Effects of Inquiry-Based Instruction on Interest among Senior Secondary School Biology Students in Lere Educational Zone, Kaduna State, Nigeria

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Abstract

The objective of the research was to investigate the "Effects of Inquiry-Based Instruction on Interest towards Ecology among Senior Secondary School Biology Students in Lere Educational Zone, Kaduna State Nigeria: Implications for a Depressed Economy". Two objectives, two research questions and two Hypothesis guided the research. The hypotheses were tested at $p \leq 0.05$ level of significance. Quasi-experimental and control groups were used for the study. The population comprised of all 1908 senior secondary school Biology students in Lere zone. A sample consisting of 118 students randomly selected from two coeducational schools in Lere Education Zone was used for the study. The experimental group was exposed to Ecology concepts using Inquiry-based Instructional strategy while the control group was taught with lecture method. Students Ecology Concept Interest Questionnaire (SECIQ) adapted by the researchers was validated by experts and pilot tested for reliability and was found to be 0.84. Wilcoxon and Mann-wittney statistics were used to analyze the data collected at $p \leq 0.05$. The results of the study revealed that differences of 14.3 existed on Interest shown when students are exposed to inquiry-based instruction and lecture teaching method in favor of the experimental group. However, there was no such difference between male and female students exposed to inquiry-based instructional strategy. The implications of these findings for a depressed economy is discussed and, based on that, it is recommended that the use of inquiry-based instruction should be encouraged among teachers of Biology to raise the level of the dwindling Interest of students towards the study of Biology.

Keywords: Inquiry, interest, experimental, control.

Introduction

A cursory look at the secondary schools in Nigeria has shown that many teachers in the system still rely much on the traditional "chalk and talk" method of teaching rather than embracing other activity-based methods of teaching that can enhance the interest of students towards teaching and learning (Bichi, 2002). Ajai & Imoko (2015) observes that the difficulty perceived by science students is their inability to make reasonable connection between concept areas and its application in solving problems in Biology. In related studies, Oladejo, (2011) identifies poor methods of teaching and improper use of instructiona*l* materials as some of the deficiencies of science teachers. Okebukola (2009) also attributes the lack of interest towards Biology to the use of ineffective teaching and learning strategies. The persistent failures in biology has also been attributed to poor performance in ecology concepts and lack of appropriate learning environment under which Biology

teaching takes place (Namaska & Mondoh, 2017). This study therefore investigates the effects of inquiry-based instruction on interest among secondary school Biology students.

One of the most common methods of teaching science at the Senior Secondary level is lecture method. Danjuma (2017) notes that this is a method of teaching that emphasizes "talk and chalk" in the teaching of science subject. More than 80% of the scientific information and principles are delivered as lectures. Teachers embrace this method for easy coverage of the school syllabus. It is characterized by one-way flow of information from the teacher who is always active, to the students who are always passive. In its true nature, lecture method is not effective for science teaching. Edarho (2020) argues against it because it does not promote meaningful learning. He further explained that the use of lecture method of teaching in science leads to rote learning. However, lecture method of teaching should not be totally discouraged, but there is need to alternate with other activity-based methods for effective teaching and learning of Biology. This can be done by use of inquiry-based instruction.

Inquiry-based instruction is a teaching method linked with Brunner's (1965) theory of constructivism where the learner constructs knowledge on his own without guidance from the teacher and seeks to discover and create answers to a recognized problem through procedure of making a diligent search (Tamim, 2011). Inquiry is a term used in science teaching that refers to a way of questioning, seeking knowledge or information or finding out about phenomenon. In using this method students learn not only concepts and principles but self-direction, responsibility and social communication. It is a highly interactive step by step approach which involves student at all levels of discussion (Obeka, 2010). It is also the way people learn when they are left alone.

