Effects of Guided Discovery Method on Students' Attitude to, and Achievement in Biology in Senior Secondary Schools, Bauchi State

Dr. R.G Dajal, Mohammed, Adamu Umar

Department of Science and Environmental Education, Faculty of Education, University of Abuja, Abuja, Nigeria

Abstract: - **This study investigated the effects of guided discovery method on students 'attitude to and academic achievement in biology in senior secondary schools, Bauchi state. Two research questions were raised and two null hypotheses were formulated. The research design was quasi experimental non- equivalent control group; the study was carried out in two randomly selected co-educational secondary schools in Bauchi state. The sample size of 94 biology students from two randomly selected intact classes in the sampled schools was used. The instruments for data collection were Biology Achievement Test (BAT) and Biology Attitude Questionnaire (BAQ). Descriptive statistics were used to answer the research questions while t-test was used to test the null hypotheses. The results of the analysis showed that there was significant difference between the mean achievement scores of experimental group and control group; there was no significant difference between the mean achievement scores of male and female students in the experimental group. There was a significant difference between the mean attitude scores of experimental group and control group and there was no significant difference between the mean attitude scores of male and female students in experimental group. Based on the study it was concluded that guided discovery method has positive effect on students' achievement as well as improving their attitude towards biology and it is gender friendly. Based on the findings, it is recommended that among others that seminars, workshops and conferences should be held for biology teachers to acquaint them with the knowledge of guided discovery method and they should be encouraged to use it in their classroom teaching.**

I. INTRODUCTION

S cience is the bedrock on which modern day technological breakthrough is hinged. Different authors have defined Science according to their own understanding. Igwe (2003) defined science as a systematic study of the nature of the behaviour of the material and physical universe through observation, experimentation, measurement and recording. In addition, Ogunleye (2006) defined Science as a dynamic human activity concerned with understanding the workings of our world. This understanding helps man to know more about the universe

The major goal of science education is to develop scientifically literate individuals that are concerned with high competence for rational thoughts and actions. Science comprises the basic disciplines such as biology, chemistry, physics and mathematics.

Biology is one of the science subjects that secondary school students offer at the senior levels in Nigerian secondary schools, (FRN, 2014).The objectives of the biology curriculum at the secondary school level are to; prepare students to acquire adequate laboratory and field skills in biology, prepare students to acquire meaningful and relevant knowledge in biology .prepare students to acquire the ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture and prepare students to acquire reasonable and functional scientific attitudes (FRN, 2014).

Ramalingam (2000) define biology as a branch of science which deals with the study of living things. The subject has opened many carrier opportunities for students in medicine, pharmacy, nursing, veterinary science, food technology, agriculture among others. Apart from career opportunities from biological studies, the subject has also contributed in areas relating to livestock raising through cross breeding of various varieties of plant and animal species, development of vaccines and drugs for preventing and curing diseases, increase in food production and awareness of genetic diseases (Ramalingam,2000). Indeed, it is worthy that biology has contributed to national development through its various uses to mankind.

In spite of the huge benefits that biology has brought to national development and mankind, the achievement of students in the subject at Senior School Certificate Examination (SSCE) level is on the decline which is of great concern to all stakeholders. Reports from scholars and educators such as Ibe & Nwosu, (2003) and Ugwuadi, (2010) indicated that the poor achievement of students in Biology is linked to the use of traditional method (lecture method) in teaching senior secondary biology. The traditional/ conventional teaching methods often used by teachers in teaching Biology include the expository method, demonstration and direct instruction among others. These traditional methods of teaching stress more on the transmission of knowledge in a manner that emphasizes memorization hence they have been characterized by some educators like Ibe and Nwosu, (2003); and Ugwuadi,(2010) as poor methods of teaching biology and other science subjects. The traditional teaching methods involve unidirectional flow of information/knowledge from teachers

to the students and do not encourage process skill acquisition needed for proper understanding of biological principles, concepts and facts. Okoli (2006), referred to these traditional teaching methods as teacher-centered approaches to learning in the sense that the teacher is considered as the possessor of knowledge to be transferred to the students, and as such decides how the knowledge transfer takes place. The unidirectional flow of information in the traditional teaching method makes students passive and unable to construct meaningful knowledge in the learning of biology. The overall reliance on this method has tended to affect students achievement in the subject.

