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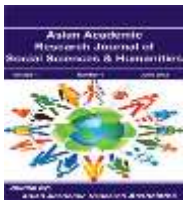

TOWARDS IMPROVING STUDENTS' ACHIEVEMENT IN SENIOR SECONDARY GENETICS BY THE USE OF CONSTRUCTIVIST-BASED INSTRUCTIONAL MODEL

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Abstract

The study determined how constructivist based instructional model would improve students' achievement in senior secondary genetics in Gwer Local Government Area of Benue State. The study used quasi-experimental design, specifically, the pre-test post –test non-equivalent control group design. A sample of 147 students from four secondary schools out of a population of 2,183 SSII students was used. A 40 item Genetic Achievement Test (GAT) instrument which was validated by 2 experts in science education and one other from measurement and evaluation, all from Benue State University Makurdi, was used to collect the data. The instrument yielded a reliability coefficient of 0.81 using split-half. Mean (M) and Standard Deviation (SD) scores were used to answer the research questions while the Analysis of Covariance (ANCOVA) was used to test the hypotheses at $p<.05$ level of significance. The result revealed that constructivist-based instructional model was more effective in facilitating students, achievement in genetics $F(1,138)=82.961$, $P=0.001<0.05$. Also the result revealed that the female students benefited more significantly than their male counterparts when taught using constructivist-based instructional model $F(1,77)=9.839$, $p=0.002<0.05$. The study recommended among others that constructivist-based instructional model be adopted in our schools for teaching the genetics aspect of biology and that teachers be trained on the proper use of the model.

Introduction

In Nigeria, the National Policy on Education (FRN, 2004), stresses the promotion of science as a means for technological development. The aim of science is to develope the students' ability to adapt to social or cultural societies by integrating the achievements of modern science and technology with existing values and culture (Gbamanja, 2002). Nwosu (2001) sees science as a dynamic and objective process of seeking knowledge, and an enterprise that involves people searching, investigating and seeking verification of natural phenomena. The evidence of science in human development is numerous, for instance, it is concerned with finding solutions to practical problems or finding simplified ways for doing things which might otherwise require a great deal of energy (Gero, 2001). According to Mulemwa (2002), the fast changing application of science and technology and the global reliance on its processes and products in all areas of human endeavour have made them valuable that any society or country without a good foundation in science and technology risks being alienated from the global village. However several research reports indicate that students achieve poorly in secondary school science subjects especially biology (Nwagbo 2001; Sandoval 2003; Okoli 2006 & Ofonime 2007).

The importance of biology in national development cannot be over emphasized as it benefits the individuals and corporate organizations in numerous ways. For instance, it helps the individual to understand the functioning and working of his or her body system. It reduces superstition and helps people maintain good health such as knowing the importance of good sanitation, eating of balanced diet, vaccinating against infectious diseases among others. The knowledge of biology also prepares an individual for vocational selection such as medicine, agriculture and teaching. It also prepares an individual to appreciate nature hence, the desire to protect it. Such individuals become better informed and educated to bring about national development (Kpangban, 2000). This assertion is in line with the position of Caccavo (2005), when he observed that we study genetics for two reasons; to gain intellectual gratification that comes from understanding natural patterns and processes and to apply that understanding to environmental problems that confront mankind. Thus genetics occupy a central position

in biology as well as school curriculum and plays very important role in scientific advancement that affects the lives of mankind.

However, available statistics from the West Africa Examination Council, Chief Examiners Reports (WAEC, 2003, 2004, 2006, 2007 & 2008) on senior secondary school students' achievement in biology revealed a poor achievement at the Senior Secondary Certificate Examination. The students' poor achievement in biology has been partly blamed on poor grasp of the concepts in genetics and basic ecological concepts. (Okafor & Okeke, 2006).

