The impact of activity-based method on the performance of Science learners from selected junior secondary schools in Nigeria

by

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I declare that the above thesis is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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15th July, 2017
DATE

DEDICATION

This work is dedicated to the Almighty God, the God of my life also to my late father WO II Sylvester Ekpo, my late mother Alice Sylvester Ekpo (may their souls rest in peace). My darling husband Sir Emmanuel Agbenyeku.My loving children Peter Agbenyeku, Obong Paul, Emmanuella, Alice, Elizabeth -Arabito, Dr. Emmanuel Jr., Mary and Martha.

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Abstract

The study investigated the Impact of Activity-Based Teaching Method (ABTM) on students' academic performance in basic science at Junior Secondary Schools in Katsina Metropolis, Nigeria. Three research questions and three research hypotheses were formulated to guide the researcher in the conduct of the research. The study randomly sampled three hundred and thirty (330) out of nine thousand and six (9,006) Junior III Basic Science Students. Three of the randomly selected schools were placed as experimental control groups. A total of one hundred and sixty five (165) students were randomly sorted out, each way, to constitute the experimental and control groups. A quasi-experimental pre-test-post-test research design was used for the study. A pre-test was administered to ascertain the equivalence of the two groups. The study subjects in the experimental group were taught a number of concepts enshrined in environmental management for sustainability using the assets in activity-based teaching method; the control group was taught the same content using the lecture method for eight weeks. The students were subjected to "Basic Science Achievement Test" (BSAT); this instrument provided data for addressing the research questions and hypotheses raised in the study; the hypotheses were tested using SPSS version 20.0 packaged at 0.05 level of significance; t-test for independent samples was used to test the hypotheses. The study revealed that basic science students taught using activity-based teaching strategy performed significantly higher than their counterparts who were only taught using lecture method; similarly, there was significant difference in the academic performance of males, as compared to female students; similarly the students exposed to activity-based teaching strategy demonstrated a higher retention ability indices in the learning of basic science concepts, as compared to their colleagues who were exposed only to the lecture method. The study recommended that teachers should employ activity-based teaching methodology (ABTM) in teaching concepts in basic science at Junior Secondary Schools in order to enhance academic performance and retention of the content that was taught. The study further recommended that there should be provisions in schools of facilities, provisions and equipment which are vital for effective implementation of activity-based teaching method (ABTM).

Keywords:
Activity-based method, teacher-centred method, impact, environmental management, sustainability, retention ability indices, basic science concepts, effective implementation, academic performance, lecture method.

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LIST OF ABBREVIATIONS AND ACRONYMS

ABL:	Activity-Based Learning
ABTM:	Activity based teaching method
ANCOVA:	Analysis of Covariance
BSAT:	Basic Science Achievement Test
DTE:	District Teacher Educator
GCK:	Government College Katsina
GIST:	Girls into Science and Technology
JSSE:	Junior Secondary School Examination
NECO:	National Examination Council
PPMC:	Pearson Product Moment Coefficient
SC:	School Certificate
SPSS:	Statistical Package of Social Studies
USA:	United State of America
WISE:	Women in Science and Education

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CHAPTER ONE

INTRODUCTION

1.1 Background

The first Nigerian National Curriculum Conference (1969) was instrumental in instituting the teaching of science in schools and colleges as basic for establishing a vivid sense of citizenship and human development amongst pupils and young learners and the Nigerian society at large. This philosophy hinges on a perspective which portrays and projects science as a core curriculum package designed to exhibit science as a unified knowledge framework which must emphasise not only its relevance to technology and societal advancement but also capitalises on instructional projections which need to establish it as a necessary instrument for creating a very strong basis for human development and advancement in all their ramifications (Sani, 2015; Woolman, 2001). The Nigerian National Policy on Education (2008) recognises that this 'scientific bent' would not only create forums for training individuals who would be enabled to achieve 'spiritual harmony' with our environment but would also be assisted to exercise their duties in making societal decisions which are more frequently influenced by the latest scientific discoveries. In an elaboration on the value of this 'spiritual' orientation of science, Andersen (1969) observes that:

> *"The profound changes men have wrought in the world by their use of science and technology have been for better and for worse; but the spirit underlying science is highly a desirable spirit; it can enable entire people to use their minds with breath and dignity and striking benefit to their health and standard of living."(p.21)*

Thus, Weatherall (1968) argues that an understanding of the 'spirit' of behind science serves as a foundation for originality in scientific ideas by providing individuals with an awareness of the professional techniques and ethics for practising science. He expatiates that this foundation is not any particular body of factual knowledge but a way of thinking and acting. In almost the same vein, Weaver (1969) expatiates that:

"Science is an adventure of humans 'spirit'; an artistic enterprise stimulated by disciplined imagination and based on faith in the reasonableness, order and beauty of the universe of which man is part. It is a study of the natural environment... not merely pieces of Chemistry, Physics, Biology, Astronomy and Geology... its contents is connected with these subjects... it is a study of problems that pop into curious minds as they live and grow from one day to the next" (p.3)

The world is confronted daily with issues that require a scientific way of thinking for informed discussion, management and sharing of resources such as water and vegetation (Olasihinde & Olatoye, 2014). Dahiru (2010) indicates that science by its nature opposes teachers' domination and cannot be taught through the chalk-and-talk method. Olatoye (2014) opined that science education lays the foundation for work in a science-related field by equipping learners with certain knowledge, skills and attitudes.Dahiru (2010) maintained that science teaching involves various activities which includes project work, small group discussions, demonstrations, activity-based teaching methods, lectures and a host of others verbal and non-verbal activities. Science education also is an indispensable arm of general education. It is an instrument for industrialisation and growth and as such should be made more functional (Ezekwe, 1995). Dahiru (2010) opined that; countries with more economic and military powers are those with highly developed science and technology, while those with immense human and natural resources but without development in science and technology remain poor. This implies that science education is vital for the development of any nation,including Nigeria. To learn science, students must be self-invested in the learning process. They must be self-aware and more self-motivated; they must recognise why learning science is useful and important.

Aktamis (2009) reflects on the fact that the pace the world keeps and the speed with which technology advances imply that the need for an understanding and mastery of science has become a crucial part of a rounded education. He expatiates that this frame of thought and perspective is expected to commence from primary education so much that the curious minds of young learners can be satisfied through opportunities to carry out scientific investigations. At this level of learning, students and young learners are

expected to be active and full of energy, to the extent that they are enabled to engage in various forms of activities which are rooted in the learning of science.