The paradigm shifts in teaching and learning biology de-emphasized the use of lecture method because it encouraged memorization of concept without actually exposing students to challenges that will make them to participate actively in teaching process and focus on methods that are activity-based in nature such as guided discovery method, concept mapping, simulation games and cooperative learning. Guided discovery method on the other hand is an approach to teaching in which students are guided by the teacher to find facts for themselves. It is against this background therefore, this study was designed to investigate the effect of guided discovery and conventional lecture methods on students' academic achievement and attitude to biology. The rationale was to determine the best method which is more effective in affecting students' achievement and also boost their attitude to biology.

Statement of the Problem

In view of the usefulness of biology in nearly all fields of human endeavor, the poor achievement and attitude of students at senior secondary schools level is of significant concern to stakeholders in education particularly at this level. Samikwa (2013), stated that most of the time the poor academic achievement of students and their attitude to biology can be attributed to many factors such as infrastructures and environment which means the classes are congested, the teaching resources such as charts, models among others are not adequate and the laboratories are ill-equipped. In the same vain Nwagbo (2001), assert that the persistent poor achievement and negative attitude of students to biology and other related science subjects is attributed to inappropriate teaching method adopted by the teachers.

Ugwuadi, (2010) stated that most biology teachers use lecture method to teach the subject, which does not in any way provide sequence of learning experience. In addition, the lecture method is imperfect because it involves verbal presentation of pre-planned lesson to the students which requires little or no instructional aid and so does not promote students' higher level of thinking.

Considering the importance of biology in all round development there is need for change in strategy in teaching so as to enable students in senior secondary schools to acquire adequate knowledge and skills in science. In view of these, researchers in science education especially biology have

always been searching for better teaching method that will enhance better students' achievement and promote their attitude so that they perform well in both internal and external examinations.

Purpose of the Study

The main purpose of this study was to determine the effect of guided discovery method on students' attitude to and academic achievement in biology in senior secondary schools Bauchi state. The Specific objectives were to:

i. Determine the possible difference in the achievement of students taught biology using guided discovery method and their counterparts taught using conventional methods;
ii. Determine the effect of guided discovery method on students' attitude to biology;

Research Questions

The following research questions were formulated to guide the study:

1. What is the difference in the mean achievement scores of students taught biology using guided discovery method and their counterparts taught using Conventional method?
2. What is the difference in the mean attitude scores of students taught biology using guided discovery method and their counterparts taught using conventional method?

Hypotheses

The following null hypotheses were formulated to guide the study and tested at 0.05 level of significance.

HO$_1$: There is no significant difference in the mean achievement scores of students taught Biology using Guided discovery method and their counterparts taught using Conventional method.

HO$_2$: There is no significant difference in the mean attitude scores of students taught biology using guided discovery method and their counterpart taught using Conventional method.

II. METHODOLOGY

Research Design

This study employed the quasi experimental design. Specifically, the study applied pre-test, post- test non-randomized control group. This is because intact classes were used so as not to disturb the normal setting of the schools' lesson. The pre-test was used to establish the equivalence of the two groups while the post-test was used to determine the effects of two independent variables that is the guided discovery method (experimental) and conventional lecture method (control) groups. The design is presented symbolically below

Table 1: Representation of Research design

Group	Pre-test	Treatment	Post-test
Experimental	01	X_1	02
Control	03	X	04

Table 1 shows that, the variables are defined such that 01 and 02 Experimental group 03 and 04 Control group. While 01 and 03 represent the pre-test for the two groups and 02 and 04 represent the post- test X_1 with treatment and X_0 lecture method. Experimental group received pre-test, posttest with treatment: Control Group received pre -test and without treatment.

Population of the Study

The target population of this study comprised of all the SS II biology students in senior secondary schools in Bauchi state. There are 204 senior secondary schools with a population of thirty-one thousand three hundred and thirteen (31, 313) SS II biology students categorized according to their sexes, Male (20,363) and Female (10,950) in the State. Ministry of Education Bauchi State, (2017).