A number of factors have been found to have contributed to the students' poor achievement in genetics in the Senior Secondary Certificate Examination (SSCE). Some of these factors according to Abari, Jimoh and Maigamo (2010) include; teachers' ineffectiveness particularly in terms of the method used by the teachers. According to Obiekwe (2008), gender is a socially ascribed attribute which differentiates feminine from masculine. Researches have shown that difference in academic achievement due to gender has caused a lot of concern to educationists (Okeke 2001; Olokun 2002; Nwosu 2004 & Isa 2005). Some schools usually provide a platform for channeling students into prescribed gender activities. For instance, the grouping of subjects in the schools encourage definite choice of subjects, such as Food and Nutrition/Technical Drawing, Physics/Home Management and so on. Such groupings enable female students to choose Food and Nutrition and Home Management while male students go for Technical Drawing and Physics. Since biology plays a vital role in technological development of every nation, it is allowed to be taking by all categories of students (FME, 2004). This study determined how the constructivist – based instructional strategy would improve senior secondary school achievement in concepts of genetics in biology.

Research Questions

The following research questions guided the study;

1. To what extent is there a difference in the mean achievement scores of students taught genetics using the 5Es constructivist instructional strategy and those taught using the conventional method?

2. What is the difference in the mean achievement scores between male and female students taught genetics using the 5Es constructivist instructional strategy?

Hypotheses

The following null hypotheses were formulated to guide the study and tested at 0.05 confidence limit.

1. There is no significant difference in the mean achievement scores of students taught genetics using the 5Es constructivist instructional strategy and those taught using the conventional method.

2. There is no significant difference in the mean achievement scores of male and female students taught genetics using the 5Es constructivist instructional strategy.

Methodology

The study used quasi-experiential design, specifically the non-equivalent type. The study area was Gwer Local Government Area of Benue State, Nigeria. The population of the study comprised all the 2,183 senior secondary 2 students offering chemistry in the twenty nine secondary schools located in the area. A sample of 147 students out of the four sampled schools was used for the study. Purposive and random samplings were used to select the students. Four mixed schools were selected from different sections of the area. An instrument known as Genetics Achievement Test (GAT) that was validated by three experts, two from science education and the other from measurement and evaluation all from Benue

State University, Makurdi was used to collect the data. The GAT consisted of forty multiple choice questions in genetics. There were one correct option and four detractors per question. The test items were developed by the researcher. The GAT yielded reliability coefficient of 0.81 using split half. It was assumed by the researchers that the use of the constructivist model to teach genetic concepts in senior secondary biology could facilitate students achievement and that the effect of the model might not be gender sensitive.

Results

Research Question One

To what extent is there a difference in the mean achievement scores of students taught genetics using the 5Es constructivist instructional strategy and those taught using the conventional method? The answer to research question one is contained in Table 1.

Table 1 Mean and Standard deviation for students' pre-test and post-test scores in constructivist-based and lecture groups.

Method	**N**	**Pre-test**		**Post-test**		**Mean gain**
		$\bar{X}$	δ	$\bar{X}$	δ	
Constructivist-based method	80	9.613	1.761	24.638	5.5123	15.025
Lecture method	67	8.119	2.562	15.224	5.048	7.105
Mean difference		1.494		9.414		7.921

Key: $\bar{X}$ = mean scores δ = standard deviation scores.

Table 1 shows the mean and standard deviation scores of students taught using 5Es constructivist instructional strategy and those taught using lecture method, in the pre-test and post-test. Those taught with 5Es constructivist strategy belong to the experimental group while those taught with lecture method belong to the control group. From the table, it could be seen that the students taught using 5Es

constructivist instructional strategy had a mean score of 9.613 and a standard deviation of 1.761 in the pre-test while in the post-test the students had a mean score of 24.638 and a standard deviation of 5.512. For the students taught using lecture method, they had a mean score of 8.119 and a standard deviation of 2.562 in the pretest while in the post-test, the students had a mean score of 15.224 and a standard deviation of 5.048. Comparing the pre-test post-test mean gain of the two groups, the students taught with constructivist-based instructional method had a mean gain of 15.025 while those taught using lecture method had a mean gain of 7.105. The pre-test and post-test mean score difference for the two groups show that students in the constructivist-based group achieved better. There is also a positive difference of 9.414 between the post-test mean scores of the two groups in favour of the 5Es constructivist-based group. This suggests that students taught using the 5Es constructivist instructional strategy achieved higher than their lecture group counterparts.

