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EDITORIAL

Journal of Science Education and Research (JSER) is a peer-reviewed published Bimonthly. It aimed at advancing knowledge and professionalism in all aspects of educational research, including but not limited to innovations in science education, educational technology, guidance and counselling psychology, childhood studies and early years, curriculum studies, evaluation, vocational training, planning, policy, pedagogy, human kinetics, health education and so on. JSER publish different types of research outputs including monographs, field articles, brief notes, comments on published articles and book reviews.

We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

Prof. Patrick C. Igbojinwaekwu
Editor-in-Chief

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EFFECT OF EXPOSURE TO GENETIC TERMINOLOGY STRATEGY ON ACHIEVEMENT AND RETENTION AMONG BIOLOGY STUDENTS IN JABA LOCAL GOVERNMENT OF KADUNA STATE, NIGERIA

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Abstract

This study investigated on the Effect of Exposure to Genetic Terminology Strategy (EGTS) and Conventional Teaching Strategy (CTS) on the achievement and retention in Genetics among Biology Students in Jaba Local Government Area of Kaduna State. It adopted a non-randomized, pretest, posttest, post-posttest, control group quasi-experimental research design. The population of the study comprised of 1,950 S.S II students from public secondary schools in the study area out of which 1,001 were male and 949 was female. Krejcie & Morgan Sampling Table was used to draw the sample, whereby for 1001 male students; 276 was recommended and for 949 female students 274 was recommended. For the sake of this study, purposive sampling technique was adopted; where 65 and 55 was used as sampled size respectively. Genetic Achievement Test (GAT) was used as the instrument for data collection. Pretest was administered to the two groups after which the Experimental Group (EG) was exposed to treatment for five weeks using the EGTS and the CG taught the same concepts using the CTS for the same period. Posttest was later administered to the EG and CG after the treatment to determine the achievement. Four weeks after the posttest was administered, post-posttest was also administered to the EG and CG to determine their level of retention. Descriptive statistic of means and standard deviation were used to answer the two research questions raised while Analysis of Covariance (ANCOVA) was used to test the corresponding formulated null hypotheses at 0.05 alpha level of significant. Based on the findings of this study, it was recommended that biology teachers should adopt the EGTS for teaching of genetics as this will enable them to cater for the diverse learning needs of the students in terms of their cognitive achievement and retention in genetics and biology generally.

Keywords: Exposure, Genetics Terminology Strategy, Achievement, Retention

Introduction

Science Education is a functional instrument for social and technological advancement which bring about socio-economic development and empowerment throughout the universe. The application of scientific knowledge to real life problems is the most powerful instrument for enabling the society to face the global challenges and innovations in education. Biology Education which is a component of science education can do much to provide a sound foundation in professional fields like medicine, pharmacy, agriculture, biotechnology, among others as well as help the students to become comfortable with using biological thinking in their daily lives as they interact with their natural environment. Biology is a life science that involves the study of plants and animals. This implies that through biology, the students understand the natural communities of plants and animals. The knowledge of biology as a subject enables one to understand the major biological processes that take place within the plants and animals. For examples, heredity, reproduction, cell division, variation, adaptation, among others.

Genetics terminology is the scientific study of terms and deals with specialized set of words and phrases used to describe and understand the various aspects of genetics and heredity. These terms form the foundation of scientific communication in genetics and biology, allowing researchers, educators and students to discuss complex concepts with clarity precision. Genetics is the study of how the different characteristics/traits of parents are transfer to their offsprings through sexual reproduction, Smith and Jones (2023). The following genetic terms were used in this study and the terms are defined for clarity and precision by Maikano (2025) as follows; Genetic Variations are the differences that exist between the members of the same species which is common in species that reproduce by sexual means. Chromosomal Mutation is the change that occurs in species which can be as a result of the increased in the chromosome number (polyploidy), decreased in chromosomal number (aneuploidy) or the change in the chemical composition of the chromosome. Genes are the ‘factors’ located on the chromosome that are responsible for the transfer of characters from parents to their offsprings. Genotype refers to the genetic composition of an organism while phenotype describes the observable characteristics of a species. Mitosis is the cell division that occurs in the somatic/meristematic/body cells where two identical daughter cells are produced at the end of the cell division while meiosis is the type of cell division that occurs in the reproductive cells/gametes which results in the production of half the number of the chromosomes at the end of the division. Chromosomes are thread-like