Garba (2012) revealed that after the "Sputnik Era" of the 1950s and 1960s the attention of scientists and science educators shifted to how to bring about reformation in science teaching and learning. Discoveries relating to the reformation of science instruction and the discovery strategies in the teaching of science in schools were emphasised. This shift increased the scope of science teaching and learning, especially in the developing countries, including Nigeria (Driver, 1986; Usman, 2000). Thus, research findings of Usman (2000) and Clark (2002) indicated that the activity-based method of teaching enhanced students' academic performance generally. These researchers generally endorsed the view that an activity-based learning method seeks to address some major problems of the traditional lecture method of teaching; the researchers also endorsed the need to bring about a paradigm shift in some key classroom processes, such as the role of teachers and instructional materials and methods. These studies capitalized on and endorsed the relevance of a number of views including the following:

(a) Activity-based teaching provides opportunities for measuring children's' learning through experience, direct observation and participation;

(b) The enhancement of the quality of primary education generally is a vital key to improving science/teaching methods in schools;

(c) When science is taught through activity-based method, learners acquire numerous benefits that include development of their insights and understanding and the up-scaling of their self-concepts;

(d) If children are to learn science, their potentialities to learning have to be unleashed very fundamentally through changing the traditional roles of the teacher and the learner;

(e) Learners/students must be guided to take charge of their own learning and allowed to work at their own pace, achieving the desired goals at their own ladder, and

(f) The use of activity-based learning approach to education focuses on the idea that learners/students should be engaged through actions and activities.

This study is therefore an attempt to fill the foregoing gaps mentioned above in the use of traditional methods in science teaching. In other words, the paradigm shift away from teaching to an emphasis on learning is to encourage power to be moved from the teacher to the student (Mokiwa, 2014). This development is in contrast to traditional forms of teaching in which an educator lectures, or otherwise relays information to students who are expected to absorb what they are told. In activity-based learning, an educator serves the function of a facilitator, assisting students through the learning process, and providing them with guidance. Various actions and tasks can be used in this type of programme, allowing students to become directly involved in the learning process rather than remaining passive. This is often accomplished through the creation of different activities and projects that students work on as they learn.

Garba (2012) reveals that group work is quite common during activity-based learning, since it allows students to take on the role of educator and work together to better understand different subjects. Under these circumstances, students work together in small groups to accomplish particular project tasks. Each group presents information learned after performing the tasks assigned to it to the rest of the class. Garba (2012) advances the view that the activity-based learning pedagogy aims to enrich students with practice and concepts with methods, using data and insight theyhave obtained through engagement with the larger world.

Apart from exploring the assets of effective instructional strategies that are rooted in the activity-based learning approach, science educators are also faced with the problem of attracting girls to science (Bichi, 2006). The issue of gender differences and achievements, particularly in schools, is far from being resolved. This frame of thought has led to the emergence of such innovative projects as "GIST" (Girls Into Science and Technology) and WISE (Women in Science and Education) that have been designed to examine ways of making science more girl-friendly. Researchers on differential gender achievements in science (Tracy, 1990; Muhammed, 2007) have attempted to link this predicament to a number of factors such as, (a) gender role model orientation and

educational background of parents; (b) peer group expectations; and (c) extracurricular class activities. In addition, culture has also contributed to differential gender achievements as revealed by Salami (1998), and Jegede et al., (1999). One of the major objectives of this study is to find out whether the use of activity-based instructional methods would enhance and improve students' academic performance in science. The study is also aimed at finding out whether the activity-based method of teaching Science produces differential effects amongst male and female students.

1.2 Rationale

The fundamental reason behind the execution of this research work bears on the deplorable performance of students in Basic Science examinations. The performance records of students in Basic Science for the past ten years demonstrates that Nigeria has displayed less than a 45 per cent credit pass in the public examination in this subject.

This situation has necessitated the need to find out the reasons behind this development. As a science teacher, the researcher was convinced that a good measure of success registered in the science classroom depended greatly on the pedagogical designs employed in teaching the subject.

It was also realised that much of the pedagogical procedures that featured in many classrooms reflected the use of the traditional teacher-centred methods. It is therefore becoming necessary to explore other pedagogical procedures so as to determine the extent to which their usage could help in enhancing and promoting students' performance in Basic Science. This frame of thought prompted the execution of this research in Katsina Metropolis.

1.3 Statement of problem

Most science teachers use the lecture method in teaching the subject (Nwosu, 2004; Ayodele, 2010; and Opatoye, 2010). However, the lecture method has been found to be ineffective in science instruction (Akinsola & Igwe, 2002). Empirical evidence clearly indicated low performance in secondary schools. Low performance ranges from students' inability to comprehend what is entailed in using laboratory effectively, and the teachers'

inability to achieve effectiveness in curriculum delivery as a result of a lack of in-depth knowledge of science in totality. Thus, it is apparent that the problem exists in the teaching and learning of science. The problem hinges on the exploration of the use of the activity-based teaching method to determine the extent to which it enhances students' academic performance in science at junior secondary Schools in Katsina Metropolis, Nigeria.

In other words, the concern of this study therefore is to investigate whether the use of an activity-based instructional method could enhance students' academic performance in science at the junior secondary school level, and also to determine the effects of gender in academic performance of students taught science concepts through the use of an activity-based method.

Considering the slow progress and low status of technological development in Katsina State of Nigeria, it has become necessary to re-assess the status of the strategies employed in teaching science and technology to future generations to determine their efficacy and worthwhileness. The current rate of failure, especially in science subjects, shows a serious and fundamental flaw in the background knowledge amongst students in the sciences.

1.4 Objectives of the study

Based on the foregoing background information, the following objectives are raised for the study:

To determine the effects of activity-based instructional methods on students' academic performance in science at the junior secondary school level in Katsina Metropolis, Nigeria;

To determine the effects of gender in the academic performance of students taught science concepts through the use of activity-based methods; and

To establish the extent to which the activity-based instructional methods enhance students' retention ability in science.

1.5 Research questions

The study is designed to seek answers to the following three questions:

1. What is the difference between the academic performance of students taught using activity-based methods and those taught using the lecture method?
2. Is there any difference between the academic performance of boys and girls when taught science concepts using activity-based methods?
3. What is the effect of activity-based methods on students' retention ability in the learning of science concepts at the junior secondary school level?

1.6 Research hypothesis

The following research hypotheses (null) were formulated to guide the study:-

A null hypothesis is a hypothesis which states that “no difference” or “no relationship” exists between two or more variables. It is a hypothesis of “no difference” (Nworgu. 1991, p. 46). Thus, the hypotheses for this study include the following:

1. There is no significant difference in the academic performance of students taught science concepts using activity-based methods and those taught using the lecture method.
2. There is no significant difference in the academic performance of male students and that of their female counterparts when taught science concepts using activity-based methods.
3. There is no significant difference in the retention ability of the knowledge of science concepts between students taught using activity-based methods and those taught using the lecture method.

On the other hand, alternative hypotheses were raised in case the null hypotheses were rejected or not confirmed. The alternative hypotheses are the following:

1. There is a significant difference in the academic performance of students taught science concepts using activity-based methods and those taught using the lecture method.

2. There is a significant difference in the academic performance of male students and that of their female counterparts when taught science concepts using activity-based methods.
3. There is a significant difference in the retention ability of the knowledge of science concepts between students taught using activity-based method and those taught using the lecture method.

