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Effects Of Beads Instructional Resource On Senior Secondary Students' Attitude And Achievement In Genetics In Nasarawa State, Nigeria

[1]Dajal, R.G. Ph.D & [2]Musa, Peter Eson, Ph.D

[1]Department Of Science and Environmental Education
Faculty of Education,
University of Abuja, Nigeria
Email: bobydajal2@gmail.com, Phone No: 08065901975

[2]FCT Secondary Education Board Area 3, Garki - Abuja, Nigeria
Email: petermusaeson@gmail.com, Phone No: 09162066667

ABSTRACT
This study investigated the Effects of Beads Instructional Resource on senior secondary students' attitude and achievement in genetics in Nasarawa State, Nigeria. The sample comprised of 150 students (84 males and 66 females) from two selected co-educational senior secondary schools in Nassarawa-Eggon Education zone, Nasarawa State, Nigeria. The design used in this study was quasi-experimental, specifically the non-equivalent pre-test, post-test, control group design. Two research questions and two null hypotheses guided the study. Genetics Achievement Test (GAT) and Genetics Attitude Scale (GAS) were used for data collection. The reliability estimates of GAT and GAS were 0.78 and 0.72 respectively using Kuder-Richardson 20 and Pearson-Product Moment Correlation Coefficient. Frequency, Mean, Standard deviation and Standard Error (S.E) were used to answer the research questions. Independent t-test was used to test the null hypotheses. The result revealed that students exposed to beads strategy of teaching achieved significantly higher mean scores (69.3) than their counterparts exposed to conventional lecture method (35.3). The male students taught genetics with the use of beads significantly performed better than the female students taught with the use of beads. The students taught genetics with the use of beads (Experimental group) significantly developed positive attitude to Biology than those taught with conventional method(Control group).The male students taught genetics with the use of beads did not perform better than female students taught with the same method. It was recommended that Biology teachers in schools should utilize beads method/ strategy of teaching Biology, and that STAN Place Limited and Education Resource Centres (ERC) should organise workshops, training and seminars for Biology teachers and Publishers of Biology textbooks to popularize the application of beads strategy in the teaching of abstract concepts in genetics (Biology).
Keywords: Education, Science, Biology, Genetics, Beads, Attitude, Achievement.

INTRODUCTION

Education is a vital instrument for national development. Science and Technology are the primary drivers of progress of nations and have constituted veritable instruments that make materials and human thrive. Similarly, Okeke (2007) affirmed that what divides the world today into developed and developing countries is the level of science and technology development therein which are attained through education

of the citizenry. There is therefore, the need for students to be effectively taught on the subjects comprising science and technology education in Nigeria if it is to become a developed country.

Biology is one core science subject taught in Nigerian senior secondary schools which is of choice among the students. Musa (2020) reported that Biology is indispensable in Nigerian science education programme because it builds the basic foundation for science and technology related fields like Pharmacy, Nursing, Medicine, Biochemistry, Botany, Zoology, Physiology, Anatomy, among many others. Biology is a natural science which examines living things and how they interact with one another and their surroundings. Tugba (2012) stated that the study of Biology helps students learn to make more informed decisions about their own health, to recognize the importance of agriculture and horticulture and develop skills of environmental management and sustainability.

Fakunle (2012) opined that understanding of the concepts of genetics appears to be more abstract (difficult) than any other topic in Biology. Therefore, Genetics is a branch of Biology which is referred to as the science of genes, chromosomes, heredity and variation in living organisms. The knowledge of Genetics is very vital in all human endeavours. Bailey (2013) defined Genetics as the study of heredity or inheritance. According to Musa (2011) and Singh and Ghandi (2015) Genetics is a branch of Biology that deals with the study of heredity and variations, the principles that account for the diversity of organisms. Genetics helps to explain how traits/characters are passed from parents to progeny.

However, many students avoid Genetics related questions in Biology at the senior secondary school level. A report from West African Examinations Council (2013) said that students still perform poorly in the area of Genetics and only few candidates attempt questions on Genetics because it is abstract. Genetics has a lot of abstract concepts and terminologies that are hard to understand, to learn and to remember.

Therefore, many researchers have emphasized and are still emphasizing about learning that would bring about conceptual change, that is, learner-centered (student–centered) approach to the teaching of Genetics. Among such methods are Consequence Mapping (Mohammed, 2016) and the use of beads (Rotbain, Marbach-Ad, and Stavy, 2006; Musa, 2011 and Musa 2020) to improve achievement in Genetics. These beads when used by teachers might help to make concepts in genetics concrete hence, facilitating understanding by students.

Beads are materials that are small, rounded, or flat structures that are of different colours which are connected by threads to bring out the different abstract concepts in genetics (Biology). These are used to teach students to facilitate meaningful understanding. Beads are synthetically produced. The use of beads instructional resource on senior secondary school students for teaching of genetics concepts has been employed as an activity strategy in the effective teaching of Biology. This shows that better results in Genetics can be achieved if Biology teachers are encouraged to use beads particularly for teaching the abstract aspects of genetics in Biology.

