social role of a male or female is learned. According to Duyilemi, cited in Laleye (2011), the word gender is socially and culturally constructed and is influenced by political, economic and religious factors which are specific to each society. Gender of students has attracted the attention of researchers in relation to the influence it may have on their performance in the school setting. This can be attributed to the stereo-typical and socio-cultural beliefs that already exist in the African setting (Wasagu & Mohammed, 2007). Several researches have been conducted to confirm this. Okafor (2001) and Iwendi (2008) in their works concluded that male performed better than female in science and technological concepts. Also, Njoku (2000) and Chinwezi (2001) postulated that boys perform better than girls when using projected visuals in learning and at all levels of science education in Nigeria. Against this assertion, Anagbogu and Ezeliora (2007) found that girls score higher than boys when exposed to different scientific trainings on cognitive, affective and psychomotor skills. Also, Nnamani and Onyibe (2016) in their findings discovered that female secondary school students that were taught using the individualised instructional method obtained higher mean scores than male students in social studies in junior secondary schools. James (2000) in his study supported this assertion as he concluded his study on gender and use of inquiry method that female students perform better than their male counterparts. Some researchers (Okebukola (1992), Gambari & Mogbo (2006), Gbodi and Laleye (2006), Yusuf (2006), Adebayo (2008), Adegunwa (2008) and Azubuike (2018) were unable to detect any difference in the performance of male and female students in their different studies in various subjects using computer- Assisted Instructional Packages.

The teacher is considered the most important resource person in achieving the goals of any curriculum. He engages in interactive behavior with the students. His primary concern is to translate educational objectives cognitive, affective or psychomotor to bring about desired change of behavior in the students. The teacher needs to discover new ways of motivating and stimulating science students with gender differences, many of whom have different learning styles and different orientations to life. Part of the drive towards greater use of modern technology in education is aimed at modernizing schools and equipping the pupils of today with skills that will enable them to use such technology in the workplace once they leave school. Use of computers in teaching-learning situation presents the subject in an environment in which there is an existing belief that only boys can survive or succeed. Researches been conducted made several attempts made to let girls know that they are not less able to their male counterparts. It is very glaring that woman seldom participates in rigorous courses in sciences. The area where they take careers in science is mainly in biology, medicine and nursing but seldom in the areas of engineering, physics, and mathematics and computer science (Duyilemi, 2000).

Okeke (2004) defines gender as all the characteristics, behaviors and roles that the society ascribes to people as male or female. Etuk (2005) saw gender as one of the earliest central components of the self-concept and therefore serve as an organizing principle through which many experience and perceptions of self are filtered. Duyilemi (2000) reiterated that gender is the relative value and status accorded to women and men by the society in which they live. Studies have shown that gender differences in education had its genesis from the Greek education where boys proceed to grammar school and move to rhetorical school while girls proceed to study grammar at home, according to Okolo (2001), genderisation of education brings into focus the class structure of the Nigeria society where today, women cannot be seen as independent persons free and equal in status, virtues and authorities with the men. Buttressing his point, he re-affirmed that women are not only poor but are also caught between two vastly different worlds – the world determined by culture and tradition that confines their activities, role and education largely to the family and home, and the world of industrialization and employment.

Njoku (2005) observed that girls do not perform well in science and Technology-related subjects. He explained that they lagged behind the boys in terms of interest or attitude, participation and achievement in science and technology. He explained further that the gender biases against female reflects in terms of language, illustrative pictures and diagrams and even activities are slanted towards male interest, preferences and worldview may not be expected to enhance a female confidence, interest, participation or achievement in science and technology subjects. The low capacity of girls to perform well in science and technology has rightly been attributed to gender biased stereotypes and biases. According to Duyilemi (2000), Erinoso (1997), and Njoku (2000), gender biases is found in the illustrations used in science textbooks. Several instances were given among which is the depicting of men as decision makers, doctors, engineers etc. While woman activities are lined with domestic roles, reproductive roles etc. Women and girls are completely absent from the recreation and leisure activities while the boy's game is more vigorous than that of girls. As a result of this, if any girl choose science, its widely believed that she is dabbling into boy's domain from which they were historically excluded by culture assumption that as a girl they are unfit for.

