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Effects of Field Trip and Discovery Methods on Senior Secondary School Students' Retention in Biology in Benue State, Nigeria

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Abstract

The study investigated the Effects of Field Trip and Discovery Methods on Senior Secondary School Students' Retention in Biology in Makurdi Local Government of Benue State, Nigeria. Four research questions were formulated to guide the study and four hypotheses were tested at 0.05 level of significance. Quasi-experimental design of the non-randomized pre-test post-test control group was used. The sample was made up of 205 SSI students from five senior secondary schools in Makurdi Local Government Area of Benue State. A multistage sampling technique was adopted to draw the sample. The instruments- Biology Achievement Test (BAT) and Biology Retention Test (BRT) were used for data collection and the reliability of BAT was 0.77 using Kuder Richardson formula (KR₂₀). The research questions were answered using mean and standard deviations while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The result showed that the Field Trip and Discovery methods enhanced

students' retention in Biology. There was no significant difference between male and female students' retention in Biology. Based on the findings of the study, secondary school Biology teachers were recommended to adopt these methods in teaching. Suggestions were also made that the methods should be used for other topics that students may find difficulties in the senior secondary schools.

Keywords: Pedagogy, Biology Education, Field Trip Method, Discovery Method, Retention

Introduction

Retention is the ability to remember or recall what has been learnt after an interval of time. Odoh (2012) defined retention as the ability of a learner to communicate to others repeatedly and overtime what he /she have learnt and how he/she has come about the results. Muhammad (2009) opined that retention may depend on the method of teaching, the interest and the attitude of the learner or the meaningfulness of the materials to the students. Researchers in Biology have observed that instructional strategy serve as pre-requisite to students' retention in their studies which has promoted the researcher to investigate the efficacy of field trip and discovery methods of teaching on student's retention in Biology irrespective of their gender.

The place of science in the life of any modern society cannot be over emphasized. In fact the level of science and technology as well as scientific literacy in any society is inextricably linked with the pace of development in such a nation. Consequent upon this, much importance is attached to science and technology all over the world. Biology is one of the science subjects offered at the Senior Secondary School Level in Nigerian Secondary Schools, (FRN, 2004). Biology is a very important science subject and a requirement for higher learning in a number of science related professional courses like Medicine, Agriculture, and Pharmacy among others. It is a science subject that enables students to acquire knowledge to live effectively in the modern age of science and technology.

In view of the importance of science and technology for nation building, research works are being done every day in order to improve the teaching and learning of Biology in schools, workshops, seminars, and conferences are being organized by professional bodies to improve the teaching and learning of the subject. Despite the workshops, seminars and conferences being organized by professional bodies in order to improve the teaching and learning of Biology, there is still poor performance in science in our senior secondary schools, judging by poor results in achievement tests and examinations taken by the students at the various levels of the educational system (Ibraheem, 2004). Chief examiners, reports on West African School Certificate Examination (WASCE) and National Examination Council (NECO) senior school certificate examination results May/June 2012 - 2014 in Nigeria showed that the performance of students in science subjects have been poor especially in Biology. According to the West African Examination council (WAEC) the chief examiners reports (2009 – 2014) candidates areas of weakness include:

- i. Poor knowledge of Biology.
- ii. Wrong spellings of biological words which give different meanings.
- iii. Poor interpretation of questions.
- iv. Inability to apply scientific knowledge to everyday life. Poor deductive reasoning.

Low achievement in Biology could be attributed to many factors such as attitudinal problems, lack of mastery of the subject language, spelling errors, confusion between similar and related concepts and poor instructional delivery approach (Salau, 2012). The author further mentioned that amongst the factors enlisted above, poor instructional delivery approach seems to be the most prominent factor that could be major cause of underachievement in biology.

Based on the data regarding low achievement in Biology, science educators are constantly exploring ways to alleviate the ugly situation of under achievement in the subject as noted by Jumoke and Oludipe (2012). This is by ensuring that the pedagogical approach which is the function of students' achievement in a subject, that is employed in the teaching and learning process should be the type that guarantee creative thinking and optimal learning outcomes. Awolola (2012) states that there exist gaps between curriculum planners' intention and what goes on in the science classroom concerning the recommended teaching methods. This author's statement is a confirmation of Ndioho in Umoru E.S (2017) who earlier pointed out that, the non-impressive achievement of students in Biology indicates that the methods of teaching employed by most Biology teachers in the classroom are not adequate and interesting. In the same light, Umeh (2008) reiterates that the main cause of students' low achievement is traceable to improper teaching methods employed by subject teachers which centres mainly on excessive talking, copying of notes, rote learning of textbook and memorization of concepts.

In spite of the consensual efforts of science educators to alleviate the ugly situation of low achievement of students in Biology, Nwezi and Nwosu In Umoru E.S (2017) maintain that the problem is connected to ineffective teaching strategies employed by teachers. The authors also stated that teachers are more inclined to traditional teaching method which appears to be the most dominant teaching method employed by many science teachers. Low achievement in Biology could be inability to remember or recall what has been taught during the instruction partly due to ineffective teaching methods. Gambari and Zubairu in Umoru and Itodo (2018) in a study stated that the persistent use of traditional teaching method makes students passive rather than active learners. This does not promote insightful learning and long-term retention of some concepts in Biology.