The search for a more effective approach for the teaching and learning of Ecology that will enhance learners' interest has persisted over the years. This is because the learners' interest and the bases for science inquiry and development of intellectual skills and attitudes that are needed to learn concepts are not utilized by Biology teachers. Inquiry method of teaching is a teaching method where the learner, is actively involved with minimum guidance from the teacher seeks to discover and create answers to a recognized problem through procedure of making a diligent search (Maikano, 2016). Inquiry is a term used in science teaching that refers to a way of questioning, seeking knowledge or information or finding out about phenomenon. Using this method makes students learn not only concepts and principles but self-direction, responsibility and social communication. It is a highly interactive step by step approach which involves student at all levels of discussion (Bassey & Amanso, 2017). It is also the way people learn when they are left alone. Some of the inquiry-based instructions are guided discovery and self-learning strategies.

From the above discussions, inquiry-based teaching can also be seen as a pedagogical approach that invites students to explore academic content by posing, investigating and answering questions to the discovered problem or problems. Also known as problem-based teaching or simply as "inquiry," this approach puts students' questions at the center of the curriculum, and places just as much value on the component skills of research as it does on knowledge and understanding of content. Krapp

(2007) opines that once interest is maintained, repeated engagement can be either self-initiated or promoted by the environment, leading to the development of first an emerging and then a well-developed individual interest, while Renninger (2006) added that if interest of a student could be generated during learning process, academic performance is certain to be enhanced. This, when applied in the daily life of the student, will contribute to the economic development of the society in which he lives, as observed by Vartuli (2016). This is necessary because the link between science education and the economic development of nation has been proved by a number of studies (Oka & Samuel; Mulyeni, Jamaris & Supriyati, 2020). World Bank (2019) reports that 60-90% of economic growth achieved by Japan and other Asian industrialized culture is explained by scientific developments. Economies worldwide agree that as the amount of schooling increases, individuals' economic empowerment also increases. Nigeria, a nation endowed with abundant natural resources, is surprisingly not among the G20 nations of the world. Only South Africa represents the whole of the African continent in that group. The average GDP for the sub Saharan Africans is the lowest in the world. The must disheartening is that Nigeria, despite its abundant resources, is placed 36th and 171st on GDP ranking in the list of African and world countries respectively.

Factors found to be responsible for poverty, among many, include low application of science and technology to boost the economy of the nation. The economic situation of Nigeria therefore, calls for urgent reorganization of the education sector for creation of an environment that guarantees high productivity. It is in the light of this need that this study was undertaken to see if inquiry-based teaching strategy can improve students' interest in science generally and biology in particular.

Statement of the Problem

In spite of the relevance of Biology as one of the major science subjects whose pass at credit level determines, to a large extent, whether students will be admitted or not to read a number of major professional science-based courses at the university, yet its failure rate is alarming (Calderon & Gonzales, 2013). Attempts to improve on the Interest and academic performance of students in these science subjects has not been completely achieved. Several factors have been identified by thin thee researchers to be responsible for this, among which a dwindling interest in biology and hence, poor performance among secondary school students. In addition to that, Poor performance in biology with particular reference to Ecology among Biology secondary school students in Lere Local Government Area has been identified by the researchers and hypotheses point at lack of interest hinged on teacher centered instructional methods instead of student-centered (Dambana, Danjuma & Sarki 2018). Educators are seeking for alternative ways to teach Biology so as to change the situation. The problem is how to enhance secondary school students' interest towards Ecology concepts in Biology. This situation has created the need for more effective teaching methods such as the Inquiry-based method to see if it will enable the students develop more interest and thus perform better in ecology. This study was therefore, undertaken to see if the use of Inquiry-based teaching strategy can make secondary school students develop more interest in Ecology which will ultimately lead to better performance in Biology.

Objectives of the Study.

Specifically, the study intends to:

(3) find out the effect of Inquiry- based teaching strategy on Biology Students interest towards ecology.

(4) determine whether there is gender related differences in the interest level of Biology Students towards Ecology when exposed to inquiry-based instructional strategy.

Research Questions

The following research questions were formulated to guide the study;

1. What is the effect of inquiry-based teaching strategy on Biology students' interest towards ecology?
2. Is there any difference in interest level between male and female Biology students exposed to Inquiry- based Instructional strategy?

Null Hypotheses

These null hypotheses were formulated and tested at $P \leq 0.05$ level of significance.

