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EFFECT OF GUIDED INQUIRY TEACHING STRATEGY ON STUDENTS' ACHIEVEMENT IN GENETICS IN KEFFI, NASARAWA STATE, NIGERIA

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Abstract

The study determined the effects of guided inquiry teaching strategy on students' achievement in genetics in Keffi, Nasarawa State, Nigeria. The study was guided by two objectives, two research questions and two hypotheses tested at 0.05 alpha level. The study used quasi-experimental research design involving the non-randomized pretest, posttest, control group design. A sample of 331 (165 male and 166 female) SS III Biology students from three senior secondary schools was selected for the study using simple random sampling technique. The contents covered were definition of genetics, genes, chromosomes, application of probability and application of principles of heredity. Genetics Achievement Test (GAT) was developed and was used for data collection. The instruments were validated by experts and yielded logical validity indices of 0.83, 0.82 and 0.93 for GAT and reliability coefficient indices of 0.79 through Kuder-Richardson 21 Formula for GAT. Descriptive statistics of mean and standard deviation were used to answer research questions while Analysis of Covariance (ANCOVA) statistics was used

for testing the hypotheses at 0.05 level of significance. Findings from this research revealed that; Guided Inquiry proves to be more engaging and effective teaching strategy for improving achievement in genetics compared to the conventional method, Guided inquiry teaching strategy deepen students' understanding, which are critical for academic success. Findings from this research revealed that there was no significant difference in the mean achievement scores in male and female students taught using guided inquiry teaching strategy. Based on the findings of this study, the following recommendations are made to enhance the effectiveness of teaching genetics through Guided inquiry teaching strategy: Guided inquiry teaching strategy should be adopted more widely in teaching Genetics. Schools and educational institutions should prioritize interactive, hands-on learning methods to engage students more effectively and improve learning outcomes.

Keywords: Achievement, Guided Inquiry Teaching Strategy, Genetics.

Introduction

Science is one of the major drivers of national development. A country with skillful scientists thrives in all sectors of human endeavor namely: health, education, economic development, agriculture, infrastructure and independence of foreign goods. The importance of science in the development of a nation cannot be over emphasized. Science is the foundation to our modern day scientific and technological world. Tofi, Usman and Lakpini (2021) define science as a body of organized knowledge and a process of inquiry. Science plays very key roles in the growth and development of a nation in areas such as transportation, communications among others. It is because of the importance of science that the Federal Ministry of Education in its National Policy on Education (2014) emphasized the teaching of science subjects to its citizenry, the core science subjects in the curriculum are; Physics, Chemistry and Biology. It was stated in the National Policy on Education (FRN, 2014) that the first cardinal aim for effective scientific teaching is to bring about development of scientific inquiry and abilities in students towards creativity.

Biology is one of the science subjects taught at the senior secondary school level, Ojekwu and Ogunleye (2020) describe Biology as the study of life. Biology is a core science subject

which every science student is expected to get a credit at the O'level before proceeding to the University to study courses such as Medicine, Pharmacy, Nursing and Veterinary among others. The importance of Biology cannot be over emphasized. In spite of the importance of Biology, there has been consistently poor achievement by science students in Biology as revealed by Ndayambaje, Bikorimana and Nsanganwimana (2021).

Genetics refers to the study of heredity and variation of inherited characteristics. Genetics involve several concepts such as cell structure, cell division, chromosomes, genes and Mendelian patterns of inheritance. Genetics is taught at senior secondary level in Nigeria and is introduced to students as a preparatory ground for human development where career abilities are groomed (Federal Republic of Nigeria, FRN, 2014). An understanding of Genetics is necessary for the diagnosis, prevention and treatment of hereditary diseases, the breeding of plants and animals and the development of industrial processes through the use of micro-organisms. Genetics can be called a science of potentials since it deals with the transfer of information from parents to offspring.

Genetics gives answers to such problems as incompatibility of blood groups, hereditary diseases like sickle cell anaemia, leukemia and others. Thus, the study of Genetics gives students the opportunity to explain most

naturally occurring phenomenon like birth of twins, sex determination, crops and livestock failures which are hitherto explained through superstition. Despite the importance of Genetics to man, it is one aspect of biology that most teachers find difficult to teach and students find it difficult to learn because of its abstract nature. This is because it deals with inheritance of traits that can be visibly seen but the explanation is not always clearly understood. Biology has many topics, some of which are abstract and difficult for students to understand. Okoli, Anazodo and Okoye (2022) identified Genetics, homeostasis, evolution, nervous co-ordination, ecology, cellular respiration among others as difficult topics in secondary school curriculum. In addition, there are five topics that are most difficult which are matter cycles, endocrine system and hormones, respiration, cell division, Genetics and evolution.