Sample Size and Sampling Procedure

A sample size of 94 SSII biology students formed the sample of the study; 45 students from the school that constituted the experimental group and 49 students from the school that constituted control group. Simple random sampling method and purposive sampling method were used in selecting the 2 schools that formed the sample size

Instrumentation

The instruments used for data collection were: Biology Achievement Test (BAT) and Biology Attitude Questionnaire (BAQ). The Biology Achievement Test (BAT) was used to measure students' achievement in Biology concepts. It consisted of twenty five (25) multiple choice items with four (4) options, lettered A,B,C and D. Each item in Biology Achievement Test (BAT) carried 1 mark. The test items were based on the concept of Respiration in animals and plants, Reproduction in plants and animals, pollination, regulation of internal environment, liver and kidney. The original test consisted of 30 items but 25 items emerged after validation. In constructing BAT, the researchers prepared a table of specification (Test Blue Print) to guide the test development, in accordance with senior secondary school curriculum. The biology Attitude Questionnaire (BAQ) was used for Attitude testing before and after the treatment. The Biology Attitude Questionnaire (BAQ) had two sections; A and B. Section A sought response on students' personal data such as sex, age while section B consisted of 4 point Likert type scale responses that is Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD) on students' attitude towards biology learning. The instrument consisted of fifteen (15) items. The students were requested to indicate their preference in agreement with the rating. Each item was rated on a 4 points scale as follows: Strongly Agree SA=4, Agree A=3, Disagree D=2, Strongly Disagree SD=1 some items were positive cued while others were negative cued. The researchers prepared two sets of lesson plans for teaching both experimental and control groups for each topic that was taught, each unit contained ten lessons that lasted for 10 weeks, one unit of set of lesson plan was prepared using guided discovery method while the other unit was prepared based on conventional lecture method.

Validity and Reliability of the Instruments

The instruments BAT and BAQ were subjected to both face, content and construct validity. The validation of these instruments was done by two experts in the Department of Science and Environmental Education from University of Abuja to check the face validity, two biology teachers from the selected schools to check the content validity. The construct validity was checked by language experts. The correction made by these experts was used to review the instruments, (BAT and BAQ).

After the validation, the BAT and BAQ items were subjected to pilot test to ascertain the reliability of the instruments. The researchers conducted a pilot test in the area which was not part of the two secondary schools sampled for the study. One intact class consisting of 40 SS II Biology students was used. The reliability of the BAT was determined using test retest method, and Pearson Product Moment Correlation Coefficient was adopted to determine the reliability coefficient (r) of the instrument which gave 0.87 while the BAQ was also pilot tested in the same school, the rating score was used to determine the reliability coefficient of the instrument using Cronbach Alpha which gave 0.72. This indicated that the items were reliable within the acceptable limits.

Data Collection Procedure

The two instruments BAT and BAQ were administered as pre-test for both experimental and control groups, after the first week the researchers went round the selected schools and taught students personally for 10 weeks during their lesson period using the prepared lesson plan. However, the last one week the researchers administered the BAT and BAQ post-test. The scripts were marked and scored with the use of marking scheme .The marks obtained from the pretest and post- test from the instruments (BAT and BAQ) were used as data for analysis.

III. METHOD OF DATA ANALYSIS

The data collected from the study were analyzed using frequency count, mean score, and standard deviation to answer the research questions, while t-test statistics at 0.05 level of significance was used to test the null hypotheses. The analysis was computer based, with the use of the Statistical Package for Social Sciences (SPSS), version 21.

Presentation of Data

The data for the study are presented under the following sub-headings: demographic data, answers to research questions and test of hypotheses.

Table 2: Distribution of Sample According to Groups and Gender

Groups	Gender		No of Students
	Male	Female	
Experimental	26	19	45
Control	25	24	49
Total	**51**	**43**	**94**

Table 2 indicates the distribution of students who participated in the study according to groups and gender. An analysis of the sample showed that out of ninety four students, forty five students were in the experimental group while forty nine students were in the control group. It then means that students in the control group were in the majority. Also the table indicates the distribution of students who participated in the study according to gender. Further analysis reveals that out of the ninety four participants, fifty one students were male students while forty three students were female

IV. ANSWERS TO RESEARCH QUESTIONS

The following research questions were posed and answered as follows:

Research Question One:

What is the difference in the mean achievement scores of students taught biology using guided discovery method and their counterparts taught using the conventional method?

To answer this research question, frequency count, mean and standard deviation were used and the results set out on table 3

Table 3: Mean and Standard Deviation for Experimental and Control Groups.

Groups	No. of Students	Mean Scores		Standard Deviation	Mean Gain
		Pre-test	Post-test		
Experimental	45	10.0	19.46	4.84	9.46
Control	49	9.96	10.04	5.00	0.08
Mean Difference		0.04	9.42		**9.38**
Total	**94**				

Table 3 indicates that the mean gain of the students in experimental group taught Biology using guided discovery method was 9.46 and that of the control group who were taught using conventional method was 0.08. The overall mean difference between the groups was 9.38 and this favoured students in experimental group taught using guided discovery method.