Njoku (2005) highlighted that gender biases against girls made them to lag behind boys especially in the physical science as science and technology subjects had been painted with the image of masculinity. It was believed that science and technology subjects especially physical sciences are perceived as boys' domain in which girls can only play marginal roles. Akomolafe (2010) citing Lynn buttressed the assertion that males have larger average brain size than females and therefore would be expected to have higher IQs. Hence, the school and classroom environment in which the girls and boys learn science and technology subjects are managed in ways that favour the boys but to the disadvantage of the girls. This according to him has resulted in the observed poor performance of the girls relative to the girls in these disciplines. As a result of this, science and technical subjects especially the physical sciences are perceived as boys' domain in which girls can only play marginal roles. Hence, the school and classroom environment in which the girls and boys learn science and technical subject are managed in ways that favour the boys but to the disadvantage of the girls.

Statement of the Problem

In this age of technology, learning via computer is no longer new. Every student irrespective of gender is expected to learn with ease using computers. A computer package was developed and validated (using Dick Carey and Carey 2005 model) for learning difficult

concepts of Basic Science by Laleye in 2016. It was discovered that the developed package enhanced learning of Basic science (Laleye, 2019a). It was also discovered that students learn better as a group (cooperative) than individualised learning. None of the studies consider gender differences in student and the influence it may have on their performance. Gender has been identified by various researchers as one of the factors influencing student's performance in science (Okeke, 2004; Adesoji, 2006; Anagbogu & Ezeliora 2007; & Eze 2007,). Some researchers believe gender affects performance of students either negatively or positively, while some believe it does not have any effect. This study found out if gender of students will affect their academic achievements when taught using the developed package CAIP within and between two instructional settings – individualised and cooperative settings.

This work checked for effects of a developed package (Computer-Assisted Instructional Package) on the learning outcome of students in Basic science as a result of their gender in two different instructional settings in Ondo State secondary schools. Specifically, the study found if there was significant difference in the performance of male and female subjects within and between the instructional settings.

Research Hypotheses

The following research hypotheses were generated for the study:

Ho_1: There was no significant difference in the performance of male and female students in individualised instructional settings when exposed to CAIP.

Ho_2: There was no significant difference in the performance of Male and Female students in the cooperative instructional setting when exposed to CAIP.

Ho_3: There was no significant difference in the performance of Male students in individualised and cooperative settings when exposed to CAIP.

Ho_4: There was no significant difference in the performance of female students in individualised and cooperative instructional settings when exposed to CAIP.

Ho_5: There was no significant interaction effect of students' gender and academic performance when exposed to CAIP.

Methodology

Quasi-experimental pre-test-post-test design was used in checking the effect of CAIP on students' academic performance, gender and instructional setting. The independent variable was study conditions. The study condition had three levels of treatments: The Computer-Based Instruction in individualized classroom setting (Experimental group 1), Computer-Based Instruction in co-operative classroom setting (Experimental group 2) and the Conventional classroom setting (Control group). The third independent variable was gender (Male and female). The dependent variable was the learning outcome.

The selected topics for the content of the developed package cut across JSS 1-3 in the Basic science curriculum. Therefore, the target population for evaluation of the developed package was all JSS 3 students in Ondo State. Purposive sampling technique was used in selecting the samples. The criteria set for this study required that research samples are selected from schools where students and their teachers are computer literate and there are enough set of computers that will serve the study groups. This implies that the sampled school for individualized instructional setting must have a minimum of 40 sets of computers while 10 sets of computers must be available in the selected school for co-operative instructional setting. As a result of this, out of all the 503 junior secondary schools in Ondo State, purposive sampling method was used to select the junior secondary school that satisfied the set criteria. Stratified random sampling was used to select 3 junior secondary schools from

the schools that met up with the set criteria. Although, all the secondary schools in the state were supplied with sets of computers, some of the schools were familiar with the usage before the supply (in these schools, students and their teachers are computer literate) and more consistent in their usage. The schools were selected because they have: Well-equipped computer laboratories with more than required number of set of computers and good stand-by generators that were needed for the study; The students and their teachers are computer literate to work on the developed package CAIP with little or no assistance and the schools are connected to the internet to download browsers for the developed CAIP if need be.