Gender refers to the social cultural and psychological dimensions of being female or male whereas gender roles are the expectations that prescribe how males and females should think Ogunkele R.A in Umoru E.S (2017) towards gender response to learning. This is because it appears that there is still a considerable bias against female students which hinders their full participation and achievement in Biology. On the other hand Solomon in Umoru E.S (2017) carried out a study on gender differences in achievement in Biology notes that boys perform better than girls, while Akanbi and Kolawolse 2006 in another gender study stated that students' achievement in Biology yielded a positive result irrespective of gender. Coultbard in Egbe-Okpenge (2017) opined that from a very early age girls appear to prefer Biology to physical sciences or technology. However, the inconsistencies in gender differences in academic achievement in Biology calls for further investigation which is one of the concerns for this study.

Oludipe and Oludipe (2010) pointed out that: The traditional teaching method is a process. The current Nigerian level, whether primary, secondary or tertiary institution level mostly tends to resemble a one-person show with a captive but often comatose audience. Classes are usually driven by "teacher-talk" and depend heavily on textbooks for the structure of the course. There is the

idea that there is a fixed world of knowledge that students must come to know. Information is divided into parts and built into a whole concept. Teachers serve as pipelines and seek to transfer their thoughts and meanings to the passive students. There is little room for the student-initiated questions, independent thoughts or interaction between students. The goal of the learner is to regurgitate the accepted explanation or methodology expostulated by the teachers.

According to Ugwu and Nzewi (2015) in the past, the traditional teaching approach used to impart knowledge was successful, but the minds of current generation vary from those of the previous generation, meaning that the current students of today are highly scientific literate and flow with the new trends in science and technology such as accessing the internet in order to enhance their knowledge. Hence the progression of education and educational technology should follow the progression of time, therefore these calls for new innovative teaching method such as field trip and discovery that could address the needs of the present day students.

For Biology to be an effective tool for the enhancement of national productivity, the recommended contemporary teaching strategies for science teaching should be employed by Biology teachers in secondary schools. These recommended contemporary teaching methods as enlisted by Umoru and Adejoh (2013) includes; problem-solving, concept-mapping, constructivist and field trips. However, Biology teachers seem not to be inclined to the use of these recent teaching strategies that are student-centred (engages students in active participation in class activities) rather they choose to use the traditional method which is teacher-centred and did active.

The traditional teaching method (lecture) can hinder the development of individual students' active and creative abilities and as such, students who are exposed to only this model of education may no longer be considered sufficient for the needs of the future educated citizenry. In the same vein, Danjuma (2005) posits that, activity based instructional strategy such as; discovery method, inquiry, demonstration and problem-solving could enhance academic achievement, self-confidence and creative thinking in learners. In the opinion of Kurumeh (2006), involvement of students in the teaching and learning process signifies a paradigm shift from the traditional method of teaching to the contemporary approach which is another means of ensuring active learning in science. Thus, the search for strategies that emphasizes active participation of students have engendered the birth of many strategies that include field trip and discovery methods.

Field trip is an instructional procedure whereby learners are taken out of the classrooms to places of educational interest. This could be an industry, an establishment or even a natural environment where science (Biology) can be learnt. Eriba (2007). This is usually done under the supervision of the teacher. The learner is afforded the opportunity to see science in action: he uses his own senses to acquire information which' by all means is most enriching procedure to learning.

The researcher is of the opinion that the planner of field trip should have a definite purpose, get students organized, ensure students safety, visit the place first and make a proper arrangement about the whole trip.

The justification for using fieldtrip as a model of instructions. The quality and quantity of materials viewed exceed what are used in the typical classroom experience. Students acquire academic skills and experience that will last. Field trips spark lifelong/learning in children. Akuto

(2012) states the advantages of field trip method as providing direct and first hand learning experiences with realities of the social and physical environment, makes learning more permanent and meaningful, helps students to develop interest, stimulates and makes teacher's work easier.

The justification for using discovery teaching method in teaching and learning of science subjects. Discovery method is very valuable in the teaching of science because science should not be taught to students but students should be left to discover it (Adejoh, 2007). He further said that the approach is student-centred, as a result, the students are actively involved in the process of acquiring knowledge rather than a passive listener, though the discovery approach students are able to acquire knowledge, skills and attitudes by finding things for themselves, the approach according to Maduewesi et al (1999) facilitates assimilation and retention of knowledge and students are more interested in and remember things they have found out for themselves. The approach also motivates mental adventure and analytical thought. The present study sought to determine the efficacy of field trip and discovery methods of teaching on senior secondary school students' Achievement and Retention in Biology.

Statement of the Problem

The present poor performance by students in Biology as evidenced by the West African Examination Certificate results call for immediate attention of Biology teachers, Biology curriculum planners and educational administrators all over the country. Chief Examiners' reports, both in NECO & WASSCE from the year 2002 to 2012 showed that the performances of students in Biology were poor.

The problem of underachievement in Biology has been attributed to poor instructional approach, lack of qualified teachers, lack of teaching materials and poor state of funding education by stakeholders in education.

Considering the importance of biology in nation building the need to teach it effectively through effective teaching methods is indispensable. This has necessitated the quest for more effective and students centered approach.

Some of the related literature reviewed, showed that innovative teaching methods yielded positive results to student achievement and retention in Biology. Davidson, Beck and Milligan (2009) asserted that retention of knowledge by students in their studies correlates with high level of instructional effectiveness, both in the classroom, interactions with peers and interactions with the faculty outside the classroom. These assertions indicate that, instructional strategy serves as a pre-requisite to students' retention in their studies which have also prompted the researcher to investigate the effect of field trips and discovery methods on senior secondary school achievement and retention in Biology.