Research Question   Two: What is the difference in the mean attitude scores of students taught Biology using guided

discovery method and their counterparts taught using conventional method?

To answer this research question, frequency count, mean and standard deviation were used and the results set out on table 4

Table 4: Mean and Standard Deviation on Attitude of Students in experimental and control groups

Groups	No. of Students	Mean Scores		Standard Deviation	Mean Gain
		Pre-test	Posttest		
Experimental	45	1.97	3.55	1.08	1.58
Control	49	2.01	2.06	1.10	0.05
Mean Difference		0.04	1.49		**1.53**
Total	**94**				

Table 4 indicates the means and standard deviation on the pre-test and post-test attitude scores of students who were taught using guided discovery and conventional methods. An examination of the table revealed that the mean gain in attitude of the students taught Biology using guided discovery method was 1.58 while that of students who were taught using conventional method was 0.05. The overall mean difference between the groups was 1.53 which favoured students taught biology using guided discovery method.

V. TEST OF HYPOTHESES

In this study, two hypotheses were formulated and tested as follows:

HO_1: There is no significant difference in the mean achievement scores of students taught Biology using guided discovery method and their counterparts taught using conventional method.

To test this hypothesis, t-test statistic was used and the results presented in Table 5.

Table5: t-Test Result in respect of Mean Achievement Scores between the Experimental and Control Groups

Groups	N	$\overline{x}$	SD	t – value	df	P
Experimental	45	19.46	4.84			
				13.12	92	0.0001
Control	49	10.04	5.00			

$P < 0.05$ Significant

Table 5: shows the summary of the result of test of hypothesis one. From the table, the calculated t- value of the test was 13.12; df was 92, while the P -value was 0.0001. Since the P- value of 0.0001 is less than 0.05 level of significance, this indicates it is significant. Based on the analysis, the first hypothesis was rejected.

HO_2: There is no significant difference in the mean attitude scores of students taught Biology using guided discovery

method and their counterparts taught using conventional method.

To test for this hypothesis, t-test statistic was used and the results presented in Table 6.

Table 6: t-Test Result in respect of Mean Attitude Scores between the Experimental and Control Groups

Groups	N	$\overline{x}$	SD	t – value	Df	P
Experimental	45	3.55	1.08			
				9.37	92	0.0001
Control	49	2.06	1.10			

P < 0.05 Significant

Table 6: shows the summary of the result of test of hypothesis two. From the table, the calculated t- value was 9.37, df was 92, while the P- value was 0.0001 Since the P- value of 0.0001 is less than 0.05 level of significance, this indicates it is significant. Based on the analysis, the second hypothesis was rejected.

VI. SUMMARY OF FINDINGS

The summary of the finding were as follows;

1. There was a significant difference between the mean achievement scores of experimental group taught biology using guided discover method and their counterparts in the control group taught biology using conventional lecture method.
2. There was a significant difference between the mean attitude scores of experimental group taught biology using guided discover method and their counterparts in the control group taught biology using conventional lecture method.

Discussion of Findings

This investigation showed that the mean achievement scores of students who were taught biology using guided discovery method was higher than those taught using conventional method with a mean gain of 9.46. Therefore, a difference in achievement existed between the group taught using guided discovery method and those taught using conventional method.

The findings of this study affirm the results of Ajewole (1990) and Ugwuadi (2010) who in their studies found that exposure of students to guided discovery method enhanced students' achievement in Biology. The findings also lend support to that of Matthew and Igharo (2013) who also found significant difference in favour of the experimental group taught biology using guided discovery method.

The reason for the difference is that guided discovery method is activity oriented teaching method that encourage active participation of students in class room activities and as well maximize comprehension of subject matter. It means that the method can be used to teach students since it reduces the

problem of poor achievement as well as boost their attitude toward biology.

Also, this study discovered that the mean attitude scores of students taught biology using guided discovery method was higher than those taught biology using conventional method with a mean gain of 1.58 which favoured the experimental group. This clearly shows that there is difference in mean attitude scores between the experimental group taught Biology using guided discovery method and control group taught Biology using conventional method.