reproductive structures that carry the genes while the genes are the factors located in the chromosomes that are responsible for the transfer of the traits/characteristics from parents to their progenies. Sex-linked traits are genetic disorder/diseases that are transfer from parents to their offsprings/progenies, such as colour-blindness, haemophilia, albinism, sickle cell, among others. Monohybrid inheritance is the inheritance of one pair of contrasting characteristics, example height (tall/short) while dihybrid inheritance is the inheritance of two pairs of contrasting characteristics, example shape (round/wrinkle) and colour (yellow/green). First filial generation (F_1) is the generation of the offsprings produce by the first or original parents while the second filial generation (F_2) is the generation produce by the F_1 offsprings and progenies are the offsprings produce by a species.

Monohybrid inheritance all the schematic diagrams

A cross between homozygous tall and homozygous short pea plant is shown below:

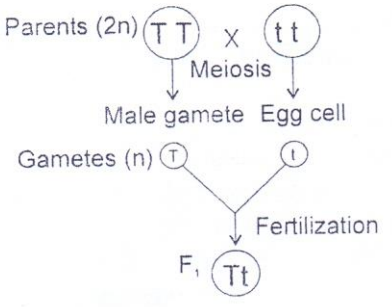
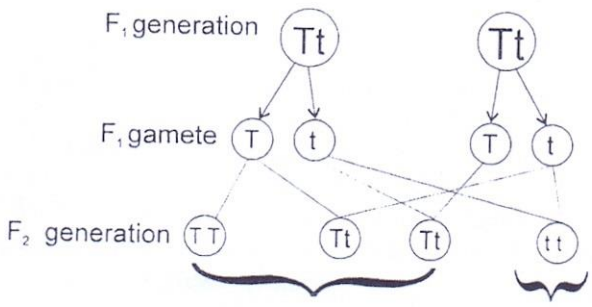


Fig. 1: A cross between tall and short pea plants

When self-fertilized, that is Tt (male) with Tt (female), the following offspring's are obtained using back cross:

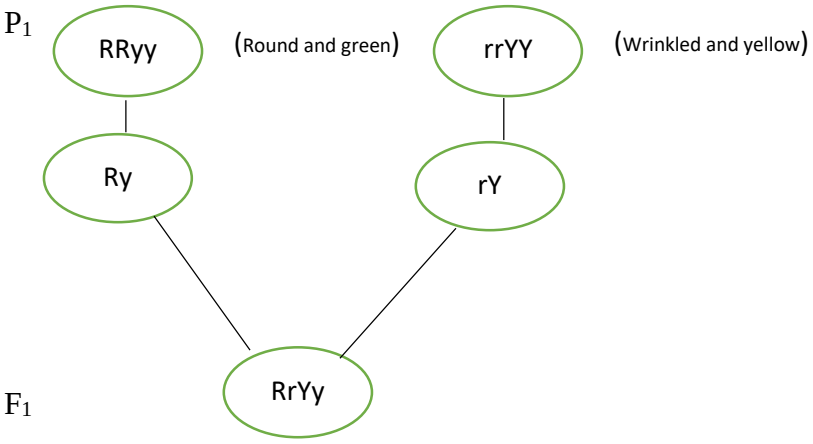


Self-fertilization between F_1 x F_1

Genotypic ratio is 1 (TT): 2 (Tt, Tt): 1(tt)

Phenotypic ratio is 3 (tall pea plant): 1 (short pea plant)

Dihybrid inheritance



A cross between round, green with wrinkled and yellow

Selfing F_1 and F_1that is RrYy x RyYy

After sorting out the gametes for the paternal and maternal parents, the respective genotypes can be fit into the Punnett square for crossing and computation as shown below:

RrYy = RY, Ry, rY and ry

Punnett square representing crosses between F_1 x F_1 generations

	RY	**Ry**	**Ry**	**Ry**
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYY
ry	RrYy	Rryy	rrYy	rryy

Genotypes and the phenotypes of the respective offspring's in the F_2 generation are as follows:

RRYY, RRYy, RrYY, RrYy, RRYy, RrYy, RrYY, RrYy, RrYy = these are all round and yellow pea plants; because the dominant gene expressed itself whether in homozygotic or heterozygotic conditions and they are nine in number.