Literature Review

Brunner's Theory of Discovery Learning (1966)

Brunner's theory of discovery learning; the idea for the use of experimental approach to enhance teaching and learning of Biology is hinged on Brunner's theory of discovery learning which emphasizes the importance of discovery method of instruction. Brunner (1966) maintained that when one is able to figure out things himself, learning is promoted and memory is strengthened. He advocated a learning situation in which learners become detective. One is able to do this either

because his cognitive structure is already tuned to absorb new information in which there is familiarity and the new information is simply assimilated or if the new learning must take place. Brunner contended that there are two forms of discovery learning namely; assimilation and accommodation. For Brunner, the sequence in learning is in a reverse manner, that is, learning starts with the complex and plans to learn the simple components is in the context of working with the complex.

Aba (2000) shared the same view with Brunner on learning by discovery when he states that one obtains knowledge for himself by the use of one's mental processes. He emphasized that the learner's memory is kept alert and enhanced by learning aids.

Bruner called his theory a theory of instruction. This is because as he puts it, a theory of instruction tells the educator how and what he wishes to teach can be best learned with improvement rather than describing learning. The biology teacher can apply this theory to classroom situation by providing learners with tasks or problems of great variety to solve and providing sufficient guidelines on instrument/apparatus so that students can play an active part in learning process (Ukpong 2000).

Piaget's Intellectual Development of Learners (1957)

Piaget, (1957) studied the intellectual development of children and theorized that a child passes through four stages of mental development. The stages are: The sensory motor stage (0 – 2 years),

- i. The pre-operational stage (2 – 7 years),
- ii. The concrete operational stage (7 – 11 years),
- iii. The formal operational stage (11 – 15 years).

Piaget looks at the development of the child's cognitive structure as varying in sequence, from sensory motor to formal operational stages although differences between cultures may be found. For example, Piaget's view point, children between the ages of seven to about eleven years are still in concrete operational stage. They have their thinking centered on concrete things rather than abstract. The concept of quantity, time, space and conservation of them are developed at this stage as a result of experience of the physical world. Biology teachers are supposed to use instructional materials to enhance classroom instruction even in a situation where they are not available; they should be improvised by teachers to ensure that students learn practically. The researcher is of the opinion that improvised materials may be used as practice devices with which the student builds accuracy; understanding and efficiency, for example mounting a prepared biological slide in microscope could show structure of plant or animal cells. Piaget's remarks at the conference on cognitive research and curriculum development held at cornel university in 1964, that good pedagogy must involve presenting the child with situations in which he experiments himself, in the broadest sense of that term trying, things out to see what happens manipulating things, posing questions and seeking his own answers, reconciling what he finds at one time with what he finds at another, comparing his findings with those of other children.

The implication of what Piaget is saying is, while experimenting with objects, children make new discoveries about a particular concept or process. Biology teachers should use innovative teaching methods (field trips and discovery methods) where students can be exposed to do experiments with objects, peer tutoring and discussion than lecture method.

The relevance of this theory to biology teachings are the teachers of biology should provide enough instructional materials and favourable environment for the student to learn concepts and principles by themselves. Biology teachers should adopt modern approach to teaching as this will help the students to perform better in examinations. The teaching of this subject should be by discovery and field trips methods which encourage learning by observing doing etc.

Field Trip Method in Biology

Field trip is an enjoyable instructional method, which allows teachers of science to take their students out of classroom to the field, external laboratories, factory, farm and scientific places of interest to learn. Schools encouraged very little environmental experiences and science teachers complained of difficulty in getting places of interest to visit. It exposes students to the real world, natural principles of science, first hand experiences which they have been having verbally in the classrooms, in the classrooms (Olakoye & Afuwape, 2004). Scientific processes are tools for this method i.e. observing, manipulating variables, experimenting, raising questions, demonstrating among others. This method helps to develop the spirit of cooperation among the learners, endurance and teacher-learners relationship. A happy moment of this nature will help students to learn and understand biology better than some other methods used in teaching biology.

Eriba (2007) defines field trip as an instructional procedure whereby learners are taken out of the classrooms to places of instructional interest. This could be an industry, an establishment or even a natural environment where science can be learnt. This is usually done under the supervision of a teacher. The learner is afforded the opportunity to see science in action. He uses his own senses to acquire information which by all means is the most enriching procedure to learning.

Asikina (2010) states that field trip method of teaching and learning, experience is an expensive verdure. The resources and fund required to run it are expensive and not easy to acquire. Most school administrators have lukewarm attitudes toward releasing funds for field trip work.

The Concept of Discovery Method in Biology

This instructional strategy is also referred to as the inquiry method (Eriba, 2007: 49). Through this student's acquire knowledge, skills and attitudes by finding out things for themselves. Students are meant by the use of this method, to use their intellectual processes to find solutions to problems generated by the teacher, books and other curriculum guides. This aspect of the discovery method is called guided inquiry. Sometimes neither the general principle nor the solution would be suggested and the students would be required to work out both, this will be referred to as the unguided form of inquiry or pure discovery.

In an inquiry lesson, the teacher is a guide, a leader, a resource person, an internal sensor and a motivator to further inquiry. The method has an upper hand over the traditional lecture method in the sense that it has a self-motivating mechanism, which challenges the learner to learn. It exposes the learner to a wilder horizon into array of knowledge (Eriba, 2007).