The poor achievement of students in Genetics has been a matter of concern to parents, government, teachers and researchers. Researchers have attributed the poor academic achievement of students to some factors such as errors committed by students (Tofi *et al.*, 2021) and also method of instructions employed by teachers as stated by Kayode (2020). The study of Biology in senior secondary schools according to Obiekwe (2018), can equip students with

useful concepts, principles and theories that will enable them face the challenges before and after graduation. The importance of Biology is so much that it needs to be taught with proper instructional strategy to arouse students' achievement.

As a result, students perform poorly in Genetics in both internal and external examinations. The teaching strategy used in teaching Genetics has been blamed for poor interest, achievement of knowledge by the students. Studies have shown that secondary school students are exhibiting low interest in Genetics (Esiobu, 2015). This low interest of students has resulted in poor achievement in examination questions on Genetics. Ibitoye and Fape (2017) held that poor achievement in biology could be traced to poor usage of instructional resources in teaching Genetics, poor state of infrastructural facilities, large class size, poor teaching strategy, use of faulty assessment practices and inadequacy of quality. The chief Examiner's Report WAEC (2018 - 2024) states that, most students do not attempt questions on genetics and even those students that, attempted end up failing. From this report, therefore, led to the student's poor achievement and retention in biology. The trends of student's achievement in Nasarawa State can also be seen from WAEC (2024) as presented in Table 1.1.

Table 1.1: West African Secondary School Certificate Examination Result in Nasarawa State from 2015 -2023

Year	Reg. Cand	No. Pass	%	No. pass	%	No. Fail	%
		A1- C6	A1- C6	D7- E8	D7- E8	F9	F9
2018	8215	3310	40.31%	4905	59.69%	1600	19%
2019	7534	3110	41.28%	4424	58.72%	1500	20%
2020	10815	4901	45.32%	5914	54.68%	2000	25%
2021	11518	4507	39.13%	7011	60.87%	2500	30%
2022	10534	4110	39.01%	6424	60.98%	2800	35%
2023	8518	3507	44.19%	5011	55.81%	3000	40%
2024	9216	3018	42.48%	5211	50.00%	2010	43%

Source: (ERC, Nasarawa State Ministry of Education, Lafia, 2024).

Table 1.1, it can be seen that in 2018 the percentage of candidate that past Biology at credit level was below 50%. Thus, the result showed candidates poor achievement in Biology. However, there was a slight improvement in 2019 and 2020 with student percentage of pass at credit level with 41.28% and 45.32% respectively. In 2021, 2022, 2023 and 2024, Students achievement in Biology was not encouraging. The percentages of pass at credit level were 39.13%, 39.01%, 44.19% and 42.48%. From the data presented, it is so glaring that the students' level of achievement in Biology from 2018 to 2024 has been very unsteady due to their poor achievement in genetics question.

Achievement is an important variable in this study. Achievement refers to result gained in an activity through committed efforts. Achievement is a result-oriented construct

that shows the extent of students' attainment in a teaching task (Oviawe, 2018). Ebiefie (2015) defines achievement as a thing that somebody has done successfully especially using his/her own effort and skills. Achievement is a measure of knowledge gained by students through the education process. Achievement usually manifests in test scores, grade point average and/ or degree certificate. Adeyemi (2018) described achievement as the scholastics standing of a student at a given moment which states individual ability. It can also be defined as the quality of students' work and efforts in school. Achievement according to Morgan et al. (2015) is an assessment strategy by which the evidence about students teaching is gathered through students work on a performed task. It is an observable or measurable behavior of a person in a

particular situation usually experimental situation. Therefore, Students' achievement is very important because, it appears to be the major criterion by which the effectiveness and success of any educational institution could be judged.

Statement of the Problem

In spite of the importance of Biology, there has been an alarming rate of students' poor performance as reported by the WAEC chief examiners for the year 2018 – 2024. Students' achievement in Genetics were all very poor and it was categorically stated that many candidates could not state possible genotype of the blood group of the father as required by the questions. This is of great concern to stakeholders including parents and researchers. Generally, teachers employ the conventional method in teaching science especially Genetics which does not yield positive result on students' achievement. This shows that teachers do not use appropriate pedagogy while teaching Genetics. In search for a more appropriate strategy, the researcher therefore carried out this study to find out the effects of guided inquiry teaching strategy on students' achievement in Genetics in Keffi, Nasarawa State, Nigeria.