RRyy, Rryy, Rryy = these are round and green and they are three in number

rrYY, rrYY, rrYy = these are wrinkled and yellow and they are three in number

rryy = this is wrinkled and green and is just one which is an indication that double recessive traits hardly occur in a population of living organisms because the principle

of natural selection would have taken place. This means unfavourable traits are been weed away in the gene pool.

Therefore, the genotypic ratio for Dihybrid inheritance is 9:3:3:1 while the phenotypic ratio is 15:1.

Statement of the Problem

Biology has a crucial role in the rapid development in science and technology. Genetics which is a component of biology is keyed in the study of science-based professional courses like medicine, pharmacy, agriculture, biotechnology, nursing, among others. In spite of this, genetics is the last topic in the secondary school curriculum and as a result of this most biology teachers do not reach and teach genetics to the students before the West African Senior School Certificate Examination (WASSCE) organized yearly by the West African Examination Council (WAEC). This has resulted in the students' low achievement in biology as a result of poor marks in genetics which is repeated yearly by the WAEC. For example, the WAEC Chief Examiner's Report (2020-2023) revealed many weaknesses of candidates in genetics, among which include; lack of understanding of basic concepts and principles of genetics, inability to carry out a simple genetic crossing and linking variation and mutation to real life situation. In order to address the above mentioned limitations, Adams and Brown (2019); Ahmed (2023) mentioned that if the students are exposed to the biology terminology before teaching the topics like ecology, communication system, genetics, among others, it will help in promoting meaningful learning and deep rooted knowledge of the concepts which will subsequently improve the students achievement in genetics and biology as a whole during the WASSCE. Retention is another key component of learning that has to do with the students retaining what they have learnt over a period of time and in this study, two weeks were used after the posttest to measure the students' retention ability. According to Brown (2020) ; Afolabi (2022), if a good pedagogy that is students centre is used, the students will learn meaningfully and that will enhance their retention ability. In this study EGTS was used in order to observe if it will allow the students to understand the basic concepts during treatment which will likely influence their achievement and retention abilities.

Purpose of the Study

The purpose of this study was to determine the Effect of Exposure to Genetic Terminology Strategy in Biology on Academic Achievement and Retention of Secondary School II Students in Jaba Local Government Area of Kaduna State, Nigeria. Specifically, the study sought to find out:

i. The Effect of Exposure to Genetic Terminology Strategy on Secondary School Biology Students Achievement in Genetics.
ii. The Effect of Exposure to Genetic Terminology Strategy on Secondary School Biology Students Retention in Genetics.

Research Questions

The following Research Questions guided the study:

i. What are the mean Achievement scores of Secondary School Biology Students taught Genetics using the Exposure to Genetic Terminology Strategy and those taught the same concepts using the Conventional Teaching Strategy.
ii. What are the mean Retention scores of Secondary School Biology Students taught Genetics using Exposure to Genetic Terminology Strategy and those taught the same concepts using the Conventional Teaching Strategy.

Hypotheses

The following Null Hypotheses were postulated to guide this study. The hypotheses were tested at 0.05 level of significant to either accept or reject them.

HO_1: There is no significant difference between the mean Achievement scores of Secondary School Biology Students taught Genetics using the Exposure to Genetic Terminology Strategy and their counterparts taught the same concepts using the Conventional Teaching Strategy.

HO_2: There is no significant difference between the mean Retention scores of Secondary School Biology Students taught Genetics using the Exposure to Genetic Terminology Strategy and their counterparts taught the same concepts using the Conventional Teaching Strategy.

Methodology

This study adopted a non-randomized, pretest, posttest, post-posttest, control group quasi - experimental research design. This non-equivalent control design was considered appropriate for this study because the participants were not randomly assigned to the two groups (EG & CG) rather treatment was randomly given to the two intact classes which were already organized. The treatment given to the EG is the EGTS while the one given to the CG is the CTS.

Population, Sample and Sampling Techniques

The population of the study comprised of 1,950 students made up of 1,001 male and 949 female from two public co-educational Secondary Schools in Jaba Local Government Area of Kaduna State, Nigeria. The sample for this study is made of 120 students (65 male & 55 female) Secondary two Students drawn from two public Secondary Schools in the study area. In each of the two sampled Schools, one intact class each was randomly assigned to the EG and CG through a flip coin. The head of the coin was assigned to the EG while the tail became the CG. 55 Students participated as the EG which were taught using the EGTS while 65 Students were assigned to the CG and were taught using the CTS.