Although there are profuse arguments against the use of the discovery method, particularly that it consumes time, no adequate equipment, and the fact that it still stands out as one of the most effective science teaching strategies when used and planned carefully by the teacher (Eriba, 2007: 50).

Based on experience, the researcher looks at the discovery method as a pupil and activity-oriented method of teaching. It involves the learner using their mental and physical processes to discover some concepts or principles. This method helps the learner to find out facts or learn about scientific phenomena. It involves critical thinking to arrive at a logical conclusion. The processes of logical thinking are: Observing, classifying things, numbers, measuring, communicating, inferring, formulating hypotheses, interpreting data etc. Adejoh (2007) says the discovery method could be guided or unguided. Human and material resources in education are to monitor the guided discovery method while unguided allows the learner to operate independently and find out facts on their own using known techniques of investigation to develop positive attitudes towards science.

Students Retention in Biology

The most important thing about learning is retaining the acquired knowledge for future use. This must be encouraged by teachers through instructional strategies employed. Ortse Yawe and Akume (2005) in Umoru and Itodo (2018). Imoko and Anyagh (2008) said that retention of a learnt material is a direct correlate of positive transfer of learning, the later which is the primary essence of education. To retain the meaning of a word or concept learners must engage a deeper analysis of the words properties rather than simply understanding the meaning and context. For a long-term recall the successful learner can not only analyze and rehearse the new word and its meaning but also can explain the meaning of the word and establish it within a suitable network of meaning Kesta and Alfalect (2013). These authors assertion was confirmed by Khabiri and Pakzad (2012) who earlier stated that the chances that the word and its meaning will be available for later use. For students to do well in an examination, his/her ability to recall was previously learnt is a necessary condition.

Retention may depend on several factors prominent amongst them is the quality of teaching strategies adopted by the teacher (Atomatiofa, 2013), this is because the teaching strategies employed by teachers can go a long way in enhancing students achievements and retention. That is why Achor et al (2014) argued that students' poor retention is as a result of ineffective teaching strategy.

In order to improve retention of information in a subject, Otse in Umoru and Itodo (2018) suggested that arrangement of learning materials by teachers should be in such a manner that students are allowed to actively participate in the learning process which will help to facilitate their retention. Usman (2010) in his research found that teaching strategy which involves active participation of the learners enhance retention. These studies specifically pointed out discussion method, collaboration learning, problem solving amongst others as teaching strategies which involve participation in the learning process and have the potentials of enhancing students' retention. By implication the above reports indicate that the use of field trip and Discovery methods of teaching which provide opportunity for students to actively participate and collaborate in sharing knowledge could also enhance students' retention in Biology. Therefore, students' retention in Biology mean what the students are able to recall after learning Biology and subsequent application of such knowledge at an appropriate time to enhance achievement. Enhancing achievement and retention in Biology is for males and females.

Gender in Biology

One of the national objectives of education as spelt out in the national policy on education (2004) is to develop a Nigerian with bright opportunities to be made available for male and female students as to attain maximum potentials in education. In order to achieve this objective, appropriate teaching strategies are expected to be employed by teachers to balance the differences in achievement. Okeke (2008) in Umoru, Adejo and Iji (2016) defined gender as socially, culturally constructed characteristics and roles which are ascribed to males and females in the society. These assigned roles conflict and inhibit curious scientific tendencies required for female students. The author further observed that the issue of gender stereotyping permeates every aspect of human endeavour and its consequences cut across social, economic, political and educational development especially in the area of science and technology. The education for both men and women is believed to play a great role on furthering social solidarity, stability and integration in the society.

Traditionally girls in our society have been encouraged to conform, whereas boys are expected to be achieve and dormant risk takers. Agreeing with this submission, Hassan and Ogunyemi (2008) acknowledged that boys are provided with toys that enhance their visual-spatial ability such as trucks. Spencer (2004) in Umoru and Itodo (2018) in an earlier study affirmed that the gender of girls is highly structured to requiring turn taking and rules. Thus, these social expectations and conformity pressures may create cultural blocks for girls and is capable of having effect on the girl child is social interaction even in the classroom.

Studies have shown that there are several conflicting reports on gender differences in achievement in sciences which include Biology. Some researchers such as Hung, (2010), Gbodi and Caley (2006), Olatoye and Adekoya, (2010) all agreed in their various researchers that gender doesn't have any effect on students' achievement in science (Biology inclusive). However, Yang (2013) examined the effect of gender achievement of students in Biology using videotaped instruction amongst Chinese students. The study revealed that there was significance difference between the mean scores in favour of the boys. This showed that the males gained more from the method compared with the females. The study recommended that various methods should be employed by teachers. Also Morribend (2004) Chukwuka (2005) and Aremu (2005) in Umoru and Itodo (2018) individually reported that boys achieve highly than their female counterparts. On the other hand Eze (2007) from a study on inquiry method of teaching reported that female students' performance in science subjects is higher than their male counterparts in the inquiry group meanwhile Dania (2013) emphasized that is there are differences in gender achievement then it is as a result of the type of instructional strategy employed by the teachers. These conflicting reports on the differences in gender achievement needs to be reinvestigated using different approach such as field trip and Discovery methods of teaching to check if it can eradicate or balance these gender related differences in achievement in Biology.