1.7 Significance of the study

It is hoped that the results of this study will contribute value to science teachers and a wide variety of teachers at the secondary school level. These teachers could capitalise on the assets of the activity-based method to demonstrate how it could be employed as a pedagogical design for enhancing the academic performance of students in science and other subjects which are offered at the junior secondary schools in Nigeria.

Secondly, the method could assist science teachers who are desirous of improving science teaching at secondary school level.

Thirdly, educational planners and curriculum developers who decide on syllabuses of secondary schools might wish to consider the results of the study with a view to recommending the activity-based method as a teaching device or design in Science in our secondary schools.

With the result of the successful completion of this study, the benefits accruing from the activity-based method could be considered as a worthy contribution to the literature in science teaching methods.

1.8 Clarification of terms and concepts

It is important here to clarify key terms and concepts as they are used and understood in this study.

1. Activity-based teaching method

This is a method of teaching where the teacher only acts as the felicitator and learners (students) are at the centre of the learning processes by their involvement in the practical activities and discussions.

2. Academic performance

This means students' achievement as a result of teaching activities; it also implies the extent to which a student has attained his or her educational objectives.

3. Impact

This refers to the expected change in students' academic achievement and performance caused by using activity-based teaching methods. (ABTM)

4. Retention indices

This refers to the ability of the students to remember and recall what they have been taught in the shortest possible time.

5. Teacher-centred method

Is a method of teaching where the teacher acts as the sole dispenser of knowledge, including learning activities.

1.9 Research design and methodology

This study adopts a quantitative methodology approach using an appreciable degree of statistical and mathematical deviation, for example, the result of Basic science achievement test (BSAT) which was based on responses of the respondent (student) were scored and analysed. These analyses provided the instrument for the data computation that features in the study. Besides, the research questions used in the study involve the use of mean; and standard deviations. The hypotheses raised in the study were addressed and tested using the t-test for the independent samples at 0.05 level of significance. As the study adopts the quantitative methodology approach; a scientific procedure was used in the analyses of results.

1.10 Division of chapters

Chapter One provides an introduction and background to the study, the problem statement, objectives of the study and the definition of concepts.

Chapter Two presents the related review of literature, including a number of empirical research studies that have a bearing on the current study. It advances the unique of this study and its contribution to knowledge advancement.

Chapter Three features the theoretical framework that lay a solid foundation of the study. This theoretical framework comprises on constructivist theory of learning whose component parts and sub-division have been provided in the chapters.

Chapter Four presents the research methodology and outlines the sampling procedure, participant selection and research ethics. It also involves a compact description of the research instrument used. The validity and reliability of the study are also discussed.

Chapter Five provide analyses of the data and the results of the study

Chapter Six present the major findings of the study.

Chapter Seven presents the implication and conclusions of the study.

1.11 Summary

The activity-based method of learning has become established as one of the learner-centred approaches for enabling teachers to achieve classroom effectiveness in science teaching. This frame of thought has been substantiated by numerous research works executed in many parts of the world as reflected in the references (Garba, 2012; Iqbal & Tayyab, 2014; Nelson, 2009; Prabha, 2011; Sabiru, 2011).

In the present study, emphasis is not only oriented at replicating the findings of researchers outside this country, but also determining the extent to which this style of learning science could enhance females' achievement and advancement in science education.

The chapter that follows looks at the literature review and a consideration of a relevant empirical study. It also considers the uniqueness of the study and its contribution to knowledge advancement.

CHAPTER TWO

LITERATURE REVIEW

2.1 Science education as a core curriculum in junior secondary schools in Nigeria

The Federal Government of Nigeria has endorsed science education as a core-curriculum at the level of junior secondary school Nigerian National Policy on Education (2004). At this level of education science is meant to be operated as an integrated science curriculum. In other words, the integrated science curriculum for junior secondary schools (JSS) is meant for the current 6-3-3-4 (now 9-3-4) system of education in Nigeria. It is intended to provide a modern integrated science course for three years to all junior secondary school students. By design, it is expected to satisfy the needs of society through the relevance and functionality of its content, method, processes and application.

The cardinal objectives of the integrated science curriculum are designed to prepare pupils to acquire the following:

Adequate laboratory and field skills in integrated science;

Meaningful and relevant knowledge in integrated science;

Ability to apply scientific knowledge to everyday life in matters in personal as well as community health and agriculture; and

Reasonable and functional scientific attitudes.

The foregoing cardinal objectives are appropriate and meaningful because they emphasise, (a) inquiry and experiment as a vehicle for science learning/teaching; (b) relevance of knowledge and skills taught; and (c) functionality.

The foregoing ideals are the pillars of modern science teaching today (Oludipe, 2011). They satisfactorily cover the cognitive, affective and psychomotor domains of learning.

2.2 The Relevance of science at the level of junior secondary school education (JSSE)

Science has been defined by different people from different perspectives, based on their perceptions of the concept. For instance, Gottlieb (2005) defined science as an intellectual activity executed by humans that is designed to discover information about the natural world in which this information can be organised to benefit the human race. Adetula (2000) linked science to the real world and endorses that it is designed to promote investigative thinking amongst children. Science can be related to the lives of all students, and it is essential to preparing students for the transition to adulthood. It can also be a vehicle for developing language skills and social behaviours (Fathman, Quinn & Kessler, 1992).

To Jegede (1984), science is a systematic body of knowledge and the processes involved in acquiring the knowledge. The processes include:- measuring, classification, observation, identification, and communication amongst others.

A child who processes knowledge of these simple terms is already becoming acquainted with science concepts. Obuchi (2012) views science as an interconnected series and conceptual knowledge which are derived through experimentation and observation and they are fruitful for further experimentation.

The Federal Government of Nigerian, national policy on education (2004) holds that science education can be viewed as a systematic and dynamic process of equipping individuals with knowledge and skills to enable them to solve the complex problems of living usefully regarding themselvesand their families, and of making worthwhile contributions to the overall progress and development of the society. The policy added that the formulation of ideas and interactions of persons are all aspects of science education.

Science education plays a vital role in the lives of individuals and the development of a nation both scientifically and technologically. Alebiosu and Ifamuyiwa (2008) indicated that it is widely and generally acknowledged that the gateway to the survival of a nation scientifically and technologically is scientific literacy which can only be achieved

through science education. To make her citizens show interest in science education, the Nigerian government emerged with a policy that 60 per cent of students seeking admission into the nation's universities, polytechnics and colleges of education should be admitted for science oriented courses, while the remaining 40 per cent of the students should be considered for arts and social science courses (Ajibola, 2008). However, Oludipe (2011) discloses that this government's effort cannot be said to have yielded much fruit, given the dwindling number of students seeking admission into science-oriented courses in the nation’s tertiary institutions: on a yearly basis more students are seeking admission into arts and social courses than those of the science-oriented courses.