Instrumentation

Genetic Achievement Test (GAT) was used as the only instrument for data collection. GAT which was adapted from WASSCE past question papers was a 40 items instrument which tested the students in Knowledge, Comprehension and Application of the genetic concepts. The same GAT was used for pretest, posttest and post-posttest. After the posttest, two weeks later, the GAT items were reshuffled and used for the post-posttest. The items were allotted one mark each, making a total score of 40 marks. The test items of GAT were validated by three experts in Science Education from the Department of Science Education, Ahmadu Bello University, Zaria, Nigeria. The validity index of 0.83 obtained implies that the instrument was valid. GAT was trial tested and the reliability coefficient 0.81 was obtained using K-R 20 formula which implies that the instrument was reliable.

Experimental Procedure

Before the commencement of the treatment, a one week intensive training was organized for the two research assistants, for the EG and CG who were B.Sc. Ed. Holders Biology teachers from the two schools sampled. The EG teacher was trained on the use of GTES lesson plans to teach genetics to the EG while the CG Biology teacher was educated more on how to use the CTS lesson plans to teach genetics based on the requirements of this study. Pretest was administered to the EG and CG before the treatment in order to ascertain their group equivalence. The treatment period for this research work lasted for four weeks during the 2023/2024 academic session in the study area after which the posttest was administered to the students in the EG and CG to measure their achievement. Three weeks after the posttest, post-posttest was administered to the EG and CG in order to measure their retention after reshuffling the GAT items.

Data Analysis

Descriptive Statistic of means and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 alpha level of significant. The adoption of ANCOVA was used to take care of the error due to initial differences in the abilities of the participating students.

Results

Research Question1: What are the mean Achievement scores of Secondary School Biology Students taught Genetics using the Exposure to Genetic Terminology Strategy and those taught the same concepts using the Conventional Teaching Strategy.

Table 1: Means Achievement Scores and Standard Deviations of Students in the Experimental and Control Groups using GAT.

Group	N	Pretest Mean	Std Deviation	Posttest mean	Std deviation	Mean gain
EGTS (EG)	55	12.40	1.85	39.09	2.71	26.69
CTS (CG)	65	11.55	1.35	26.12	4.09	14.57
Mean difference		0.80		12.97		12.12

Table 1 shows that the posttest means scores of students taught genetics using EGTS (EG) is 39.09 with standard deviation of 2.71 while those taught the same concepts using the CTS (CG) has the mean scores of 26.12 with the standard deviation of 4.09 difference between the pretest and posttest mean scores of EG is 26.69 while that of the CG is 14.57. The pretest and posttest achievement mean scores differences for the two groups show that the EG is higher than the CG. The implication is that the students taught genetics using the EGTS (EG) gained in achievement more than the CTS (CG).

Research Question 2: What are the mean Retention scores of Secondary School Biology Students taught Genetics using the Exposure to Genetic Terminology Strategy and those taught the same concepts using the Conventional Teaching Strategy.

Table 2: Means Retention Scores and Standard Deviation of EG and CG of Students using GAT

Group	N	Pretest Mean	Std deviation	Post-posttest mean	Std deviation	Mean gain
EGTS (EG)	55	12.80	2.50	37.54	3.41	24.74
CTS (CG)	65	11.70	2.50	27.69	2.51	15.99
Mean difference		1.10		9.85		8.75

Table 2, reveals that the post-posttest retention means scores of students taught genetics using the EGTS (EG) is 37.54 with the standard deviation of 3.41 while that of those taught the same concepts using the CTS (CG) is 27.69 with standard deviation of 2.51. The difference between the posttest and post-posttest mean scores of the EG is 24.74 and that of the CTS (CG) is 15.99. The implication is that the students taught genetics using the EGTS (EG) acquired more positive retention than the subjects in the CTS (CG).

$H0_1$: There is no significant difference between the mean Achievement scores of Secondary School Biology Students taught Genetics using the Exposure Genetic Terminology Strategy and their counterparts taught the same concepts using the Conventional Teaching Strategy.