Research Questions

The following research questions were asked to guide the study:

- i. What are the mean retention scores of students taught Biology using Field Trip Method and those taught with lecture method?
- ii. What are the mean retention scores of students taught Biology using discovery method and those taught with lecture method?

- iii. What are the mean retention scores of males and females students taught Biology using discovery Method?
- iv. What are the mean retention scores of males and females students taught Biology using field trips Method?

Statement of Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

- i. There is no significant difference between the mean retention scores of students taught using Field Trip Method and those taught with lecture method.
- ii. There is no significant difference between the mean retention scores of students taught using Discovery Method and those taught with lecture method.
- iii. There is no significant difference between the retention scores of males and females students taught Biology using Discovery Method.
- iv. There is no significant difference between the retention scores of males and female students taught Biology using Field Trip Method.

Methodology

Research Design

The research design for this study was quasi-experimental of non-randomized pre-test, post-test, control group. The adoption of quasi-experimental is because it was not possible for the researcher to meet all the conditions of a true experiment. Intact classes were randomly assigned to experimental and control groups, this is to avoid disrupting the school activities and programmes. Another reason for the choice of this design is that it is a powerful and valid design which could be used to identify confidently the cause of any given effect.

Area of Study

The study was carried out in Makurdi local government area of Benue State. It has a population of 300,377 people at 2006 population census. National Population Commission (2009) A visit to Makurdi local government area shows that it is bounded by Guma local government area to the North, Tarka local government area to the East, Gwer-East Local government area to the South and Gwer-West local government area to the West. Makurdi local government area has twelve council wards. These include: OLD GRA, central, Ankpa, Wadata, High level, Wururkum, New GRA, Fidi, Agan, Nyiev, Mbawa and North Bank. Also the area is chosen because it has many secondary schools and there was little evidence of similar research been carried out except this current study.

Population of the Study

The targeted population for this study consisted of all the 1680 senior secondary schools (SS1) students in Makurdi Local Government Area of Benue State. The SS1 classes have the population of 1680 out of twenty senior secondary schools. (Benue State Teaching Service Board) statistics unit, students' enrolment 2013/2014 academic session. SS1 were used because it is from where the senior secondary school Biology syllabus in external examinations like WAEC and NECO start.

Sample and Sampling Technique

The sample size for the study was 205 out of 1680 SS1 students. Multistage sampling technique was adopted. Precisely purposeful and simple random sampling techniques were used at different stages. Purposeful sampling technique was adopted in selecting five (5) schools from the twenty secondary schools in the area. The criterion for the selection was that the schools were to have SS1 class and examination center for WAEC and NECO. The Biology teacher must possess two to five year of teaching experience. Another was that the school authorities were to permit their schools to be used. Simple random sampling technique was used to select four experimental and one control schools by balloting. Out of the four schools selecting for experimental groups 2 were for discovery and 2 for fieldtrip while one school for a control group. Finally, intact classes were randomly assigned into both groups.

Instrument for Data Collection

Two instruments were used for these studies which include Biology Achievement Test and Biology Retention Test.

Biology Achievement Test

BAT is a 50 multiple choice objectives items with four options per question, in which the students are expected to choose the correct option. Total mark obtainable is 50. The test items covered the topics on ecological factors affecting the distribution of organisms in terrestrial habitat. The questions were selected from the past WAEC questions. The items were based on the instructional objectives contained in SS1 Biology curriculum as to measure students' achievement and retention in Biology. BAT was according to lower ordered questions based on knowledge, comprehension and application of the cognitive domain and high order questions covering analysis, synthesis and evaluation in the blue print of BAT.

Biology Retention Test

The Biology retention test is a reshuffled BAT. BRT was conducted after two weeks of the administration of the post-test. This period was sufficient enough to ascertain if students would retain the knowledge of lessons taught. (Custer, 2010). For the two instruments the numbers of questions were the same. The rearrangements of the questions were the difference between the two instruments.

Control of Extraneous Variables

The unforeseen extraneous variables threats that would have joint effect with the independent variables (the teaching methods) on the dependent variables (achievement and retention) such that the main effects would not been fully realized were identified and controlled. These were controlled as follows:

- i. Effect of pre-test and post-test the period between the pre-test and post-test were six weeks. This period should be enough to prevent the pre-test from affecting the results of the post-test.
- ii. Pre-test and post-test items are the same in content but different in arrangement.
- iii. Only mixed schools and far away from each other was used.
- iv. Pre-testing of the respondents were carried out to ensure the same level of equivalence exist amongst the students before commencement of the experiment and this was corrected through the use of analysis of covariance.

- v. Different lesson plans are prepared for the researcher to be handed over to the teachers to reduce teachers' influence on lesson preparation.

Experimental Procedure

Three sets of lesson plans were developed by the researcher and used in teaching both experimental and control group. Discovery method and field trip methods lesson plans were for the experimental groups while lecture method lesson plan was for the control group. The lessons were taught for six weeks by the permanent Biology teachers in the schools selected. They used study guides and were briefed from the researcher. The topics cover the definition of habitat and ecological factors affecting the distribution of organisms in the habitat.

The research assistants were given two days training by the researcher on how to teach the topics using Discovery field trip methods. The procedure for administering the instruments and general conduct of the study were specified to the research assistants. The Biology teachers were advised to use the same length of time (40 minutes per lesson for six weeks) to teach the content to the groups.