Objectives of the Study

The study sought to:

1. determine the achievement of students in Genetics taught using guided inquiry

teaching strategy and those taught using conventional method

2. ascertain the achievement of male and female students in Genetics taught using guided inquiry teaching strategy

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught Genetics using guided inquiry teaching strategy and those taught using conventional method?
2. What are the mean achievement scores of male and female students taught Genetics using guided inquiry teaching strategy?

Statement of Hypotheses

The following null hypotheses were tested at 0.05 level of significance

- H₀₁.** There is no significant difference in the mean achievement scores of students taught Genetics using guided inquiry teaching strategy and those taught using conventional method
- H₀₂.** There is no significant difference in the mean achievement scores of male and female students taught Genetics using guided inquiry teaching strategy

Methodology

The study investigated the effect of guided inquiry teaching strategy on students' achievement in genetics in Keffi, Nasarawa state, Nigeria. Quasi-experimental design was adopted and population of the study comprises of 6,638 SS3 student's in Keffi, Nasarawa State. The sample size of 331, three co-educational schools were selected from a total of 15 schools in the area using a simple random sampling technique. The instruments used was Genetics Achievement Test (GAT) with 40 items. The instrument was validated

by three experts one in Measurement and Evaluation and two in Science, Technology and Mathematics Education Departments of Nasarawa State University, Keffi, to ensure their relevancy to the research under study. The instrument obtained a validity index of 0.86. Cronbach alpha coefficient was used to determine the internal consistency of the research instrument. The instruments obtained a reliability coefficient of 0.79. Data was analyzed using Pearson Product Moment Correlation to answer the research questions and also test the hypotheses at 0.05 level of significance.

Results

The data were presented and analyzed according to research questions and hypotheses formulated.

Research Questions 1: What are the mean achievement scores of students taught Genetics using guided inquiry teaching strategy and those taught using conventional method?

Table 1: Mean Scores and Standard Deviation of Students in Genetics Taught Using Guided Inquiry Teaching Strategy and those Taught Using Conventional Method

Group		Pretest	Posttest
EG	Mean	43.75	67.85
	N	110	110
	Std. Deviation	10.607	7.223
CG	Mean	33.78	54.32
	N	113	113
	Std. Deviation	7.017	6.566

Table 1: highlights the achievement scores of students taught Genetics using two different teaching strategy: Guided Inquiry (EG) and Conventional Method (CG). For Guided inquiry, the mean pretest score was 43.75, Idris, Uzoechi & Tanko.

which increased to 67.85 in the posttest with standard deviation of 10.607 and 7.223, respectively. In contrast, students taught using the Conventional Method recorded a smaller increase, with a mean pretest score of

33.78 rising to 54.32 in the posttest phase with standard deviation of 7.02 and 6.57. The higher posttest scores for guided inquiry teaching strategy suggest that this teaching method is more effective at improving student achievement in Genetics. Furthermore, the

standard deviations indicate relatively similar levels of variability in achievement for both methods. This implies that guided inquiry teaching strategy improves student achievement in teaching genetics compared to the Conventional Method.

Hypothesis One: There is no significant difference in the mean achievement scores of students taught Genetics using guided inquiry teaching strategy and those taught using conventional method.

Table 2: Result of ANCOVA of Students Taught Genetics Using Guided Inquiry Teaching Strategy and those Using Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta squared
Corrected Model	14058.264 ^a	2	4686.088	86.663	0.000	0.443
Intercept	47439.954	1	47439.954	877.342	0.000	0.728
Group	8026.180	2	4013.090	74.217	0.000	0.312
Error	17681.664	327	54.072			
Total	1322647.000	331				
Corrected Total	31739.927	330				

a. R Squared = 0.443 (Adjusted R Squared = 0.438)

Table 2: presents the results of ANCOVA of students taught Genetics using guided inquiry teaching strategy and those using conventional method. The results show $F_{(2,327)} = 74.217$, $P = 0.000 < \alpha = 0.05$ level of significance. Since p value of 0.000 is less than 0.05 level of significance, it means there

is a significant difference in the mean achievement scores of student taught genetics using guided inquiry teaching strategy and those taught using conventional method. Therefore, the null hypothesis is rejected. Hence, the need for post hoc multiple comparison procedures as in table 3.

Table 3: Pairwise Comparisons of the Post-Intervention Mean Achievement Scores of Students Taught Guided Inquiry Teaching Strategy and those Using Conventional Method

(I) Group	(J) Group	Mean Difference(I-J)	Std. Error	Sig ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
E1	E2	-0.365	1.078	1.000	-2.959	2.229
	CG	10.529	1.083	0.000	7.924	13.135
CG	E1	-10.529	1.083	0.000	-13.135	-7.924
	E2	-10.894*	0.990	0.000	-13.277	-8.511

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparison: Bonferroni

Table 3: shows the result of pairwise comparisons of the post-intervention mean achievement scores between guided inquiry teaching strategy, $p = 1.000 > \alpha = 0.05$, implying there is no significant difference in the mean achievement scores of students taught genetics using guided inquiry teaching

strategy. For guided inquiry versus conventional method, $p = 0.000 < \alpha 0.05$, meaning there is a significant difference in the mean achievement scores of students taught genetics using guided inquiry and those using conventional method

Research Question Two: What are the mean achievement scores of male and female students taught Genetics using guided inquiry?