1. There is no significant difference in the interest level towards ecology by SSS Biology Students when exposed to inquiry-based instructional strategy and lecture method.
2. There is no significant difference in interest level towards Ecology between male and female Biology students exposed to inquiry-based instructional strategy.

Methodology

This study investigated the effect of inquiry-based instruction on interest among senior secondary school Biology students in Lere Educational Zone. The research design for this study is quasi experimental. The schools are located at different places to avoid interaction between the Experimental and Control the control groups. The sample schools are G.S.S Geshere and G.S.S Kono, S.S II intact classes were used with a population of 56 and 62 respectively. The instrument used is Student Ecology Concept Interest Questionnaire (SECIQ) made up of 25 items. The instrument was validated by experts and the reliability was found using PPMC to be 0.84. The experimental group was taught using inquiry-based instructional strategy adapted from French (2021) model, while the control group was exposed to lecture method. The teaching lasted for six weeks. The data collected were analyzed using mean, standard deviation and z-test statistics at $P \leq 0.05$ level of significant.

Results

Result of the data analysis was presented in tables 1-4, research questions and null hypotheses respectively.

Research Question One: What is the effect of inquiry –based teaching strategy on biology students' interest towards ecology?

In order to answer this research question, Descriptive statistics of Mean Rank and Sum of Mean Rank were used.

Table 1: Difference in the Mean Rank and Sum of Mean Rank of Interest towards Ecology of Students Exposed to Inquiry Teaching Strategy and those Taught Using Lecture Method.

Groups	n	Mean Rank	Sum of Mean Rank	Mean Difference
Experimental	56	97.65	2861.00	
				14.3
Control	62	83.35	2704.00	

Table 1 revealed that difference exist in the interest shown by SSS students when they were exposed to inquiry method and lecture teaching method in Ecology. Their mean interest Scores were 97.65 and 83.35 in posttest experimental and posttest control respectively. When the difference between their interest rates was computed, it was found to be 14.3 in favor of experimental group. This clearly indicated that students exposed to inquiry method i.e. experimental group showed more interest in Ecology than the control group.

Hypothesis One: There is no significant difference in the interest shown in ecology by SSS students when exposed to inquiry-based instruction and lecture method.

To answer the null hypothesis Wilcoxon-Mannwitney Non-Parametric statistical tool was used for the analysis at $p \geq 0.05$ level of significance for retaining or rejection of the null hypothesis.

Table 2: Wilcoxon Mann-Whitney Rank Test Difference in the Ecology Concept Interest Shown by SSS II Students in Experimental and Control Group.

Groups	N	Mean Rank	Sum of MeanRank	Df	Mann-Whitney U	P	Remark
Experimental	56	97.65	2861.00	116	978	0.001	S
Control	62	83.35	2704.00				

Significant at P ≤0.05

In Table 2, the p-value of 0.001 was observed at df= 116. Since the p-value was less than the alpha value of 0.05, it means therefore that the difference in the interest shown by SSS students when exposed to inquiry-based instruction and those taught with lecture method was significant in favor of the experimental group. Therefore, the null hypothesis which stated that there is no significant difference in the interest shown by SSS II Students when exposed to inquiry-based instruction and lecture teaching method in Ecology is hereby rejected.

Research Question Two: Is there any difference in Interest level between male and female biology Students exposed to Inquiry- based Instructional strategy?

Table 3: Difference in the Mean Rank and Sum of Rank between Male and Female Students Interest level exposed to Inquiry Teaching Strategy.

Groups	n	Mean Rank	Sum of MeanRank	Std. Dev	Mean Difference
Male	73	45.300	2861.00	8.6239	
					0.466
Female	45	45.766	2704.00	9.9807	

In Table 3, the outcome of the statistics showed that there was difference in the level of Interest along gender line when students were exposed to inquiry- based and lecture method. The computed mean ranks were 45.300 and 45.766 for males and females respectively, indicating a mean difference of 0.466 in favor of females. This means that females showed a higher level of interest than the males in the experimental group.