The researcher, through the research assistants administered the pre-test to all the groups before treatments. This was to enable the researcher to determine the homogeneity of the students in terms of achievements and retention in Biology. Each lesson lasted for 80 minutes as it reflects lesson time table. The study lasted for six weeks. Two weeks later, Biology retention test was administered to all the groups to enable the researcher determine the retention ability of the students.

Validation of Instruments

The Biology achievement test (BAT) was given to three experts two of them from measure and evaluation department of the University of agriculture and Benue state university respectively. The third person was from government secondary school NAF Base Makurdi who was a season biology teacher WACE and NECE examiner To see the extent to which the instrument evaluates what it was designed to evaluate, to confirm the extent the test represents what has been specified in the blueprint, to access in terms of adequacy to measure what it was set to measure including the language and difficulty level. The few comments made by the validators include stick to your table of specification, appropriation of test languages are okay, and typographic error minimal. The comments were taking care of. Out of 50-item questions 45 survived the scrutiny and were administered to the students.

Trial Testing

Trial testing was conducted to gather information on the reliability of the test items for the intended level of students that participated in the study. The researcher trial tested the test items on 30 senior secondary one level students SS1 from Airforce Secondary School Makurdi that had the same characteristics with the schools for the main study but were not part of the study population. The duration of the test was for one and half hours.

Reliability of the Instrument

The reliability of the BAT (multiple choice items) was computed using Kuder,-Richardson formula (KR_{20}) to measure the internal consistence since the items were scored on a single test which gave a coefficient value of 0.77 which was high for internal consistence.

Method of Data Collection

A letter of introduction was obtained from the Head of Department College of Agricultural and Science Education of the Federal University of Agriculture Makurdi and then delivered to the principals of the schools whose students were to be used for permission to conduct research in their schools. The researcher also sought the cooperation of the Biology teachers in these schools to help in the administration of the instruments to the students. Instructional guide was there for Biology teaching. Each correct answer in the instrument attracted one mark while zero was given to any incorrect answer. Thus, the maximum was 45 marks while the minimum score was zero. The researcher trained Biology teachers for three day to teach the two groups for a total of six weeks. Before commencing the treatment, a pre-test was administered to the two groups and their scores compared by means of t-test in order to establish equality of abilities between the two groups. After the treatment, the post-test was administered to the two groups with the aid of Biology teachers in the schools. Two weeks later after the post-test, the retention test was administered to them. The students' scores in all the tests were calculated and compiled for further analysis.

Method of Data Analysis

Descriptive statistics of mean and standard deviation was employed to answer the research questions because they are discreet data while inferential statistics of analysis of covariance was used to test the formulated hypotheses at 0.05 level of significance. The choice of ANCOVA was due to the fact that it statistically removes the initial differences across the non-randomized groups. It also removes the bias that may have resulted from using intact groups whose equivalence were not determined. ANCOVA also eliminates differences on the dependent variables which may be due to the differences in extraneous variables.

Results and Discussion

Results of this study were presented according to research questions asked and hypotheses formulated.

Research Questions One

What are the mean retention scores of students taught using Field Trip Method and those taught Biology using lecture method?

Answer to this research question was presented in Table 1.

Table 1: Posttest and Retention Mean Achievements Scores of Students taught Biology using Field Trip and Lecture Methods

	Method	N	Mean	Std. Deviation	Std. Error Mean
Posttest	Field Trip Method	73	32.56	6.55	.77
Retention	Field Trip Method	73	30.22	6.99	.82
	Mean difference		2.34		
Posttest	Lecture Method	44	18.75	4.36	.66
Retention	Lecture Method	44	17.80	4.53	.68
			0.95		

Table 1 revealed that the posttest mean achievement scores of field trip is 32.56 with standard deviation of 6.55 while the retention is 30.22 with standard deviation of 6.99. The mean difference of 2.34 is the retention of what was taught. However, in the lecture method, the learning mean achievement scores is 18.75 with standard deviation of 4.36 while the retention mean achievement score is 17.80 with standard deviation of 4.53. The mean difference for retention is 0.9545 is an indication that experimental group has retained more than the control group.

Hypothesis One

There is no significant difference between the mean retention scores of students taught using Field Trip Method and those taught Biology with lecture method.

The result of this hypothesis was presented in Table 2.

Table 2: ANCOVA test of students taught using field trip and lecture methods in their retentions

Dependent Variable: Retention

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6918.290 ^a	2	3459.145	228.909	.000
Intercept	43.044	1	43.044	2.848	.094
Post-Test	2680.951	1	2680.951	177.412	.000
Method	11.440	1	11.440	.757	.049
Error	1722.702	114	15.111		
Total	85001.000	117			
Corrected Total	8640.991	116			

a. R Squared = .801 (Adjusted R Squared = .797)

Table 2, reading on the row heading Method, revealed that Mean Square = 11.440, F = .757, df = 1 and Sig. = .049 = p. Since $p < 0.05$, the noted difference in the retention of students

taught using discovery and lecture method is significant. So, the null hypothesis was rejected with the conclusion that there is a significant difference between the mean retention scores of students taught using Field Trip Method and those taught Biology with lecture method

Research Question Two

What are the mean retention scores of students taught using discovery method and those taught Biology using lecture method?

Answer to this research question was presented in Table 3.

