



Effect of Guided Inquiry Instructional Approach on Senior Secondary Biology Students' Academic Achievement in Akwa Ibom State

Isaac, Esther Israel & Kalu-Uche, N.

Department of Science Education, College of Education, Michael Okpara University of Agriculture,
Umudike, Abia State, Nigeria

Corresponding author: esther.isaac0355@gmail.com

Abstract

The purpose of the study was to find out the extent to which guided inquiry would be effective in promoting Biology students' academic achievement in Akwa Ibom state. The study adopted a pre-test post-test quasi-experimental design. Intact classes of SS1 students were used for the study. Two research questions and two hypotheses guided the study. Mean and standard deviation were used to answer the research questions. ANCOVA was used to test the hypothesis at 0.05 level of significance. BAT, based on the concept of plant nutrition was validated by three lecturers. Reliability co-efficient of 0.83 using Kuder Richardson 20 was obtained. The major finding of the study was a significant difference in students' achievement taught plant nutrition using guided inquiry and lecture method. Based on the findings of this study, it was recommended that teachers should use guided inquiry method in teaching and learning of Biology concepts to solve problems.

Keywords: Academic Achievement, Gender, Guided Inquiry, Lecture Method

Introduction

Biology is a natural science subject which deals with the study of life ranging from microscopic-cellular molecules to the biosphere, encompassing the earth's surface and all the living things. Biology is crucial for national development and survival of any nation. It plays an important role in all aspects of human life (Sarojini in Akunwa and Obidiwo, 2018). Therefore, Biology should be given a serious attention because of its importance.

Biology has contributed to many fields of learning such as Medicine, Agriculture, Biotechnology, Pharmacy, Microbiology, Education, and Health Care. Biological knowledge helps in the treatment of diseases, production of food and conservation of natural resources. It is a key subject in the school curriculum and the philosophy behind the subject is to produce knowledgeable, highly motivated and effective learners who will be able to develop themselves as professionals in the subject. It is a science subject which aims at equipping students with appropriate scientific skills, attitudes, competencies and the ability to apply scientific knowledge to every challenge of life (Ahmad, Abubakar and Yau, 2018).

In view of the importance of Biology, the analysis of students' achievement according to West African Examination Council (WAEC) chief

examiners' 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022 and 2022/2023 reports indicate that 49.8%, 60.89%, 53.89%, 48.71%, 60.46%, 84.09%, and 79.81% of the total number of West African Senior School Certificate Examination (WASSCE) candidates in Akwa Ibom State had credit passes in Biology. (SEMB, Akwa Ibom State: 2023). WAEC Chief Examiner's reports (2023) listed some of the weaknesses of the candidates to be poor answers to questions and candidates showed lack of knowledge in the description of the process of photosynthesis.

Unfortunately, studies have attributed to fluctuating academic achievement of students in Biology to ineffective use of instructional strategies. For O' Banon, many teachers prefer and use lecture method of teaching which is teacher-centered approach and includes all the teaching methods that see the teacher as possessor of knowledge and the students as passive recipients of knowledge. Unlike teacher-centered approaches, student-centered approaches are all the instructional methods of teaching that shift the focus of instruction from the teacher to the students. It sees the teacher as a guide in the learning process. The teacher's role in a student-centered learning environment is that of a facilitator and guide. The students are in control of

their own learning and the power and responsibility are the students' concern. Learning may be independent, collaborative, cooperative and competitive. The teacher may engage the students collectively, individually or in groups in the classroom. Their involvement would include questioning, disciplining, guiding, validating, monitoring, motivating, encouraging, suggesting, modeling and clarifying (Okam, 2017). Examples of student centered approaches include investigative laboratory approach, guided inquiry method, discovery method, and problem based learning approaches.

Guided inquiry is an instructional method which allows the students to independently use their mental processes to find out, design experiment to collect data, understand difficult concepts, generalize and provide answers to problems with minimal guidance from the teacher. This process will lead to exploration and discovery. Guided inquiry method uses the same idea as scientists do when they conduct experiment, thereby making the students become semi- scientists. When students are taught using guided inquiry method, they should become familiar with the processes used by scientists and the new knowledge that results (Okwor, 2017).

The learner is guided by the teacher to discover scientific facts, formulate hypotheses through observations and organized activities. In this approach, the teacher provides the necessary teaching materials and guides the students to arrive at new knowledge. It helps the students to participate actively in the learning process and discover things for themselves. The teacher is a resource person responsible for the planning of learning situation as well as exposing the learners to learning experiences. It is on this basis that the current study will examine the effect of guided inquiry instructional approach on senior secondary Biology students' academic achievement (Dawaki, 2016). However, a lot of research reports indicated that guided inquiry method enhanced students' achievement in Biology lessons. The situation is worthy of re-investigation especially in the area of this study where none of the studies took place.