Research Question Two

What is the difference in the mean achievement scores between male and female students taught genetics using the 5Es constructivist instructional strategy? Table 2 provides answer to research question three.

Table 2: Mean and standard deviation for pretest and posttest scores of male and female students in Constructivist-based group

Gender	**N**	**Pre-test**		**Post-test**		**Mean gain**
		$\bar{X}$	δ	$\bar{X}$	δ	
Male	26	9.577	1.858	22.000	4.261	12.423
Female	54	9.630	1.730	25.907	5.628	16.278
Mean difference		0.053		3.907		3.855

Key: $\bar{X}$ = mean scores δ = standard deviation scores.

From Table 2, it can be seen that the post-test mean achievement, scores of male students taught genetics using the 5Es constructivist instructional strategy is 22.000 with standard deviation of 4.261, while that of the female is 25.907 with standard deviation of 5.628. The difference between the pre-test and post-test mean achievement scores of the male students is 12.423 and that of the female students is 16.278 The difference between post-test mean scores of the two sexes is 3.855 and it is in favour of the female students. The implication is that the female students achieved higher than the male students in the constructivist-based class.

Hypothesis One

There is no significant difference in the mean achievement scores of students taught genetics using the 5Es constructivist instructional strategy and those taught using the conventional method.

Table 3: Tests of between subjects effects for constructivist-based and lecture groups scores in Genetics Achievement Test.

Source	**Type III Sum of squares**	**df**	**Mean square**	**F**	**Sig**
Corrected Model	4479.679a	8	559.960	27.271	0.000
Intercept	831.698	1	831.698	40.504	0.000
Pre-test	727.053	1	727.053	35.408	0.000
Method	1703.487	1	1703.487	82.961	0.000*
Error	2833.627	138	20.534	3.318	0.071
Total	68171.000	147			
Corrected Total	7313.306	146			

Key: * Significant at $P < 0.05$

From Table 3, the results of the main effects on the 5Es constructivist-based and lecture method indicated by $F(1, 138) = 82.961$, $P = 0.000 < 0.05$. Since the P-value is less than 0.05, there is a significant difference in the mean achievement scores of students in both groups. The students in the 5Es

constructivist-based group achieved higher in the post-test scores than the lecture method group. Thus the null hypothesis is rejected. This means that there is a significant difference in the mean achievement scores of students taught with 5Es constructivist instructional strategy and those taught with lecture me

Hypothesis Two.

There is no significant difference in the mean achievement scores of male and female students taught genetics using the 5Es constructivist instructional strategy.

Table 4: Tests of between subjects effects for constructivist-based male and female students' score in Genetics Achievement Test.

Source	Type III Sum of squares	df	Mean square	F	Sig
Corrected Model	332.919a	2	166.460	6.199	0.003
Intercept	924.604	1	924.604	34.434	0.000
Pre-test	64.969	1	64.969	2.420	0.124
Gender	264.188	1	264.188	9.839	0.002*
Error	2067.568	77	26.852		
Total	50961.000	80			
Corrected Total	2400.487	79			

Key: * Significant at P < 0.05

Table 4 shows that F – ratio for the difference in achievement between the male and female students in the constructivist-based group at (1, 77) degrees of freedom is 9.839, the P = value is 0.002 < 0.05. Since the P value is less than 0.05, it means there is a significant difference between the mean achievement scores of male and female students taught genetics using the 5Es constructivist instructional strategy. This implies that the hypothesis of no significant difference is rejected.