In each of the schools, 60 students were selected from the JSS 3 class out of which 40 were purposively selected in equal numbers for gender i.e., 20 boys and 20 girls. In order words, result of 120 students was used for final analysis of data, 60 boys and 60 girls.

The instruments for this research were the treatment instrument which is the Computer-Assisted Instructional Package (CAIP) and the test instrument which is Basic Science Achievement Test (BSAT). CAIP was developed based on Ina Fourie (1994) model. The model addressed the background of students, age and instructional setting and the differences by providing significant experiences for each individual learner. Validation of the developed package (CAIP) was done in line with Dick, Carey and Carey (2005)'s recommendation (Laleye, 2016). BSAT which was the test instrument was drawn by the researcher based on the topics in CAIP. It was a diagnostic test that is made up of 25-item multiple-choice objective tests with four options. BSAT was given to all the participating groups for evaluation at the pre-test and post-test levels. The pre-tests and post-tests were marked and scored. Four (4) marks are awarded for each item, giving a total mark of one hundred (100), that is; 4x25 = 100. The score therefore formed the basic data for testing hypotheses. The result obtained from the test was used to determine the gender influence on Junior Secondary Students' Performance in Basic science in the two instructional settings when taught using Computer-Assisted Instructional Package.

The instruments used were validated by giving them to experts for face, construct and content validity. Modification and corrections were made where necessary before the final production. Test-retest method was used to find the reliability of the test instrument. An equivalent fourth school was selected to establish the reliability of the test instrument-BSAT. BSAT was administered to the group of 30 students in JSS3 in the school. After a period of two weeks, the same test BSAT was re-administered to the same group of students that sat for the previous test. The individual's score from the two tests were correlated and analysed using Pearson Product Moment Correlation (PPMC). The result was 0.78 at 0.05 levels of significance.

Treatment and Administration of instrument

For the Experimental group 1, 40 desktop computers with 18cm monitors were used while experimental group 2 used 10 desktop computers. Experimental group 2 came to the studio in groups, each group consisting of four students stayed with each of the computers. The researcher, Basic science teachers and the computer operator stayed by the corner watching the students working in a natural environment. In the control group school, their teacher taught the topics on the CAIP using the necessary instructional materials. Lessons were conducted after school hours in order not to disturb their normal school work. Permission was sought from the principals and teachers of the concerned schools to meet with the students after the school hours since all the students reside in the hostel. BSAT for the pre-test was rearranged and administered to the students as post-test after treatment. The

scores of students in BSAT were statistically analysed using Analysis of Co-variance (ANCOVA) to test the hypotheses raised for the research. Pre-test scores and school were entered as co-variates. Since there was significant difference, the post-hoc analyses were done using scheffe-post hoc test and Multiple Classification Analysis (MCA). All hypotheses were tested at 0.05 level of significance.

Results

Ho_1: There is no significant difference in the academic performance of male and female subjects exposed to CAIP in individualized settings.

The mean scores of male and female subjects exposed to CAIP in individualize instructional setting were obtained and subjected to statistical analysis using Analysis of Covariance (ANCOVA) at 0.05 level of significance. The result is presented in Table 1.

Table 1: Academic performance of male and female subjects Exposed to individualized Instructional Settings using ANCOVA

Source	SS	df	MS	F_{cal}	F_{table}
Corrected model	14829.61	2	7414.805	45.150	3.23
Covariate (pretest)	13839.59	1	13839.585	84.272	4.08
Gender	29.045	1	29.045	.177	4.08
Error	6076.365	37	164.226		
Corrected Total	20905.975	39			
Total	197929.000	40			

P>0.05

Table 1 presents the academic performance of male and female students exposed to individualize instructional settings. The result shows that F_{cal} (0.177) is less than F_{table} (4.08). The null hypothesis is accepted. Therefore, there is no significant different in the academic performance of male and female students exposed to individualized instructional settings.

Ho_2: There is no significant difference in the academic performance of male and female subjects in cooperative instructional settings when exposed to CAIP.