Obuchi (2012) maintains that Basic Science constitutes an aspect of science education. At the junior secondary school level, basic science is viewed as special training given to young individuals in order to expose them to the realms of nature. The author holds the view that we live in a world of scientific achievement and technological advancement, and as such, science and technology have done much for the comfort and betterment of mankind. The author further advances that basic science education, as a corner stone for scientific and technological development, is for membership of an increasingly technological workforce (Fradd & Lee, 1995).

Science education can help students learn about the physical environment in which they live and develop a multicultural world view of scientific phenomena. For many students, particularly those who are learning the English language, science activities are recognised worldwide; thus for millennium achievement, the future of Nigeria, depends on the extent of science and technology knowledge of this nation. Basic science and technology inculcate in individuals the habit of science and its processes and the attitude of scientists to enable them acquire requisite skills which engender in the recipients the power of constructive reasoning, effective mental ability as well as imaginative thinking. Basic Science education enables the recipient to use the knowledge in the acquisition of practical and allied skills (Hinarullam, 2002; Mgbekem, 2004).

The activity-based learning methodology is rooted in the view that learners have the capacity to learn through personal actions and experience, and they test ideas about

the world. The learners interpret things according to their own thoughts and experiences. Activity-based teaching methods help them to construct their knowledge. Thus Rillero (1994) endorses the view that a child best learns science by doing science. Doing science is not only limited to reading or learning but it includes students in laboratory work to test ideas and develop understanding (Ewers, 2001). Thus any science-teaching plan is incomplete without science experiences.

The present classroom teaching in Nigeria still leaves much to be desired; teachers are still using traditional methods of teaching for teaching science. This has resulted in rote learning and true understanding of concepts does not occur in our secondary schools.

Nowadays, as emphasised by Iqbaland Tayyaba (2014), science teaching is not meant to make every student a scientist but to develop a scientific attitude and a positive attitude towards science in every student. Learners need to be actively engaged with explanatory ideas, verification of scientific concepts and theories and forming relationships between scientific concepts and theories.

In Nigeria, most science teachings are teacher-centered, and are based on memorisation of factual knowledge. Thus teachers teach classes by using typical lectures in science at all levels and especially in primary and secondary schools. The consequences of this situation leads to rote learning on the part of learners, with no deep understanding of scientific concepts, phenomena or theories.

Activity-based learning (ABL) derives essentially from the use of a variety of activity-based teaching methods. The prerequisite for this learning should be based on doing experiments or activities. The method derives strength from the view that if learners are provided the opportunity to think and solve problems on their own, then the learning becomes long-lasting. The important features of activity-based teaching are that it is learner-centred and it encourages self-leaning. It also allows the learners to study according to theirown abilities and skills.

2.3 Strategies for activity-based learning methods in Basic Science

Research on effective Basic Science teaching focuses on instructions that promote students' involvement and activity. Basic Science is referred to as an integrated science course: it is the first form of science a child (student) comes across at the secondary level. Hence, Basic Science prepares students at the junior secondary school level for core science subjects such as physics, chemistry, biology, mathematics, and geography among others. An activity-based method calls for a shift from teacher domination to students' involvement. This is because science cannot be taught using teacher domination (Dahiru, 2010). Researchers of science education (see for example, Dahiru, 2010; Mokiwa, 2014, 2017; Lederman, Lederman & Antik 2013) have reported that most Science teachers in the school system often teach the science concepts by the "telling method" (Azuka, 2013). This involves passing on information to students, making lesson notes and then evaluating the students. In this process, the students become very "passive" while the teacher becomes "very active". Students do not easily comprehend the lesson taught. They may easily forget the lesson taught and this may lead to their poor performance in the subject (Basic Sciences). Kaka (2007), cited in Azuka (2013), observed that the lecture method is not suitable for the nature of science and the age of students because it prevent the active participation of the learners in the teaching and learning process.

Dawaki (2012) and Azuka (2013), identified the following strategies that promote active learning:

- Discovery approach
- Use of teaching aids
- Cooperative learning or small group learning
- Problem-solving
- Inquiry method
- Project method, and
- Demonstration method

i. Discovery approachof teaching

This is an instructional method which allows the students the independence to use their mental processes to contribute to knowledge understand difficult concepts, generalisations, and principles or provide answers to problems with minimal guidance from the teacher. The processing will lead to exploration and discovery. It is also a method where the learner is guided by the teacher to discover scientific facts and formulae through observations and organised activities.

In this approach, the teacher provides the necessary teaching materials and guides the students to carry out some activities which would lead the students to arrive at new knowledge. Such discovery activities could be done individually or in groups of a few students. This approach enables students to participate actively in the learning process and discover things for themselves. The discovery method can either be guided or unguided, either inductive or deductive. Both guided and unguided discovery involves finding out and requires students to engage in some complex mental processes including formulating problems for investigation; formulating hypotheses to guide investigation; designing experiment to collect data; making generalisations from knowledge acquired from data; finding solutions to problems; and developing certain scientific attitudes such as objectivity, curiosity, open-mindedness and honesty.

Yusuf (2007) carried out a study to determine the effects of guided discovery and expository instructional methods on the transfer of learning. He found that the guided discovery group performed better with respect to the transfer of knowledge in biological concepts than the expository group students. A learner is active in discovery learning which provides for individual differences as well as making the process of learning self-sequenced and, goal perceived and the pace self-determined (Akinbobola, 2009).

a) Advantages of discovery approach

The method equips the students with the means of gaining knowledge on their own through active participation, and developingtheir minds by using them to solve problems.

i. The method also challenges students to find out information for themselvesthus making instruction students-centred.
ii. It encourages analytical thought and promotes development.
iii. Whether guided or unguided, the discovery approach, trains and opens up students' minds to knowledge from interacting with the environment and they eventually use the knowledge to solve problems.
iv. It develops students' potential and ability to work on their own, thereby gaining skills to deal effectively with their environment.
v. The discovery approach offers the best tool for developing manipulative skills in students.
vi. It provides intellectual development of the student, leading to a high degree of assimilation and retention of things student have discovered on their own.
vii. Successful discovery builds up self-confidence in the students and provides motivation for further exploration.
viii. The work of teacher becomes that of a director, supervising and directing every student in his class instead of just a "talker" (Yusuf, 2007).

b) Disadvantages of discovery approach

i. It does not lead to the coverage of a large amount of knowledge within a short time.
ii. The method requires much funds to buy equipment and material.
iii. Most of the teachers might not be able to apply this approach as it calls for a great deal of creativity and practice.
iv. It can become frustrating for both teacher and students as the students may not be discovering anything outside the intended.

ii. Use of teaching aids

Akuma (2011), cited in Okam (2012), reflects that up till now, the instructional materials accessible to teachers are chalk, pictures and prints (textbooks, magazines and journals). These are first-generation instructional media. “Nowadays, basic science teachers have to advance into the use of second generation media"(Akuma, 2011). These include films, slides, video tapes,the radio and television programme. Okam (2009), revealed that computers and CD ROMs, as well as internet have come into use as E-learning facilities in our schools. In the same vein, Ofoegbu (2009), cited in Okam (2012), listed some advantages of computers as:- (a) holding a great deal of information in its memory; (b) manipulating information rapidly; (c) adjusting the type of feedback to the response of the learner; (d) retaining and analysing records of the progress of the learner and using this information to adapt future instruction sequences to the needs of the learners; (e) maintaining a high level of control over what the learner is allowed to attend to at one time or putting this control in the hands of the learner and; (f) when coupled with a CD-Rom drive, some limitations are overcome, such as lengthy segments of high quality audio.