Research reports suggest that besides teachers' instructional strategies, gender seems to have a role in the extent to which students learn Biology concepts. Gender refers to the cultural constructs and social positions which members of the society attach to being male and female. Gender is a range of physical, mental and behavioural characteristics pertaining to and differentiating the masculinity and femininity of individuals (Sparks, 2015). Researchers have different views on the

influence of gender on academic achievement of students in Biology. For example, Oludipe (2012) noted that male students achieve higher than their female counter parts in science. Agomuoh cited in Enebechi (2021) reported that male students achieved better in Biology than the females. However, Etiubon and Udoh (2017) opined that in a classroom setting where students are actively involved in interactive lesson with the teacher, there will be no difference in their academic performance. Based on the foregoing, this study investigated the effect of Guided inquiry instructional approach on senior secondary Biology students' academic achievement in Akwa Ibom State, using gender as a moderator variable.

Research Questions

1. What are the mean achievement scores of students taught plant nutrition using guided inquiry instructional strategy and lecture method?
2. What are the mean achievement scores of male and female students taught plant nutrition using guided inquiry instructional strategy?

Hypotheses

- Ho₁: There is no significant difference between the mean achievement scores of students taught plant nutrition using guided inquiry instructional strategy and lecture method.
- Ho₂: There is no significant difference between the mean achievement scores of male and female students taught plant nutrition using guided inquiry.

Research Method

The study adopted a pretest, posttest, non-randomized quasi-experimental research design. The study was carried out in Akwa Ibom State. The population of the study consisted of 11,732 senior secondary one SSI students offering Biology in the 230 public senior secondary schools in Akwa Ibom State. The sample of this study comprised of two hundred and thirty (230) senior secondary one (SS1) Biology students (male and female) in thirty one (31) Local Education Committee in Akwa Ibom State. Multi-stage sampling was used for the study as follows; simple random sampling technique was used to select one (1) Local Education Committee (LEC) out of thirty one (31) in Akwa Ibom State through balloting. Purposive sampling technique was used to sample two (2) secondary schools from sampled Local Education Committee. Reasons for using purposive sampling are as follows: schools that have well equipped Biology laboratory. The government owned co-educational secondary schools were

considered because of gender. Simple random sampling technique was again used to assign the two (2) schools to experimental group 1 and 2 as control group through balloting. The following were obtained from each of the intact classes, in experimental group 1, the male student were nineteen (19) and the female students were twenty four (24). While in the control group, the male students were twenty five (25) and the female students were twenty two (22). In all, forty four (44) males and forty six (46) females Biology student will be used for the purpose of analysis and discussion. At the end, a sample of ninety (90) students was used for the study. The students in the experimental group were taught plant nutrition using guided inquiry instructional strategy, while the students in the control group learnt the same topic using lecture method. Plant nutrition is among the difficult topics in WAEC Chief Examiner’s report (2023) – candidates showed inability to interpret the instructions, describe the procedures in plant nutrition and also lack knowledge in the description of photosynthesis. The instrument used for this study is Biology Achievement Test (BAT) which was selected from WAEC past questions by the researcher (researcher’s developed). The BAT contained 50 multiple choice test items, with each containing options A-D, from which the students chose the correct answer. Each wrong answer is 0 and correct

answer equals to 2 marks (2x50 = 100marks). Face and content validation of the instruments were established by three lecturers. Two lecturers in Biology Education and one lecturer in Measurement and Evaluation validated BAT in terms of its content relevance, items clarity as well as relevant to the objectives of the study. Comments and correction were incorporated into the final version of the instrument. The content validity was ensured using a test blue print. The reliability of the instrument for the study was determined by administering the validated instrument to 20 SS1 Biology students from a school in a zone that was not listed among the selected schools. Kuder Richardson 20 (K-R₂₀) was used to calculate the reliability index and this gave a reliability coefficient of 0.83. The teachers of the sampled schools were used as research assistants and they taught the groups, and administered the pre-test, post-test to the students to avoid disruption of normal school administration. The data collected were analyzed using mean and standard deviation to answer the research questions and Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. Hypotheses were rejected when the calculated p-value was less than 0.05 level of significance and was not rejected when the calculated p-value was greater than 0.05.

Results

Table 1: Mean Achievement Scores of Students Taught Plant Nutrition using Guided Inquiry Instructional Strategy and Lecture Method.