In order to test the hypothesis, mean scores of male and female subjects exposed to CBIP in cooperative instructional setting were computed and subjected statistical analysis involving Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Table 2: Academic performance of male and female subjects exposed to cooperative instructional setting using ANCOVA

Source	SS	df	MS	F_{cal}	F_{table}
Corrected model	8383.08	2	4191.54	37.01	3.23
Covariate (pretest)	8382.98	1	8382.98	74.02	4.08
Gender	86.91	1	86.91	.767	4.08
Error	4190.42	37	113.26		
Corrected Tota	12573.50	39			
Total	248196.00	40			

P>0.05

Table 2 presents the academic performance of male and female students exposed to cooperative instructional setting. The result reveals that Fcal (0.767) is less than Ftable (4.08) at 0.05 level of significance. Therefore, the null hypothesis is accepted. This implies that there is no significant difference in the academic performance of male and female subjects exposed to cooperative instructional settings.

Ho_3: There was no significant difference in the performance of male students exposed to CAIP in Individualized Instructional setting and those in Cooperative Instructional setting when taught using CAIP.

In other to test the hypothesis, mean scores of male students in the Individualized and Cooperative Instructional settings were obtained and subjected to statistical analysis using Analysis of Covariance (ANCOVA) at 0.05 level. The result is presented in Table 3.

Table 3: Academic performance of male subjects exposed to individualized and cooperative instructional settings using ANCOVA

Source	SS	Df	MS	F_{cal}	F_{table}
Corrected model	12235.90	2	6117.95	42.24	3.23
Covariate(pre-test)	11955.00	1	11955.00	82.54	4.08
Gender	657.37	1	657.37	4.54	4.08
Error	5359.20	37	144.84		
Corrected Total	17595.10	39			
Total	237524.00	40			

P<0.05

Table 3 presents the academic performance of male students exposed to individualize and cooperative instructional settings. The result shows that F_{cal} (4.54) is greater than F_{table} (4.08) at 0.05 level of significance. The null hypothesis is rejected. Therefore, there is significant difference in the performance of male students exposed to individualize and cooperative instructional settings. In order to test the effect of treatment on the adjusted post-test mean scores of subjects, Multiple Classification Analysis (MCA) was used. The result presented in Table 4.

Table 4: Multiple Classification Analysis (MCA) showing the effect of individualized and cooperative instructional setting

		Grand Mean = 77.30		
Variable+ Category	N	Unadjusted Devn'	Eta	Adjusted for independent+ Covariate	Beta
Individualized	27	-0.94		-2.54	
Cooperative	29	5.81		5.00	.78
Multiple R^2					.652
Multiple R					.808

The result of Multiple Classifications Analysis showing the effect of individualized and cooperative instructional setting is presented in Table 4. The results show that male subjects exposed to cooperative instructional setting had higher adjusted post-test means score of 82.30 (77.30+5.00) compared to their male counterparts in the individualized instructional setting group with an adjusted post-test mean score of 74.76(77.30 + (-2.54)

H_O4: There is no significant difference in the performance of female students exposed to individualize and cooperative instructional settings when taught using Computer-Assisted Instructional Package.

To test the hypothesis, mean scores of female subjects exposed to individualized and cooperative instructional settings were obtained and subjected to statistical analysis involving Analysis of Covariance (ANCOVA) at 0.05 level of significance. The result is presented in Table 5.

Table 5: Academic performance of female subjects Exposed to individualize and Cooperative instructional settings using ANCOVA

Source	**SS**	**Df**	**MS**	**F_{cal}**	**F_{table}**
Corrected model	12235.95	2	6118.97	43.27	3.23
Covariate(pre-test)	9942.72	1	9942.72	70.31	4.08
Gender	1219.06	1	1219.06	8.62	4.08
Error	5232.43	37	141.42		
Corrected Total	17470.38	39			
Total	208601.00	40			

P<0.05

Table 5 shows that F_{cal} (8.62) is greater F_{table} (4.08) at 0.05 level of significance. The null hypothesis is rejected. Therefore, there is significance difference between the academic performance of female subjects exposed to individualize and cooperative instructional settings when taught with CAIP.

Testing the effect of treatment on adjusted post-test means scores of subjects multiple Classification Analysis (MCA) statistics was used. The result is shown in Table 6.