Teaching aids help to make Basic Science concepts real and throw light on its mysteries. Therefore, there is a need for Basic Science teachers to be conversant with computers as well as ICT facilities so as to effectively teach the subject. This is because "education in the 21st Century calls for a shift in the delivery system to match the new knowledge, skills, attitudes and technologies that are emergent" (Okam, 2009). Oladejo et al. (2011), in their study on Instructional Materials and Students Academic Achievement conducted in Oyo State, revealed that there is a significant difference in the achievement of students taught using instructional materials and those taught using the conventional method. Richmond et al. (2011), in their research on *Impact of Audio-Visual Aids onJunior Secondary School Students' Achievement in Basic Science*, found that the mean achievement scores of both male and female students improved significantly with the use of audio-visual aided instruction. He recommended that Basic Science teachers should explore the use of audio-visual-aided instruction to teach the subject, Basic Science.

iii. Collaboration Method

Cooperative learning is a systematic pedagogical strategy that encourages small groups of students to work together for the achievement of a common goal.

Collaboration allows students to actively participate in the learning process by talking to each other and listening to other points of view. Collaboration establishes a personal connection between students and the topic of study and discussions are examples of this teaching method.

Cooperative learning creates an interactive classroom for all students. This interactivity may alleviate the challenges faced by lecturers and may assist in achieving other organisational objectives. Atkins (2010), mentioned that advocates of collaborative classrooms assumed that students learn better from each other and that the teacher is not the only source of information in the classroom.

Binta (2014), conducted a research study on the influence of cooperative teaching strategy on academic achievement of Basic Science students in Soba in Kaduna State, Nigeria.

The findings of her study revealed that the academic achievement of students exposed to the lecture method of instruction was lower than those who were exposed to a cooperative teaching strategy. Theodora (2011), conducted a research on the effect of group instructional strategy on students' performance in selected Basic Science concepts. He used purposive sampling and, 365 juniorsecondary school year-one Basic Science students was selected from a school of science, in Ile-Ife, Osun State, Nigeria. His study revealed that those exposed to group instructional strategy performed better than those exposed to individual learning treatment; the below-average students exposed to group instruction gained scores over what they had scored when not exposed to this method, which shows that there was an improvement in their performance, hence, a better more understanding of the Basic Science concepts.

Also, there is a significant difference in the collective work done by students exposed to group instruction and their performance individually revealing that the students gained better insights when they worked on assignments together than when these were is done individually.

Atkins (2010), argues that effective communication and collaboration are essential to becoming successful learners. Students learn best when engaged in activities that reflect their interest and experiences. Basic Science teachers can employ collaboration to assess students' abilities to work as a team, leadership skills, or presentation abilities.

iv. Problem-solving method

In the problem-solving method the students actively participate in the learning experiences in the process of finding solutions to problems. The students, who learn through their mistakes or successes, become creative and develop reflective or critical thinking. The problem-solving method as stated by Meziobi et al. (2008) in Dawaki (2012), entails that students should select problems that are relevant to their needs, the object of study and the priority or pressing needs society to reflect the changing times and needs. Dawaki (2012), outlined the following procedures for problem-solving method:

i. The teacher may introduce and clarify the theoretical basis in which the problem is stated.
ii. Students are then on their own to provide tentative suggestion or solutions to the problems through their working individually, in pairs or in groups.
iii. With the actual results, conclusions and generalisations may be reached. The initial problem may be completely solved or partially solved in which case further data would be sought to ensure that problems are remedied or considerably reduced.
iv. In the utilisation of the problem solving teaching-learning methods, the students are actively and directly involved in defining their own learning task, setting their goals, collecting, rearranging and evaluating the necessary data to help them solve the problem.

The advantages and disadvantages of problem-solving as stated by Meziobi et al. (2008) are as follows:

a) Advantages of problem-solving method

i. The problem which is presented to the students poses challenges to them and makes them work independently or in groups to find solutions to the problems.

ii. Since this method, in some situations, allows students to seek solutions to problems in groups or in pairs, such teamwork enhances social interaction among the students.

iii. It elicits the active participation of learners in the teaching-learning process,

iv. It inculcates in the learners the spirit of creativity which in fact is the basis of this method.

b) Disadvantages of the problem-solving method

i. It is time-consuming and energy sapping as some of the problem-solving activities may take a long time to accomplish.

ii. It entails patience or endurance on the part of the teachers, and the students who lose patience in the face of seemingly difficult problems may see their situation as frustrating.

v. Inquiry method

The importance of inquiry grew from Dewey's ideas. Dewey (1938) cited in Dawaki (2012), argued that citizens in a democratic society should be inquirers with regard to the nature of their physical and social environment and be active participants in the construction of society. They should ask questions and have the resources to find answers to these questions, independent of external authority. Since there is a shared, collaborative aspect to life in a democratic society, students also need to develop a capacity for communal inquiry into the nature of the world.

In the light of the above, science education presupposes that student should be allowed to explore fact and ideas by themselves, and to solve problems in a logical and systematic manner. Okam (2007), opined that these processes of science are characterised by various skills such as observing, comparing, inferring, hypothesising, experimenting, and collecting interpreting of data.

Okam (2007), observed that in this method, the teacher as a resource person is responsible for the planning and contriving of the learning situation to which the students respond. As the controller he or sheis alsoresponsible for exposing students to a learning experience that offers a stimulating impetus to inquisitive minds. Engaging in inquiry can also help students develop a wide range of skills, such as psychomotor and academic or intellectual skills. Psychomotor skills involve doing something physical, such as gathering and setting up apparatus, making observations and measurements, recording data and drawing graphs while academic or intellectual skills include analysing data, making comparisons, evaluating results, preparing reports and communicating results to the others or the teachers. Furthermore, students' attitudes and dispositions such as curiosity, inquisitiveness, independence of mind, freedom from external authority, and a personal search for meaning about the world can also improve.

a) Advantages of inquiry method

i. It inculcates reflective thinking in the learner through exposure to inquiry-oriented processes and skills as well as issues and problems requiring solutions.
ii. The reflective thinking acquired through the inquiry method enables the beneficiary toindependently, or in collaboration with knowledgeable ideas, solve personal social-problems, thereby living and surviving successfully in a complex society.
iii. It arouses the curiosity of the learners, stimulates their interest and makes them actively involved in the teaching-learning process.
iv. Inquiry-oriented teaching engenders real learning because it fosters self-reliance which is consistent with one of the laudable Nigerian National objectives, namely the building of "a self-reliant nation" (NPE, 2004).

b) Disadvantages of inquiry method

i. It is time-consuming and as a result the syllabus is rarely covered in depth.
ii. The planning of a good inquiry lesson is not easy.

iii. It creates a burden and task of thinking on the part of the learners; if progress is not being made, this situation could lead to frustration.