Teaching Method	N	Pre-test		Post-test		Mean Difference
		Mean	SD	Mean	SD	
Guided Inquiry	43	33.63	13.76	86.14	11.44	52.51
Lecture Method	47	30.89	16.30	66.30	21.99	35.41

N=90

Result in Table 1 indicate that the Guided Inquiry Instructional Strategy group had a mean Pre-test Score of 33.63 and standard deviation of 13.76, a mean Post-test Score of 86.14 and standard deviation of 11.44, with a mean difference score of 52.51. The Lecture Method had a mean pre-test score of 30.89 and a standard deviation of 16.30, a mean

post-test score of 66.30 and a standard deviation of 21.99, with a mean gain score of 35.41. The standard deviations values are far from the mean which indicate that the scores are widely spread. Thus, students taught with Guided Inquiry Instructional Strategy had the highest mean achievement scores.

Table 2: Analysis of Covariance (ANCOVA) for the Mean Achievement Score of Students taught Plant Nutrition Using Guided Inquiry Instructional Strategy, and Lecture Method.

Source of variation	Sum of Squares	Df	Mean Square	F	p-value	Decision
Corrected Model	10446.380 ^a	2	3482.127	12.601	.000	
Intercept	135430.384	1	135430.384	490.101	.000	
PRETEST	770.715	1	770.715	2.789	.097	NS
GROUP	10131.862	1	5065.931	18.333	.000	
Error	34265.120	86	276.332			
Total	812272.000	90				
Corrected Total	44711.500	89				

a. R Squared = .034 (Adjusted R Squared = .011), NS = Not Significant

The results of data analysis in Table 2 shows that the F ratio is 18.333 with (124) degree of freedom. Since the P-value of 0.00 is less than the associated alpha level of 0.05 ($p > 0.05$), the null

hypotheses which states that there is a significant difference between the mean achievement scores of students taught plant nutrition using guided inquiry instructional strategy, and lecture method is rejected.

Table 3: Mean Achievement Scores of Male and Female Students Taught Plant Nutrition Using Guided Inquiry Instructional Strategy

Gender		Pre-test		Post-test		Mean gain
		Mean	SD	Mean	SD	
Male	19	38.00	16.11	86.74	11.47	48.74
Female	24	30.17	10.70	85.67	11.64	55.50
Mean difference		7.83		1.07		6.67

Result in Table 3 shows that in the guided inquiry instructional strategy group, the male students had a mean pre-test score of 38.00 with a standard deviation of 16.11, a mean post test score of 86.74 with standard deviation of 11.47, and a mean gain score of 48.74. The females on the other hand had a mean pre-test score of 30.17 with a standard deviation of 10.70, a post-test score of 85.67 with a standard deviation of 11.64, and a mean gain score of 55.50.

The standard deviations range of 16.11 and 10.70 shows that the individual achievement mean scores of male and female students taught plant nutrition using guided inquiry instructional strategy are far apart from average achievement mean score of the student. The mean gain difference (achievement) between the male and female students is 6.67 in favour of the females.

Table 4: Analysis of Covariance (ANCOVA) for the Mean Achievement Scores of Male and Female Students Taught Plant Nutrition Using Guided Inquiry Instructional Strategy

Source of variation	Sum of Squares	Df	Mean Square	F	p-value	Decision
Corrected Model	316.402 ^a	2	158.201	1.221	.306	
Intercept	47518.153	1	47518.153	366.740	.000	
Pretest	304.257	1	304.257	2.348	.133	
Gender	69.364	1	69.364	.535	.469	NS
Error	5182.761	40	129.569			
Total	324560.000	43				
Corrected Total	5499.163	42				

a. R Squared = .058 (Adjusted R Squared = .010) NS = Not Significant

The analysis in Table 4 reveal the F calculated value of (0.535) and p-value .469. Since this p-value is greater than the 0.05 alpha when tested

at 0.05 level of significance, the null hypothesis which states that there is no significant difference between the mean achievement scores of male and

female students taught plant nutrition using guided inquiry instructional strategy is thereby, not rejected. It implies that this strategy is gender friendly since there is no significant difference between the mean achievement scores of male and female students taught plant nutrition using guided inquiry instructional strategy.

Discussion

There is a significant difference between the mean achievement scores of students taught plant nutrition using guided inquiry instructional strategy and lecture method. The observed differences in the students' performance could be attributed to the use of guided inquiry instructional strategy by being coached to think critically towards finding answers to the questions that have been bordering them. The results of this study is in agreement with the report of Abu (2023) who revealed that students taught with guided inquiry instructional method achieved significantly higher than students taught with lecture method. The finding is also in agreement with that of Oluyemi (2020) who revealed that the use of guided inquiry instructional strategy in teaching Biology resulted to better academic performance.