Table 3: Posttest and Retention Mean Achievements Scores of Students taught Biology using Discovery and Lecture Methods

	Method	N	Mean	Std. Deviation	Std. Error Mean
Posttest	Discovery Method	88	33.78	5.24	.56
Retention	Discovery Method	88	31.49	4.95	.53
	Mean difference		2.30		
Posttest	Lecture Method	44	18.75	4.36	.66
Retention	Lecture Method	44	17.795	4.53	.68
	Mean difference		0.95		

Table 3 revealed that the posttest mean achievement scores of discovery method is 33.78 with standard deviation of 5.24 while the retention is 31.49 with standard deviation of 4.95. The mean difference of 2.30 is the retention of what was taught using discovery method. However, in the lecture method, the learning mean achievement scores is 18.75 with standard deviation of 4.36 while the retention mean achievement score is 17.80 with standard deviation of 4.53. The mean difference for retention is 0.9545 is an indication that experimental group has retained more than the control group.

Hypothesis Two

There is no significant difference between the mean retention scores of students taught using Discovery Method and those taught Biology with lecture method.

The result of this hypothesis was presented in Table 4.

Table 4: ANCOVA test of students taught using discovery and lecture methods in their retention

Dependent Variable: Retention

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6776.533 ^a	2	3388.267	251.675	.000
Intercept	290.159	1	290.159	21.553	.000
PostTest	1276.439	1	1276.439	94.812	.000
Method	168.772	1	168.772	12.536	.001
Error	1736.709	129	13.463		
Total	104202.000	132			
Corrected Total	8513.242	131			

a. R Squared = .796 (Adjusted R Squared = .793)

Table 4, reading on the row heading Method revealed that Mean Square = 168.772, F = 12.536, df = 1 and Sig. = .001 = p. Since $p < 0.05$, the noted difference in the retention of students taught using discovery and lecture method is significant. So, the null hypothesis was rejected with the conclusion that there is a significant difference between the mean retention scores of students taught using Discovery Method and those taught Biology with lecture method.

Research Question Three

What are the mean retention scores of males and females students taught Biology using discovery Method?

Answer to this research question was presented in Table 5.

Table 5: Mean Retention Scores of Male Female Students taught Biology using Field Trip

Sex	Method	Mean	Std. Deviation	N
Male	Field Trip Method	33.0278	6.45639	36
Male	Retention Scores	30.8333	6.28604	36
	Mean difference	2.1945		
Female	Field Trip Method	32.1081	6.70317	37
Female	Retention Scores	29.6216	7.66069	37
	Mean difference	1.21		

Table 5 revealed that the male, students' the means retention score is 30.8333 with standard deviation of 6.2860. For female students, the mean retention score is 29.6216 with standard deviation of 7.66069. The mean difference is 1.21.

Hypothesis Three

There is no significant difference between the retention scores of males and females students taught Biology using Field Trip Method.

The result of this hypothesis was presented in Table 6.

Table 6: ANCOVA Test of Male and Female Students Taught using Field Trip on their Retentions

Dependent Variable: Retention

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2660.785 ^a	2	1330.392	108.073	.000
Intercept	.024	1	.024	.002	.965
Post-Test	2633.994	1	2633.994	213.970	.000
Sex	2.363	1	2.363	.192	.663
Error	861.708	70	12.310		
Total	70186.000	73			
Corrected Total	3522.493	72			

a. R Squared = .755 (Adjusted R Squared = .748)

Table 6, reading on the row heading Sex, it revealed that Mean Square = 2.363, F = .192, df = 1 and Sig. = .663= p. Since $p > 0.05$, the note in the difference in retention of male and female students taught using field trip not significant. So, the null hypothesis was not rejected with the conclusion that there is no significant difference between the retention scores of males and females students taught Biology using Field Trip Method.

Research Question Four

What are the mean retention scores of males and females students taught Biology using Discovery Method?

Answer to this research question was presented in Table 7.

Table 7: Mean Achievements and Retention Scores of Male Female Students taught Biology using Discovery

Sex	N	Mean	Std. Deviation	Std. Error Mean
Retention Male	48	32.8542	4.74897	.68546
Retention Female	40	29.8500	4.73693	.74897
Mean difference		3.0042		

Table 13 revealed that the means retention score is 32.8542 with standard deviation of 4.7490. For female students the means retention score is 29.8500 with standard deviation of 4.7369. The mean difference is 3.0042.

Hypothesis Four

There is no significant difference between the means retention scores of males and females students taught Biology using Discovery Method.

The result of this hypothesis was presented in Table 8.

Table 8: ANCOVA test of male and female students taught using Discovery Method

Dependent Variable: PostTest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	102.822 ^a	2	51.411	1.915	.154
Intercept	8101.077	1	8101.077	301.739	.000
Pre-Test	.003	1	.003	.000	.992
Sex	100.451	1	100.451	3.741	.056
Error	2282.076	85	26.848		
Total	102825.000	88			
Corrected Total	2384.898	87			

a. R Squared = .043 (Adjusted R Squared = .021)

Table 8, reading on the row heading Sex, it revealed that Mean Square = 100.451, F = 3.741, df = 1 and Sig. = .056 = p. Since $p > 0.05$, the noted difference between male and female students taught using discovery method is not significant. So, the null hypothesis was not rejected with the conclusion that there is no significant difference between the male and female students taught Biology using Discovery Method.