Discussion

A two by two between group analysis of covariance was conducted to assess the effectiveness of two methods of teaching genetics for male and female students in senior secondary schools. The independent and moderator variables were the 5Es constructivist instructional strategy and gender. The dependent variable was achievement. Scores on the achievement test administered prior to the commencement of the experiment (pre-test) were used as covariate to control for the individual differences.

The results of the study as indicated by $F(1,138) = 82.961$, $P = 0.000 < 0.05$ has shown that students taught genetics using 5Es constructivist instructional strategy outperformed their counterparts taught using lecture method. The pre-test mean scores of the students in the constructivist-based group were not statistically different from that of the lecture method group. This is a confirmation that the two groups of students entered the instruction on equal strength. This finding is necessary in order to show that any significant difference observed in the post-test mean scores would not be attributed to chance but the effect of the intervention.

The post-test's mean scores of students in the constructivist-based method group were found to be significantly different from those of their counterparts in the lecture method group. This findings have revealed the efficacy of the use of the 5Es constructivist-based instructional strategy in enhancing students' achievement in genetics. This findings corroborates Sidi (2009), Obiekwe (2008), Ofonime (2007), Madu (2004) and Mandor (2002) who asserted that 5Es constructivist instructional strategy, promotes students' competence and understanding. This equally agrees with the finding of previous studies from Iliya and Okwo (2006), Moemeka (2002) and Nwagbo (2001) who confirmed that appropriate teaching method leads to students' improved achievement in biology.

The superiority of the 5Es constructivist instructional strategy over the lecture method could be attributed to the fact that 5Es constructivist instructional strategy promotes the building (that is the

construction of knowledge) that occurs in students minds when they learn. Dogru and Kalender (2007) are of the view that learning is the result of individual mental construction, whereby the learner learns by matching new against given information and establishing meaningful connection, rather than internalizing mere factoids to be regurgitated later on.

The likely explanation for the out-come of this study may not be unconnected with the fact that 5Es constructivist instructional strategy promotes competence in skills of gathering information, organizing, communicating, interpreting, observing drawing conclusions and making inferences. A student who is exposed to this type of strategy is more likely to posses a meaningful in-depth knowledge of the content area. Such students will be able to organize their thoughts in an orderly manner that is essential to enhance their achievement in biology.

The study found that female students performed significantly better than their male counterparts. The findings agree with those of Obiekwe (2008) and Dashe (2005) who found that gender was strongly associated with biology achievement. However the findings disagree with that of Ogbeba (2010) and Offonime (2007) who found that gender is not a significant factor in the achievement of biology students. The authors maintained that gender differences in achievement in biology are still at variance as to which sex performs better in academic achievement. The finding of this study may not be unconnected to the fact that female students frequently expressed themselves and show more confidence in a mixed gender setting when exposed to the 5Es constructivist instructional strategy. The superiority of the female students over the male students may also be attributed to chance since the difference in their mean achievement

Conclusion and Recommendations

It is evident from the study that the use of constructivist-based instructional model could provide a good platform for students to learn more effectively. This means that the constructivist-based instructional model improved students achievement in biology. On the basis of the findings, the following recommendations are made:

1. Since the students in the 5Es constructivist instructional strategy group achieved higher in the GAT, the method should be encouraged to be used by biology teachers in teaching the subject.

2. Workshops and seminars should be organized by the Ministry of Education for in-service and practicing biology teachers to keep them abreast of the 5Es constructivist instructional strategy.

3. Supervisors and school heads should monitor the use of the 5Es constructivist instructional strategy by both teachers and students.

4. The teacher training institutions should include the 5Es constructivist instructional strategy in the biology method course content. This will ensure that the biology teachers are adequately trained on how to use the technique.

5. Text books should be written by researchers and placed in education resource center to illustrate more on the application of the 5Es constructivist instructional strategy on different content areas in biology especially genetics.

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