Rotbain, Marbach-Ad and Stavy (2006) and Musa (2020) reported that the use of beads has enhanced students' attitude and achievement towards the learning of genetics. Harrell, (2005) reported that "attitude is one hundred percent (100%) of everything you do". Harrell also opined that attitude is the cornerstone upon which we build our lives. Shitu (2013) refers to attitude as an effective response that involves relatively stable positive or negative feelings.

One related factor that is confronting the use of learner-centered (students-centered) method of teaching is its ability to have the same impact on both male and female students equally. According to Betiku (2000), gender refers to all the characteristics of male and female, which a particular society has determined and assigned to each sex.

Researches on gender and academic achievement such as that of Ibrahim (2013) and Olorukooba, Lawal and Jiya (2012) observed that boys achieved better than girls, but studies by Bunkure (2012) and Dahiru (2013) pointed out that girls achieved better than boys. Akanwa, Ndirika and Udoh (2018) also stated that gender has no effect on students' achievement in science. Musa (2020) reported that there is no difference between male and female students achievement in genetics (Biology). To this extent, this study was prompted to investigate the effects of beads instructional resource on senior secondary students' attitude and achievement in genetics in Nasarawa state, Nigeria.

Purpose of the Study

The purpose of the study was to determine the Effects of Beads Instructional Resource on Senior Secondary Students' Attitude and Achievement in Genetics in Nasarawa State, Nigeria. Specifically, the objectives of study were to:

i. find out the effect of the use of beads on students' attitude based on gender; and
ii. find out the effect of the use of beads on the achievement of students in genetics.

Research Questions

1. What is the effect of the use of beads on students' attitude based on gender?
2. What is the effect of the use of beads on the achievement of students in genetics?

Hypotheses

H$\mathbf{0_1}$: There is no significant difference between the attitude of male and female students taught genetics with beads.

H$\mathbf{0_2}$: There is no significant difference in the mean achievement scores of students taught genetics using beads and their counterparts in the control group.

METHODOLOGY

The study adopted non-equivalent quasi-experimental design. The study, used two groups: experimental and control. The experimental group (EG) was exposed to treatment that is, teaching students using beads strategy, while the control group (CG) was taught using conventional lecture method. The design was considered appropriate because the sample was used in their intact classes. The researchers adopted the design because in a co-educational school system, class registers, schedules, subject allocations, time table etc. cannot be disrupted for the purpose of a research work. For this reason, it was necessary to use groups as they are already organised into classes. The study was carried out in Nasarawa State North Central Nigeria, that is, in Nassarawa-Eggon Local Government Area. The population of the study were all senior secondary two (SS2) biology students in public co-educational senior secondary schools. The population of the study comprised of 16,588 SS2 Biology students in Nasarawa State, North Central Nigeria. Out of this number, males consisted of 9,204 SS2 students and females consisted of 7,384 SS2 students in Nasarawa State (Nasarawa State Ministry of Education, 2019).

The sample constituted the number of students that are in the intact classes in the co-educational senior secondary schools. Nasarawa State has thirteen (13) Local Government Areas. Using simple random sampling technique, one Local Government was picked out of the thirteen Local Government Areas in Nasarawa State. Simple random sampling is a sampling technique where every item in the population has an equal chance and likelihood of being selected for the study. The sample size for the study was 150 SS2 Biology students. Thereafter, two schools were purposively sampled. The sampled schools with the number of sampled students for the experimental and control groups are presented in table 1.

Table 1: Sampled schools distribution

S/N	Sampled Schools	Sampled Students		Total
		Male	**Female**	
1.	GSSS Nassarawa Eggon	43	36	79
2.	GSS Galle	41	30	71
Total	**2**	**84**	**66**	**150**

Instrumentation

The instruments used in this study were Genetics Achievement Test (GAT) and Genetics Attitude Scale (GAS). GAT was researchers made instrument made up of 50 short answered questions based on SS2 genetics scheme of work. The topics taught to the students were: chromosome-the basis of heredity; the work of Gregor Mendel–founder of genetics; transmission and expression of characters in organisms; and how characters are transmitted from generation to generations. Two weeks intensive training was organized for the teachers who participated in teaching the students in the sampled schools. The experimental group teachers were given detailed explanation on how to use beads in the lesson and the

general requirements of the research. The control group teachers were simply given a lesson plan based on lecture method developed by the researchers, without training and no use of beads. The students in experimental group were taught for eight (8) weeks using beads instructional resource after the administration of the pre-test instruments. The students in the conventional (control group) were taught without beads. Earlier, a pilot test was administered at a school which did not form part of the study to ensure that the instruments were reliable and valid. The reliability index of GAT was 0.78 obtained from Kuder–Richardson 20 formula which indicated that the instrument was reliable. The reliability of GAS was obtained using Pearson-Product Moment Correlation Coefficient (PPMCC) which gave a reliability index of 0.72. After eight (8) weeks of treatment, a post-test of GAT and GAS were administered to the experimental and control groups. The descriptive statistics of frequency, mean, standard deviation and standard errors was used to analyse the data and provide answers to the research questions. The two (2) null hypotheses were tested using independent t-test at 0.05 level of significance. The level of significance was at 0.05 for rejection or acceptance of the hypotheses.