Summary Major of Findings

The major findings of the study were that:

- i. Students taught using field trip have significantly higher retention in biology than the students taught using lecture method.
- ii. Students taught using discovery method have significantly higher retention in biology than the students taught using lecture method.
- iii. There no significant difference in retention scores of males and females students taught Biology using Field Trip method.
- iv. There no significant difference in retention scores of males and females students taught Biology using discovery method

Discussion of Findings

According to the major findings it was revealed that students taught biology using field trip achieved significantly higher than those taught using lecture method. This finding is in agreement with Ezechi (2018) who said that field trip is an effective method of teaching since it helps students acquire useful knowledge while having fun and relaxation at the same time. Also Ajaja (2010) said that field trip experiences enhanced students' understanding of process of science, improved students' attitude towards biology and significantly influenced their biology achievement. Furthermore, Yau (2010) said that Government should make the use of field trip teaching strategy compulsory particularly in the teaching and learning of ecology concept at senior secondary school level. This result was so because students are able to see things practically and so that prepared their background knowledge for their schema and equipped learning of biology.

It was further revealed that students taught using discovery have higher achievement than those taught using lecture method. This finding is in agreement with Oghenevwe (2009) who the discovery method was superior and more effective than the inquiry method. Therefore science teachers should consistently make use of the discovery approach in teaching biology. Also Mirasi, Osodo, and Kibirige (2013) noted that mean achievement of students taught using Guided discovery method was higher than that of the Exposition-with-interaction method. Thus, the use of Guided discovery in teaching biology is recommended. This is so because with the lecture which is popular in our schools, teachers progress at teaching speed to cover the syllabus without caring for students' individual differences and learning pace and abilities. So, no wonder that students the teaching.

In addition it was also revealed that students taught using field trip have significantly higher retention in biology than the students taught using lecture method. This finding is in agreement with Wada (2010) who said that Field-trip teaching strategy enhanced retention, motivated students and it is gender friendly. Also Ajaja (2010) further said that field trip experiences enhanced students' understanding of process of science, improved students' attitude towards biology and significantly influenced their biology achievement as well as retention. This was so because field trip promoted and encouraged active engagement in learning, self-motivation, discovery learning and learning by experience.

Furthermore, the findings also revealed that no significant difference in achievement scores of males and females students taught Biology using Field Trip Method. This finding is in agreement with Wada (2010) who said that Field-trip is gender friendly. This is so because the method promoted and encouraged active engagement in learning, self-motivation, discovery learning and learning by experience which both male and female students equally enjoy.

In addition, the findings revealed that there no significant difference in achievement scores of males and female students taught Biology using Field Trip Method. This finding is in agreement with Enohuan (2015) who said that there is no significant difference in the mean achievement scores of male and female students taught biology concepts using instructional materials which is another innovative method.

Finally, the findings that there no significant difference in retention scores of males and female students taught Biology using Field Trip method. This finding is in agreement with Enohuan (2015) who said that there is significant difference in the retention ability of male and

female students exposed to another innovative method as the use of instructional materials. This is so because both male and female students have equal feeling toward biology without stereotype.

Conclusion

Summary

This study was conducted to determine the effect of discovery and field trip methods on students' achievement and retention in Biology. To guide the study, four research questions were asked and four hypotheses formulated.

For research design of the study, a quasi-experimental research design was used. A sample of 205 respondents was drawn through multi-stage sampling technique in five secondary schools that offer biology in Makurdi local government area of Benue state.

Two instruments were used to collect data at pretest, posttest and post posttest (retention). The collected data for the study was analyzed. The research questions were answered using mean and standard deviation and ANCOVA to test the hypotheses.

The results showed that students exposed to the discovery and field trip achieved higher than students in the control group. It also revealed that the female and male students achieve equally in the experimental groups. Also, students' retention was higher in the experimental groups.

Conclusion

The field trip and discovery methods enhance better performance due to its students' involvement approach. The manner in which the students themselves were engaged in finding, exploring and experimenting has prepared them more readily for biology lessons. This approach made the students to follow the lessons execution with understanding. At the end, they were able to perform better have higher retention of what they learnt higher than those taught using lecture. So, it is concluded that the methods were innovative and resourceful.

Based on the finding of the study the discovery and field trip methods enhance students' achievement due to its creation of curiosity in the students by making them to be desirous to learn and know biology. This finding makes the researcher to conclude that the methods are elegant to students' achievement, retention and gender friendly.

The field trip and discovery methods were found to be groundbreaking and practical to both genders (boys and girls). That was why the imbalance in achievement of male and female students was minimized to the barest minimum. Therefore the researcher concluded that the methods were worthy to be adopted for equality of experience gain by every student irrespective of gender.

Recommendations

Based on the findings of the study, the following recommendations were made:

- i. Biology teachers in schools should be encouraged to use field trip and discovery methods in teaching other concepts in biology.
- ii. Since field trip and discovery methods were found not to be gender discriminative, biology teachers in the schools should be encouraged to use them to enhance students' achievement in biology concepts.
- iii. Teacher education institutions should be encouraged to include field trip and discovery methods in their biology method curriculum for training and retraining of biology teachers.
- iv. Text books writers should be encouraged to incorporate field trip and discovery approach in their writings. This will go a long way in making biology teacher to be more educated about the approach.
- v. Finally, the use of field trip and discovery methods was discovered to be time saving, teacher- goal achieving and resourceful. Therefore, professional bodies such as Science Teachers Association of Nigeria (STAN) and other stakeholders in biology education should propagate the use of field trip and discovery methods in teaching biology concepts through the organization of conferences, seminars and workshops.

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