Vi. Project method

The project method constitutes a teaching-learning design in which is meant to enable a teacher to relate his or her teaching to real-life situations in the interests of learners. The method is conceived as a collaborative learning design in which young learners are trained to identify problem areas of their interests and an operative manner so as to solve the problem encountered.

The idea behind the project method is that learner/students would learn to think if they worked on project of genuine interest to them. Tanner and Tanner (2008) endorsed that “thinking” is problem solving. They maintained that “thinking” constitutes the key to intelligent action, as opposed to impulsive or routine action. They also visualised “thinking” as a scientific method applied to all human problems, ranging from the simple problems of daily living to complex social and abstract intellectual problems. They recounted Dewey’s view (1952), that there are five phases in the complete act of thought.

These phases, constituted as indispensable traits. include:- (a) defining the problems; (b) noting the conditions surrounding the problem – that is, identifying all the significant factors surrounding the problem, including gathering the data concerning the problem; (c) formulating hypotheseis for the possible solution of the problem; (d)elaborating (reasoning out) the probable value of the various hypotheses for solving the problem and (e) actively testing the hypotheses to see which ideas offer the best solution for the problem.

The project method, according to Tanner and Tanner (2008),“constitutes a holistic,purposeful and activity-centred instructional design conceived in a social environment”; it is proposed as a complete theory for curriculum development. Since it is a child-centred pedagogical design, it is often pinned down to an actual choice between the learner and the teacher. From this perspective, it is preferable for learners to have practice in all the steps of any given projects, namely: purposing, planning, executing and judging.

The project method represents a problem-centred instructional design which is geared at integrating subject matter, teaching reflective thinking and helping learners to solve their problems.

The activity-based method is rooted in creativity. From this perspective, the teacher presents to his or her students a problem within their reach and understanding. Thereafter, they are left alone to find a solution to it. The teacher has a number of steps to, adhere to including the following:

(a) Makes the needed learning materials available in classroom or outside where the learning is to take place; (b) arranges the classroom into work areas; (c) uses the classroom according to these work areas; (d) permits students to choose their own activities; (e) permits students to decide whether they want to work individually, in pairs or in groups; (f) permits students to interact with each other; (g) tries to act as a guide, catalyst, or resource person between the learners and the learning materials.

vii. Demonstration method

Demonstrating is the process of teaching through examples or experiments (Akinbobola, 2011). For example, a basic science teacher may teach an idea by performing an experiment for students. Demonstration is an instructional strategy in which the teacher demonstrates an activity with explanations where necessary while students or learners watch. Demonstration is a technique of teaching concepts, principles or real things by combining oral explanation with the handling or manipulation of real things (Akinbobola, 2011).

According to Adeyemo (1998), demonstration is an activity strategy where the teacher does some work and the learners endeavour to do it the way the teacher has done it. Adeyemo holds that this method is employed when the teacher wants the learners to do a piece of work the way he or she has done it and learn a little by listening, a little more watching but as a rule, learn most by actually doing the piece of work. Mundi (2006), described it as a display or an exhibition usually done by the teacher while the students watch with keen interest. The demonstration method refers to the type of teaching method

in which the teacher is the principal actor while the learners are expected to do at the end of the lesson with the teacher showing them how to do it and explaining the step-by-step process to them (Ameh, Daniel & Akus, 2007).

Akpan (1998), opined that demonstration can be used where the apparatus is complicated, and where students can make mistakes in interpretation. Demonstrations help to raise student interest and reinforce memory retention, because they provide connections between facts and real-world applications of those facts.

2.4 Relevance of audio-visual materials in basic science.

2.4.1 Audio-visual materials as teaching aids

In educational literature several terms can be used as an alternative for ‘audio-visual teaching materials’ i.e., ‘educational technology’, ‘audio-video media;, ‘instructional technology’, ‘learning resources’, ‘audio-video equipment’, ‘communication technology’ and ‘educational media’ (Selvi, 2007). Basically all these terminologies refers to the same concepts i.e. teaching aids that are widely used by teachers, guides, facilitators and tutors to complement their words and that ultimately help learners to improve learning and to stay focused, clear and curious.

Earlier the only term used for teaching aids was audio-visual aids’ but with the advancement and opening of new horizons in the field of electronic technology and communication media, new and improved equipment and aids for teaching and learning have been developed, and instead of mere ‘teaching aids’ improved terms were used i.e. ‘educational’ or ‘instructional technology’.

Educational technology refers to the use of any technology in the classroom, which helps in increasing the pace of learning and results in helping teachers to teach less and learners to learn more (Singh, 2008). Audio-visual teaching aids are good means of communicating with people and students. Audio-visual teaching aids facilitate and assist the regular and traditional teaching session. The audio-visual teaching materials as maintained by Jadal (2011),help in maintaining and retaining students’ interest almost till the very end of the classroom session. The use of audio-visual teaching aids in the

classroom or other training sessions improves the performance of the students, when a teacher gives maximum exposures along with different perspectives; using variety of Audio-visual aids for particular concept maximum students receives success in comprehending such lecture. Audio-visual aids are tool or mechanics used to facilitate the learning experience of the individual and to make it more realistic and dynamic (Jadal, 2011).

Advantages and disadvantages of audio-visual teaching materials

An old Chinese proverb says like "One picture has more worth than a thousand words"; indeed if a teacher uses words along with pictures student learners are better able to grasp the crux of the concept earlier. When an audio-visual teaching material is used by the teacher, there must be some benefits and advantages of in its use. Some commonly known advantages of using audio-visual aids are expressed in the opinions of the following scholars:

i. The use of audio-visual aids helps in comprehension by bringing the child in direct contact with the concept and how it actually works in real life situations (Kinder, 1959).
ii. Using audio-visual aids improves teachers' performance by saving time and energy (Brown, Lewis & Hercleroad, 1985).
iii. The use of audio-visual aids provides students with opportunities to think, speak and interact with the teacher and peer without fear and hesitation, resulting in students' personality development (Brown et al., 1985).
iv. Students are more attentive, motivated and interested as compared to the classroom session that functions without the use of audio-visual aids (Sampath et al., 1998).
v. The use of audio-visual aids provides freedom to the students i.e. students discuss, comment and express their opinions which they cannot do while a typical teacher lecture is in progress. At the same time this discussion helps them in developing language other than their mother tongue, gaining confidence by probing and showing tolerance to opposite opinions (Sampath et al., 1998).

vi. Conceptualising is clearer and more concrete as the use of audio-visual aids appeals, to activates and utilises the five senses of individual students i.e., see, hear, touch, taste and smell (Prasad, 2005).

vii. Prasad (2005), advocates that audio-visual aids provide a basic means of planning, organising and invigorating the curriculum.

viii. The retention rate of the students' increases with the use of audio-visual aids (Prasad, 2005).

ix. Audio-visual aids help in maintaining class discipline as every one of the students is focused and attentive towards learning. When a teacher lectures the students, they get bored and start whispering resulting in indiscipline in the classroom (Prasad, 2005).

x. The basic aim of education must be to lead students towards self-learning and lifelong learning and this aim can be achieved through the use of audio-visual aids as it improves the learning capacities of individual students i.e. a learning experience that is worthwhile and memorable (Singh, 2008).

xi. Activity-based learning leads to critical thinking, reasoning, creativity and the development of an inquiring mind which is the real aim of education. Audio-visual aids entail activity for teachers as well as for students, keeping student attentive and motivating them to think and inquire, resulting in deep comprehension about what is being taught (Mangal, 2008).