RESULTS

Research Question 1: *What is the effect of the use of Beads on students' attitude based on gender?*

Table 2: Descriptive Statistics Showing Mean Scores of Male and Female Students on Attitude in the Post-test

Gender	N	Mean	S.D	Std. Error
Male	43	3.84	0.37	
				0.105
Female	36	3.75	0.55	

Results on table 2 indicated that Male students had a mean score of 3.84 with a standard deviation of 0.37 while the female students had a mean score of 3.75 with a standard deviation of 0.55. In other words, the male students slightly developed positive attitude towards learning Genetics than the female students.

Research Question 2: *What is the effect of the use of Beads on the achievement of students in Genetics?*

Table 3: Descriptive Statistics Showing Mean Achievement Scores in the Post-test.

Groups	N	Mean	S.D	Std. Error
Experimental	79	69.3	11.0	
				1.61
Control	71	35.3	8.3	

Results on table 3 indicated that subjects in the experimental group had a mean score of 69.3 with a standard deviation (S.D) of 11.0 while those in the control group had a mean score of 35.3 with a standard deviation of 8.3. The result showed that the subjects in the experimental group had higher mean achievement scores than their counterparts in the control group.

Hypothesis 1: There is no significant difference between the attitude of male and female students taught Genetics with Beads.

The hypothesis was tested using independent t-test and the results were presented in table 4.

Table 4: Two-tailed t-Test Result in Respect of Genetic Attitude Scale (GAS) of Male and Female Students taught Genetics with Beads.

Gender	N	$\bar{X}$	S.D	d.f	t-value	Std.Error	Sig.@0.05	Decision
Male	43	3.84	0.37					
				77	0.831	0.105	0.408	Not Significant
Female	36	3.75	0.552					

Result on Table 4 showed that there was no significant difference in the attitude to Genetics as a result of gender (*p= 0.408*, which is greater than 0.05 level of significance). As a result, the first hypothesis was

accepted. In other words, male students taught Genetics with the use of beads did not perform better than female students taught with the same method. Therefore, the use of beads is gender friendly.

Hypothesis 2: There is no significant difference in the mean achievement scores of students taught Genetics using Beads and their counterparts in the control group.

The hypothesis was tested using independent t-test as presented in table 5.

Table 5: Two-tailed t-Test Result in Respect of Genetics Achievement Test (GAT) of Students taught Genetics with Beads and those taught with Conventional Method

Group	N	$\bar{X}$	S.D	d.f	t-value	Std.Error	Sig.@0.05	Decision
Experimental	79	69.3	11.0					
				148	21.1	1.61	0.000	Significant
Control	71	35.3	8.3					

Result on Table 5 showed that there was significant difference in the achievement in Genetics Achievement Test as a result of difference in method of teaching (*p= 0.000*, which is less than 0.05 level of significance). As a result, the second hypothesis was rejected. In other words, students taught genetics with the use of beads (Experimental Group) significantly achieved better than those taught with conventional method (Control Group).

DISCUSSION OF FINDINGS

The result on table 3 showed that the students in the experimental group had higher mean achievement scores (69.3) than their counterparts in the control group (35.3). This result agreed with the studies conducted by Rotbain, Marbach-Ad and Stavy (2006), Musa (2011), Singh and Ghandi (2015) and Musa (2020).

The result on table 4 showed that the male students taught genetics with the use of beads perform better than female students taught with the same method. This result is in agreement with the studies by Ibrahim (2013) and Olorukooba, Lawal and Jiya (2012) which reported that boys achieved better than girls, but studies by Bunkure (2012) and Dahiru (2013) pointed out that girls achieved better than boys, which is in disagreement with the current study. When the results in table 4 were subjected to higher analysis, it was statistically proven that both sexes achieved equally. In other words, there was no significant difference in the achievement of male and female students exposed to Beads strategy in their attitude. This clearly showed that the sex of the students do not have any influence on their achievement in Genetics Achievement Test (GAT) as the strategy was gender friendly. This result agreed with the findings of Akanwa, Ndirika and Udoh (2018) and Musa (2020) that reported that gender has no effect on students' achievement in genetics and science generally.

CONCLUSION

The result of this study shows that beads instructional resource is effective in enhancing attitude and achievement for both male and female students in genetics concepts.

RECOMMENDATIONS

The following recommendations have been made based on the findings and conclusion made in this study.

i. Genetics teachers should utilise pragmatic method of teaching and learning of genetics concepts by using beads to make concepts concrete and avoid conventional method, since the present study has proved it to facilitate learning outcomes.
ii. STAN Place Limited and Education Resource Centres (ERC) should organise workshops, training and seminars for Genetics teachers and Publishers of Biology textbooks to popularize the application of beads strategy in the teaching of abstract concepts in genetics.

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