The information used to answer this research question is presented in Table 4.

Table 4: Mean Achievement Scores and Standard Deviation of Male and Female Students Taught Genetics Using Guided Inquiry

GenderE1		Pretest	Posttest
Male	Mean	37.71	65.33
	N	51	51
	Std. Deviation	7.762	7.339
Female	Mean	48.98	70.02
	N	59	59
	Std. Deviation	9.975	6.423

Table 4: shows the mean achievement scores and standard deviations for male and female students who participated in guided inquiry (E1). The findings indicate that both genders exhibited pre-to-post test scores improvements in mean achievement scores, 37.71, which increased to 65.33 posttest with standard deviation of 7.76 and 7.34, respectively. While female students had a mean pretest score of 48.98, rising to 70.02 posttest with Standard Deviation of 9.98 and 6.42. Male students had a mean pretest score of

Hypotheses Two: There is no significant difference in the mean achievement scores of male and female students taught Genetics using guided inquiry.

The result of the test of hypotheses two is presented in Table 5.

Table 5: Analysis of Covariance (ANCOVA) of Mean Achievement Scores of Male and Female Students Taught Genetics Using Guided Inquiry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta squared
Corrected Model	1478.039 ^a	2	739.019	18.790	0.000	0.260
Intercept	13060.479	1	13060.479	332.072	0.000	0.756
Pretest	877.983	1	877.983	22.323	0.000	0.173
GenderE1	24.501	1	24.501	0.623	0.432	0.006
Error	4208.334	107	39.330			
Total	512017.000	110				
Corrected Total	5686.373	109				

a. R Squared = 0.260 (Adjusted R Squared = 0.246)

Table 5 presents the results of ANCOVA analysis comparing the mean achievement scores of male and female students taught Genetics using guided inquiry and those using conventional method. The results show $F_{(1,107)} = 0.623$, $P = 0.432 > \alpha = 0.05$ level of significance. Since p value of 0.432 is greater

Discussion of Findings

Guided inquiry showed significantly higher achievement compared to those taught using the Conventional Method. The result indicated the significant difference in the mean achievement scores of students exposed to guided inquiry and those exposed to conventional method. This finding is in agreement with the findings of Joda, Mohammad and Abel (2017), investigated the effect of guided inquiry method of teaching on Senior Secondary School Biology Students academic achievement and retention of concepts, the results of the analysis showed that there was significant difference between the mean achievement scores of experimental

than 0.05 level of significance, it means there is no significant difference in the mean achievement scores of male and female students taught Genetics using guided inquiry and those taught using conventional method. Therefore, the null hypothesis is not rejected.

group and control group. This showed that students introduced to guided inquiry teaching strategy will excel in their academic achievements.

In addition, the findings are similar to that of Abu and Abubakar (2023), Adeyinka, Marie and Oluwaseun (2022), Faria and Lobato (2024), James, Joda and Ugwuadu (2024), Kessy and Irénée (2021) and Ali, Adamu, Kuti and Tukura (2020) who carried out a study on the effect of guided inquiry and conventional methods on students' achievement in biology. The study showed that students taught with guided inquiry method had higher mean achievement score in biology, than the conventional method.

Conclusion

Based on the findings of this study, it was concluded that guided inquiry teaching strategy has been found to have a positive effect on students' achievement in this study. This study has shown that students who engage in guided inquiry teaching strategy tend to achieve higher grades than those who do not. This is because guided inquiry teaching strategy provides students with more opportunities to practice and apply their knowledge and skills and it allows them to receive feedback on their work from multiple sources, which can help them identify areas for improvement. The use of guided inquiry teaching strategy is gender friendly as it promotes meaningful learning of concepts, students' academic achievement of both genders.

Recommendations

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

1. Teachers should receive continuous professional workshop in the use of the teaching strategy. This training should focus on the design and execution of interactive experiments, as well as the management of classroom dynamics to ensure that all students can actively participate and learn.
2. All stakeholders in the education sector need to enforce the encouragement of teachers to have additional higher qualifications in Education, so that they will be exposed to different methods of teaching and assessment which always help to improve the academic achievement of the students.

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