Disadvantages of audio-visual aids

Besides advantages, there are some limitations in using audio-visual teaching materials aids, as posited by Mangal (2008).

i. One-to-one communication between teacher and student is obstructed.

ii. Overuse of audio-visual aids can distract the minds of students from the subject matter.

iii. The importance of the teacher in the classroom is reduced.

iv. The extra cost of using audio visual aids will ultimately burden the parents.

v. The teacher has to invest more time in preparing the lectures.

Using audio-visual aids as teaching materials

Teaching aids are valuable instructional tools that can help make learning more effective and interesting. They facilitate learning through the stimulation of the senses. To be effective, aids should be used to achieve a definite purpose and they should be well constructed to gain the learner's attention and sustain interest. For effective use of audio-visual aids as stated by Oyesola (2014) the following must be borne in mind:-

i. Place or hold aids where all can see;

ii. Identify points of difficulty and possible areas of misunderstanding before the aids are introduced;

iii. Give pupils/students a chance to study the aids before discussing them;

iv Direct the attention of pupils/students to parts of the aid and so encourage observation and discussion:-

v Do not display at the beginning of lesson unless the aid is to be used immediately, that is, only introduce the aids as and when they are relevant to the part of the lesson;

vi. Do not keep the aids until the end of the lesson to be introduced as a reward for good behaviour; and

vii. Very frequently, it is undesirable to introduce a fully completed aid to the class. It is often better to introduce an outline to which the teacher adds information (perhaps applied by the class) during the lesson. The students understand a diagram better as a result of observing the way it is build up.

Characteristics of good audio-visual teaching materials

As maintained by Oyesola (2014), one of the basic functions which audio-visual materials are expected to perform is to help students visualise the various phenomena

with which Basic Science deals. In order to achieve this function, any audio-visual aid must possess the following:

i. It must be clear, clean, interesting and in a good condition;
ii. It should be of a suitable size, i.e. it must be large enough (bold) for the whole class or small for group work;
iii. It must be adequate, accurate, giving up-to-date information;
iv. It must be relevant to the topic being discussed;
v. It must not be over crowded with details;
vi. It must illustrate the specific point being taught;
vii. It any audio-visual aid must be realistic in terms of the pupils' ability to interpret aids;
viii. It should be related to pupils' experience.

Selection of audio-visual teaching materials

Oyesola (2014), maintains that adequate teaching aids (audio-visual) should be made available to accomplish effective teaching in Basic Science. To be effective, audio-visual Aids should be used to achieve a definite objective and they should be well constructed to gain the learners' attention and sustain their interest. It follows therefore that teaching aids must be carefully selected and used. When selecting audio-visual teaching aids, teachers should apply the same guidelines used when choosing learning activities. As posited by Oyesola (2014), these include the following:

a) Audio-visual teaching aids should be used to achieve specific objectives;
b) Audio-visual teaching aids should be suited to the maturity level of the students; and
c) Audio-visual teaching aids must be used with skill and understanding.

Oyesola further maintained that the choice of audio-visual teaching aids is therefore guided by various considerations or factors. In more specific terms, the following factors should be borne in mind in selecting audio-visual teaching aids (Prasad, 2005):

a) Appropriateness i.e., is it relevant to the topic being discussed?
b) Level of sophistication of the students: this refers to the age or level of maturity of the students;
c) Cost effectiveness: This is very important. Making appropriate software is cheaper optionthan depending on commercially produced materials;
d) Availability;
e) Technical quality: clear, bold and/or produced in appropriate conventional symbols.

Classification of audio-visual teaching materials

Using audio-visual teaching materials and other technologies developed in this modern scientific era for the purpose of achieving concrete education proves beneficial for teacher, student and the educational system as a whole. They bring diversification in methods of instruction. They are equally useful at all levels of education. The appropriate use of audio-visual aids in the teaching of English, Geography, History, Science, Language, Arts, Agriculture and many other technical and vocational subjects is increasing day by day. Prasad (2005), contends that audio-visual aids and their use are not only limited to educational purposes. Rather, if we go back in history we find Martin Luther suggesting the use of empty walls for the promotion of the Protestant movement. In fact this idea led to the invention of the writing board or black board which is used worldwide today in almost every school.

While studying the broad umbrella term of audio-visual teaching materials', onecomes across different types of audio-visual equipment, ranging from simple hand-made charts to highly sophisticated projectors. The classification of audio-visual teaching materials as posited by Prasad (2005) can be categorised under two groups ie.,

1. Projected audio-visual aids
2. Non-projected audio-visual aids

Projected audio-visual aids

According to Samreen, Sufiana and Malik (2012), aids enlarge an image of the material or text projected on a screen which is at a distance from the projector. While using projected aids (film strips, slide projector, overhead projector, and opaque projection) the room is either totally dark or may be partially dark.

The bright colours and images on the screen catch the attention; sound and motion make a presentation more dynamic as compared to non-projected aids. Projected aids are equally effective for every age group as well as for a small or large group. Equipment used for projection requires electric power. A clean white wall can be used effectively for front projection. Cine projection as stated by Samreen et al. (2012) includes the following:

a) **Filmstrips**: Filmstrips are a connected series of pictures, drawings, photographs and diagrams joined together to illustrate a single concept, story or a lesson. According to Jadal (2011), filmstrips differ from moving films as there is no appearance of movement.

b) **Slide projector**: According to Samreen et al. (2012), slides area commonly used instructional device to complement verbalism. They involve projection through the passing of strong light on transparent slides. A slide projector is a light house with a hauler for holding the slides. A slide projector proves valuable where motion in pictures is given less importance for comprehension. Slides require a little more space for storage than filmstrips. There are two types of slides,namely photographic slides and handmade slides.

c) **Overhead projector**: An overhead projector is used to present large sized transparencies in normal daylight conditions (Botham, 1967). The slides require total or partial darkness, whereas the; overhead projector does not require total blackout. Students can take notes in the normal mode as they do when working without an overhead projector. The teacher or facilitator faces the students completely and the projected image or text is behind and over her/his head (Sampath et al., 1998).

d) **Opaque projector**: Slide and filmstrip projectors and overhead projector can only be operational for projecting transparent material but opaque projectors can be effectively used to project opaque material i.e. books or magazines or any drawing or pictures on a slide paper (Mangal,2008). The projection made by an opaque projector

depends upon the distance which the projector is from the screen. An important feature the of opaque projector is that text, maps, diagrams and other materials available in books or magazines can appropriately be projected without removing them from their original source.