The results of the current work confirm the findings of Ajewole (1990), Sola and Ojo (2007), who in their studies found that guided discovery method enhances students attitude towards science.

The reason for the difference is as a result of guided discovery method which provided opportunity for active participation of the learners/ students, this arouse their interest and consequently boost their attitude toward science. It means the method help to boost students' attitude towards biology.

VII. CONCLUSION

The study was informed by the need to improve the academic achievement of secondary schools students in Biology which deterioted over the years. The aim to proffer solution to this problem has led to the conception of this study which investigated the effects of guided discovery method on students' attitude to, and achievement in Biology in senior secondary schools, Bauchi State.

The researchers however, concluded based on the analysis of the result in this study that the use of guided discovery method enhances the academic achievement of students in Biology as well as boost their attitude than the conventional method. With guided discovery method, students learn better about biology, carried out their responsibilities and make effort to achieve the stated objective.

Therefore, contrary to conventional method, guided discovery method helps students to be in self-learning and it is an appropriate method for teaching biology concepts since students are actively involved in learning process this result in affecting the academic achievement and also boosted their attitude toward biology.

VIII. RECOMMENDATIONS

The following recommendations were made based on the findings of this study;

1. Biology teachers should be encouraged to incorporate guided discovery method of teaching since the method provides the opportunity of engaging students in learning activities and this affects their achievement and attitude towards biology concepts.
2. Stakeholders and relevant professional bodies like Science Teachers Association of Nigeria (STAN)

should organize seminars, workshops and conferences for Biology teachers to adopt the use of guided discovery teaching methods in the teaching of biology

3. Stakeholders should also provide conducive learning environment with necessary infrastructural facilities needed for effective guided discovery teaching since the method was found to be effective in boosting students' attitude towards biology.

REFERENCES

[1]. Ajewole, G.A. (1990). *Effect of guided discovery and expository instructional methods on students' transfer of learning.*Journal of the Science Teachers Association of Nigeria, (2), 26 59-66.

[2]. Federal Republic of Nigeria (2014). *National Policy on Education*. Lagos: Heinemann Educational books Ltd.

[3]. Ibe, E. & Nwosu, A. A. (2003). *Effects of Guided-Inquiry and Demonstration on Science Process Skills Acquisition among Secondary School Biology Students.*Journal of the Science Teachers' Association of Nigeria 38 (1 & 2) 58-63

[4]. Igwe, I.T. (2003) *Enriching Science Education. The place of improvisation in the classroom. Science teachers' association of Nigeria (STAN) 41st Annual conference proceedings* pp 51-53

[5]. Matthew, B. M. & Igharo, O. K. (2013). A study of effects of guided inquiry teaching method on students' achievement in logic*: International Research Journal* 2(1) available on line at www.iresearcher.org.

[6]. Nwagbo, C. (2001). *The Relative Effect of Guided-discovery and Expository Methods on The Achievement of Biology Students of Different Levels of Scientific Literacy. Journal of Science Teachers 'Association of Nigeria*.36 (18, 2), 43-51.

[7]. Ogunleye, A. O (2006) Toward the optimal utilization & management of resources for the effective teaching of physics in schools proceeding of the 41st Annual conference of the Science Teachers, Association of Nigeria (STAN) University of Lagos pp. 215-216

[8]. Okoli, J.N. (2006) Effect of investigative approach and expository method as acquisition of science process skills by Biology Students of different levels of scientific literacy*, Journal of the science teachers association of Nigeria*, 41 (1 & 2), 79-88.

[9]. Ramalingam, S.T. (2000*). Modern biology senior secondary science series*(New edition). Onitsha: Africana – FEP Publishers (Ltd)

[10]. Samikwa, D.C (2013). Factors which influence academic achievement in biology in Kenya. A perspective for global competitiveness. *International Journal of currentresearch*5(12),4296-4399.Availableonlinehttp//www.journal,cra.com Education 16:9-13.

[11]. Sola, A.O.& Ojo, O. E. (2007). Effects of Project, Inquiry and Lecture Demonstration Teaching Methods on Senior Secondary Students' Achievement in Separation of Mixtures Practical Test. *Educational Research and Review*2(6),124-132 .

[12]. Ugwuadi, O. R. (2010).The effects of guided inquiry & lecture method on students' academic achievement in biology in Adamawa state: *knowledge review journal.*21 (1) retrieved28/7/16from www.globalacademicgroup.com.