Female students taught plant nutrition using guided inquiry instructional strategy achieved higher than their male counterparts. However, the differences were not statistically significant. It indicates that both methods were effective without gender influence. The result of this work is in line with the findings of Etiubon and Udoh (2017) who observed that in a classroom setting where students are actively involved in interactive lesson with the teacher, there will be no difference in their academic performance. However, the result of this work is slightly contrary to the findings of Agomuoh cited in Enebechi (2021) who reported that male students achieved better in Biology than the females. This shows that the instructional strategy is gender friendly that is, it favours both male and females students and do not discriminate.

Conclusion

The study investigated the effect of guided inquiry instructional approach on senior secondary Biology students' academic achievement in Akwa Ibom State, Nigeria. Based on the findings of this study, Biology Students taught plant nutrition using guided inquiry instructional strategy achieved higher than students taught plant nutrition using lecture method (control group). The Mean achievement scores of females' students taught plant nutrition using guided inquiry instructional strategy was higher than their male counterparts. In conclusion, guided

inquiry was seen to enhance Biology students' academic achievement than lecture method.

Recommendations

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

1. Biology teachers in Akwa Ibom State secondary schools should adopt guided inquiry strategy since it enhances academic achievement of students.
2. In-service training of Biology teachers on the job to adopt the use of guided inquiry in the teaching and learning of plant nutrition in the classroom. Training of these teachers could be done by the Government or relevant professional bodies like Science Teachers Association of Nigeria (STAN) through seminars, workshops and conferences.
3. Biology teachers should incorporated innovative instructional strategies like guided inquiry strategy in teaching Biology. It will enable the students to develop inquiry skills needed for concept and knowledge construction which will help them to appreciate Biology better and improve on their achievements.
4. Future researchers should use the result of this study to investigate methods through which school administrators and teachers can effectively develop guided inquiry to teaching-learning so as to help the students learn better and then, increase the academic performance of students in secondary schools.

References

- Abu, A.O. (2023). Effect of Guided Inquiry Method on Students' Academic Achievement in Biology at Senior Secondary School in Idah Kogi State. *Journal of Science, Technology and Mathematics Pedagogy I* (1), 30-36
- Ahmad, S. I., Abubakar B. B., and Yau, S. (2018). Biology education a panacea for sustainable national development. published in *frontiers environmental microbiology*. (Volume 4, issue 2) Doi:10.11648/J.fem.2018042.14 page(s) 71-74.
- Akunwa L. and Obidiwo, J. B. C. (2018). *Modern Biology for Senior Secondary Schools*. Published by Sarojini T. Ramalingam. Revised edition by Akunwa and Obidiwo (2018).
- Dawaki, J. H. (2016), effect of activity based instructional strategy on the academic performance of student integrated science in junior secondary school in Kaduna State M.Ed



- thesis unpublished submitted to the Ahmadu Bello University Zaria, Nigeria.
- Enebechi, R. I. (2021) Effect of Inquiry Based Learning approach on Senior Secondary School Students' Retention in Biology. Department of Science Education, Nnamdi Azikiwe University, Awka. British international journal of education and social science official publication of center for international research development (CIRD) vol. 8 no.8: August, 2021.
- Etiubon, R. U. and Udoh, N. M. (2017) effects of practical activities and manual of science students' academic performance on solubility in Uruan Local Education authority of Akwa Ibom State. *Journal of Education and practice*. 8 (3), 202-209.
- O'Bannon, B. (2017). Planning for instruction (instructional method). Retrieved from <http://www.feutked/rbonannon/in/strategies/htm>
- Okam, C. C. and Umar, F. H. (2017) some curricular issues militating against social studies education in Nigeria. Overcoming the problem through an enlargement of teachers capacity-assets in the subject. In: The challenges of teacher education in the 21st Century Nigeria (Book of Peading). Faculty of Education, University of Abuja, Nigeria.
- Okwor, F. A. (2017). Effect of guided discovery and guided inquiry teaching methods on students' achievement in Agricultural science. Unpublished PGDE Project, University of Nigeria, Nsukka.
- Oludipe, I. I. (2012) gender different in Nigeria in junior secondary students' academic achievement in *basic science journal of education and social research* 2 (1): 93-100.
- Oluyemi, A.V (2020) Effect of Guided Inquiry Teaching Strategy on Academic Performance in Secondary School students' in Biology in Ekiti State. Euro Afro studies international journal issue: 4, volume 1, 2020 (EASIJ.com), p, 44-54 DOI: www.doi.org/0.5281/zenodo.37825.62, [https://www.easij.com/911-issues/thoughwaresconsultingandmultiservicesinternational\(TWCMSI\)](https://www.easij.com/911-issues/thoughwaresconsultingandmultiservicesinternational(TWCMSI))
- Sparks, S. (2015) students gender study and academics differences. *Academic journal*, 2 (2 & 3): 48-60 journal of education and practice ISSN 2222-1735 (paper).
- West African Examinations Council Chief Examiner Report May/June 2015-2023