Hypothesis Two: There is no significant difference in the interest level between male and female students when exposed to inquiry-based instruction.

To answer the null hypothesis, Mann-Witney U statistic was used for the analysis at $p \geq 0.05$ level of significance for retaining or rejecting the null hypothesis.

Table 4: Mann-Whiteny U-Test of Difference in the Interest Level of Male and Female Students Exposed to Inquiry Teaching Strategy

Groups	n	Mean	Std. Dev.	df	Mann-whitney u	P	Remark
Male	73	45.300	8.6239				
				116	1180	0.847	Ns
Female	45	45.766	9.9807				

Not Significant at P ≤ 0.05

The result in table 4 showed that the p-value of 0.847 was observed at df = 116. Since the p-value was greater than the alpha value of 0.05, it means therefore that the difference in the interest level between male and female students when exposed to inquiry-based method was not significant. Hence the null hypothesis which stated that there is no significant difference in the interest level between male and female students when exposed to inquiry-based instruction was retained, meaning that the inquiry-based teaching strategy is gender-friendly.

Discussion of Results

This research work investigated the effect of inquiry-based instruction in interest among secondary school Biology students. Two hypotheses were stated and tested based on the scores of the subjects obtained in Student Ecology Concepts Interest Questionnaire (SECIQ).

From the findings in HO_1, there was significant difference in the interest levels shown in ecology by SSS students when exposed to inquiry-based instruction strategy and lecture method in favour of the of the inquiry-based strategy group. This indicated that the use of inquiry-based instruction enhanced/boosted students' interest towards learning of ecology. Increased interest towards learning of Biology recorded could be due to the activity-embedded nature of inquiry-based instructional strategy in which students at this age not only love doing things with their hands but find fun and therefore, satisfy their curiosity (Piaget, 1952) as they work in the natural environment. This finding is supported by Imoko & Awagah (2006) who observes that the use of inquiry-based instruction raises the level of students' interest in mathematics because it is fun. One other reason could be the joy of interaction in groups' activities among students as they share ideas among themselves and with the Teacher during the discussion sessions. Oladejo, (2011) also discovers that an individual's attention and/or engagement with particular events and objects determine the direction of interest development. Therefore, this study has shown that the use of inquiry-based instructional strategy enhanced students' interest towards learning ecology concepts.

Analysis of HO_2 shows there is no significant difference in the interest level of male and female students exposed to inquiry-based teaching strategy. The hypothesis was therefore, retained. This shows that inquiry-based instructional strategy is gender friendly. This corroborates the findings of Mari (2001). However, it disagrees with the work of Maikano (2016) who reveals in a study that differences exist between males and females who were taught computer concepts using inquiry-based instruction. Amosa (2018) also reveals that gender differences may exist in many different areas of education from performance to interest, from classroom activities and course enrolment to perceptions about careers. While Maikano (2016) and Amosa (2018) used computer concepts and careers perception respectively, the present study used ecology concepts. Therefore, with the empirical evidence in this study, it is shown that there is no significant difference in rise in interest level between male and female biology students exposed to inquiry-based teaching strategy. Inquiry-based teaching strategy here is thus gender friendly.

Implications for a Depressed Economy

The implications of these findings for a depressed economy like Nigeria are: (i) there is the urgent need for more robust teaching strategies in science education that will generate productivity and thus raise the economic status of this nation (ii) biology students need motivation in the classrooms to attract many of them to read biology or science in general, knowing that scientific development is the bedrock of economic development of a nation. (iii) incentives are necessary to draw students' interest to read sciences like biology which can create jobs opportunities and self-reliant economic ventures.

Conclusions

Based on the findings of this study, one could conclude that:

i) inquiry-based instructional strategy raises students' interest in Ecology.
ii) inquiry-based instructional strategy is gender friendly

Recommendations

On the basis of the findings emanating from this study,

1. The use of inquiry-based instruction should be encouraged among teachers of Biology to enhance students' interest towards the study of Biology.
2. Both male and female senior secondary school students should be taught Biology using inquiry-based instruction as it does not discriminate along gender line.

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