Table 3: Result of Analysis of Covariance on Students Achievement in the EGTS (EG) and CTS (CG)

Source of Variation	Sum of squares	DF	Mean square	F	Sig.	Partial eta squared
Corrected model	3026.101	2	153.510	100.220	.000	.642
Intercept	607.940	1	607.940	40.268	.000	.264
Pretest	494.603	1	494.603	32.761	.000	.226
Group	2317.579	1	2317.579	153.510	.000	.578
Error	1690.890	118	14.330			
Total	96226.000	121				
Corrected total	4716.991	120				

Table 3, is One Way ANCOVA between groups analysis of covariance to compare the effect of EGTS (EG) and CTS (CG) on students' academic achievement in genetics. The result F (1,118) = 153.510, P = .000 < 0.05 shows that the two groups differ significantly. Thus, the null hypothesis is rejected. Therefore, there is a significant difference in the mean academic achievement scores of students taught genetics using EGTS (EG) compare to those taught the same concepts using the CTS (CG). The effect size (eta-square = .578) is high and it indicates 57.8 % of the difference in the mean score is based on the strategy used in the EG (EGTS).

$H0_2$: There is no significant difference between the mean Retention scores of Secondary School Biology Students taught Genetics using the Exposure Genetic Terminology Strategy and their counterparts taught the same concepts using the Conventional Teaching Strategy

Table 4: Result of Analysis of Covariance on Students Retention in the EGTS (EG) and CTS (CG)

Sources of Variation	Sum of squares	DF	Mean square	F	Sig.	Partial eta squared
Corrected model	2046.121	2	1023.061	95.120	.000	.727
Intercept	509.850	1	509.850	30.275	.000	.280
Pretest	485.504	1	485.504	31.671	.000	.668
Group	2243.261	1	2243.261	146.420	.000	.554
Error	1243.211	118	10.536			
Total	87325.000	121				
Corrected total	3827.871	120				
a.R squared	.727 (adjusted –R squared = .727					

Table 4 is one way ANCOVA between groups analysis of covariance to compare the effect of EGTS (CG) and the CTS (CG) on students retention in genetics. The results F (1,118) = 146.420 P = .000 < 0.05 shows that the two groups do differ significantly. Thus, the null hypothesis is rejected. Therefore, there is statistically significant difference in the mean retention scores of the students taught genetics using the EGTS (EG) and those taught the same concepts using the CTS (CG) in favour of the EG. Therefore, the null hypothesis is rejected. The effect size (eta square = .554) is high and it indicates that only 55.4 % of the difference in the mean retention scores is based on the strategy used which is the EGTS (EG).

Discussion

Findings of the study revealed a significant difference F (1,118) = 153,510, P = .000 > 0.05 between the academic achievement of S.S. II biology students taught genetics using the EGTS over their counterparts taught the same concepts using the CTS. This is in agreement with the findings of Adams et al (2019) and Ahmed (2023) who found that the adoption of Biology Terminology Exposure Strategy (BTES) greatly improves students' achievement. The reason for the improved achievement is because the adopted the Exposure Genetic Terminology Strategy (EGTS) that appealed to the students various cognitive aspects which provoked critical thinking, meaningful learning and increased the motivation of the students to learn which improved their achievement.

Findings of the study also show that a significant difference F(1,118) = 146.420 P = .000 < 0.05 exists in the retention ability of the students taught genetics using the EGTS (EG) over their counterparts taught the same concepts using the CTS (CG). This finding agrees with the finding of Brown (2020) and Afolabi (2022) which said that Biology Terminology Exposure Strategy (BTES) helped students to understand and also retained terms and concepts in biology classroom which ordinary they would not have retained if the teacher had used the conventional teaching strategy. The reason could be that the students in the experimental group were more actively involved in the learning of genetics because the terms and concepts were already well known to them which made their applications in the study easier. This also increased the enthusiasm of the experimental group with greater autonomy for the learners to learn, achieved and retained significantly as compared to their counterparts in the control group which lacked this autonomy.

Conclusion

The findings of this study revealed that the EGTS (EG) had significant effect on the academic achievement and retention of the students taught genetics which was not so with their counterparts taught the same concepts using the CTS (CG). Hence biology teachers are encouraged to always expose their students to the terminology of the different concepts in the topic before teaching the topic for meaningful learning to occur.

Recommendation

Based on the findings of this study, the following recommendations were made;

1. Biology teachers should adopt the use of Exposure Genetic Terminology Strategy (EGTS) and Biology Terminology Exposure Strategy (BTES) when it comes to the teaching of genetics and biology
2. Seminars and workshops should be organized to the biology teachers on the use of the Biology Terminology Exposure Strategy (BTES) to teach the students at the secondary schools level.

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