Table 6: Multiple classification analysis of the adjusted post-test mean scores of female students

Grand Mean =63.68					
Variable Category N	+ N	Unadjusted Devn	Eta	Adjusted for independent + Covariate	Beta
Individualized	31		-2.86		
Cooperative	31	13.16	1.35	9.35	.78
Multiple R2					
Multiple R					

Table 6 presents the effect of treatment on the adjusted post-test means scores of female subjects. The result shows that, with a grand mean of 63.68, female subjects in the cooperative group had higher adjusted post-test mean score of 73.03(63.68+9.35) than those exposed to individualized instructional setting with an adjusted post-test mean score of 60.82 (63.68+(-2.86)

Ho_5: There is no significant interaction effect of students' gender and Computer-Assisted Instructional Package on students' academic performance in Basic Science.

In order to test the hypothesis, mean scores of students' academic performance of male and female student exposed to individualized learning and cooperative learning environments were subjected to statistical analysis using Analysis of Covariance (ANCOVA) at 0.05 level of significance. The result is presented in Table 7.

Table 7: Gender and Computer-Assisted Instructional Package on students' performance in Basic Science using 2 x 2 ANCOVA.

Source	SS	df	MS	F_{cal}	F_{table}
Corrected Model	24868.22	4	6217.05	43.57	2.45
Covariate (Pretest)	21787.08	1	21787.08	152.68	3.92
Gender	67.05	1	67.05	.47	3.92
Group	1953.52	1	1953.52	13.70	3.92
Gender Group	49.40	1	49.40	.35	3.92
Error	10702.27	75	142.70		
Corrected Total	35570.49	79			
Total	446125.00	80			

P>0.05

The null hypotheses are accepted (F = .35, P>0.05). Therefore, there is no significant effect of students' gender and Computer-Assisted Instructional Package on students' academic performance in Basic Science. It implies that male and female students exposed to the same learning environment do not differ significantly in their academic performance in Basic Science. Similarly, the main effect of gender on students' performance is not statistically significant at 0.05 level (F = .47, P>0.05). However, the effect of treatment (Individualized and Cooperative learning environment) is statistically significant at 0.05 level (F = 13.69, P<0.05).

Discussion

Considering students' gender, analysis was done in the two instructional settings considering their performance within and in-between the settings. Within the individualized and cooperative instructional settings, there was no significant difference in the performance of

male and female subjects in BSAT after exposure to CAIP in the two instructional settings. This finding corroborates the findings of Azubuike (2018); Oludipe (2012); Nwagbo & Chikelu (2011); Adebayo (2008); Adegunwa (2008); Gambari & Mogbo (2006); Gbodi & Laleye (2006); and Yusuf (2006). This implies that the male and female subjects used as samples for the research work performed relatively the same in all the instructional settings, method of teaching notwithstanding. This is against the assertions of Nasr & Asghar (2011), Okoro (2011), and Adesoji (2006), who believed that there should be significant differences in the academic performances of the male and female subjects; results of their empirical studies are in favour of male subjects.

In-between the instructional settings, male students in cooperative instructional setting performed better than their counterparts in the individualized instructional settings. Also, the results of the female students' in-between the two instructional settings revealed that female students in the cooperative setting performed better than their counterparts in individualised instructional setting. This supports the assertion of Azubuike (2018) that students learn faster and better when they cooperate and collaborate among themselves than individualised learning. This may be attributed to the active roles played by each member of the group thereby retaining the knowledge of the concept thereby improving academic achievement.

Apart from this, gender had no significant interaction effect on students' academic performance in Basic Science; this implies that male and female students tended to have similar levels of academic performance. However, learning setting had a significant effect on students' academic performance, but gender and instructional setting did not have a significant joint effect. This is in line with the findings of Nwosu and Nzewi (2009) which pointed out that gender is not a significant factor to be associated with the school achievement, if given the opportunity with the right learning environment that stimulates interest and curiosity for exploring new ideas, Male and Female subjects will achieve equally. This means that Computer Assisted Instructional Package removes disparity in the achievement of male and female students in Basic science.

Conclusion

Based on the findings of this research, it could be concluded that both male and female students performed better when they collaborate or learn in groups. Also, students' gender does not influence their performance when taught using computer package.

Recommendation

It is therefore recommended that students should be treated and taught equally irrespective of their gender in computer- assisted instructional classes. Also, students should be encouraged to learn independently since technology –driven learning encourages independent study.

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