Non-projected audio-visual aids

The most commonly used audio-visual teaching aids which do not employ the use of projectors to project enlarged images of objects or text are grouped under non-projected audio-visual teaching aids. They are inexpensive to use and are relatively less sophisticated as compared to projected aids. Non-projected aids are further subdivided into five types i.e., graphic aids, display boards, 3-D aids, activity aids and audio-visual aids (Sampath et al., 1998).

a) **Graphic aids**: Graphic aids are commonly used to describe ideas and concepts with little or no verbalism. Like other teaching aids, graphic aids help students to better understand and retain the information. Some basic types of graphics aids as stated by Prasad (2005) are: photographs, and pictures and flash cards.

b) **Charts**: Charts are widely used visual/graphical aids to present concepts and ideas that are complicated and that cannot be easily comprehended by just mere words, no matter whether written or oral. Charts are a mixture of different types of graphics i.e. pictures, diagrams, cartoons, graphs, written text or drawings. Teachers usually restrict one idea per charts, thus making a concept clear without ambiguity (Brown et al., 1985).

c) **Diagram**: A diagram is a simple and explanatory drawing showing inter-relations and explaining ideas and concepts by using lines, symbols and geometrical forms. Diagrams go beyond mere representation rather they are self-explanatory or self-describing (Mangal, 2008).

d) **Globes and maps**: The use of maps and globes along with other audio-visual instructional material will help students develop a better understanding of the different continents and countries along with oceans and poles and the people living

there. The globe is a mini earth. It is widely used in understanding the concepts related to land and water the fact and that the earth is nearly round and rotates on an inclined axis around the sun. This results in the changing ofday and night, seasons, food eaten and clothing worn across the world and many more are directly and indirectly affected (Kieffer and Cochran, 1955).

Along with globes, maps can be introduced to make students understand the globes as a map: a flat representation or diagram of the earth or some part of it as per scale (Prasad, 2005). An effective map includes pictorial symbols to depict specific areas, desert, ocean, mountains and the like.

e) **Graphs**: Graphs are widely used to represent complex information and numerical data in a simpler, quicker and more effective way. The graphs are shown on two axels i.e. X and Y. The rate of understanding and interpreting the graph is higher as compared to other aids. Basically line, bar, circle and pictorial graphs are used to represent the data (Prasad, 2005).

f) **Display boards**: For the purpose of displaying information, display boards are widely used. In well-designed schools special areas are allotted for display boards/areas. Partition walls between two classes serve as good source for display: ceilings are also utilised for planet, stars and moon projection. The school grounds can be designed so that they represent a learning laboratory i.e. botanical garden, soil plots, aquatic areas and geological paths. All these work much more than a mere bulletin board and come under the umbrella of display area (Sampath et al., 1998). Displays can be categorised into the following types: Black/chalk board, white/marker board, flannel/felt board, bulletin board, magnet boards, and peg board.

a) **Three dimensional aids (3-D Models):** Models are imitations and replicas of any original object. These 3-D models can be reduced or enlarged in size as compared to the original items. Models present a simple form of abstract and complex concepts. Different types of models used in teaching and learning, according to Mangal (2008), are:- models, (solid models, cutaway and x-ray models, working models, sand models and the like), objects specimens; mock-ups; dioramas and puppets.

b) **Activity aids**: Activity aids provide real life experiences to students (Prasad, 2005). When students face difficulties in real life situations, they learn different social skills, i.e. cooperation, decision making, communication skills, taking part in competitions, field trips, and exhibitions are types of activity aids. Some basic activities are: field trips/study tours, exhibitions, demonstrations and dramatisation.

c) **Audio and visual aids**: All those teaching aids through which information can be heard and seen simultaneously are audio-visual aids (Prasad, 2005). Teaching aids that only utilise one sense at a time; hearing or seeing-are audio or visual aids. Results achieved by bringing together these two devices are very encouraging i.e. high-level learning and high retention power as compared to when they are used separately. Some largely used audio and visual aids are the: radio and television, cassette/record player/tape-recorder, video and multimedia.

2.5 Relevance of instructional materials in basic science

Audio-visual teaching materials plays a vital role in the teaching and learning of Basic Science. Below are some advantages as stated by various scholars:

1. **Serving as a source of information**: Menaught (2007), observed that audio-visual teaching materials are very useful teaching and instructional as well as promotional aids. He further stressed that where consistency of presentation is desirable, audio-visual materials are useful. They provide experiences not easily secured in other ways and hence contribute to the depth and variety of learning.

2. **Stimulating interest**: According to Katherine (2009), learning takes place effectively when the teacher sets out to provide a learning situation in which a child will learn because of his or her natural reactions to the provided materials. During the process of learning, the teacher has to provide a learning situation to satisfy the natural reaction of the learner and this is through the use of instructional aids. The attention of the learner is caught and his or her interest is also won and he or she is ready to learn.

3. **Extending experience**: Gopal (2010), stressed that audio-visual materials help the teacher to overcome the physical difficulties of presenting subject matter. That

is to say, with audio-visual materials, the barrier of communication and distance is broken. The nature and structure of matter can be brought into the classroom with the aid of slides, films, filmstrips and projectors. This is important because, according to Dike (1993 p.148) "once the phenomenon is visualized, the picture and knowledge becomes very clear and permanent". Supporting to this assertion, a 20th century Chinese philosopher stated that “one picture is worth a thousand words".

4. **Making learning permanent**: Audio-visual resources can play a major role in making learning permanent, Gopal (2010), stressed that audio-visual methods do seem to facilitate the acquisition, the retention and the recall of lessons learned, because, they seem to evoke the maximum response of the whole organism to the situations in which learning is done. Perceptual materials readily associate themselves with the unique experiential background of each individual. Natoli (2011), stressed that audio-visual materials are important in the teaching and learning processes because having seen something, most people remember, for whatever that thing was, it conjures up an image at a mere mention and can be talked about freely. Natoli further maintained that students forget because of a lack of interest and opportunities to use the knowledge they have gained later on.

Audio-visual resources can therefore contribute to the clarification of information presented by allowing students to visualise what is learned. Thus the saying: "What I hear, I forget; what I see, I remember; what I do, I know".

5. **Encouraging participation**: Natoli (2011), asserts that ‘Audio-visual materials are rich opportunities for students to develop communication skill while actively engaged in solving meaningful problems’. Natoli further maintains that students certainly like it more and learn better if they are engaged in important and appealing activities. For example, involving students in bulletin board display will enhance their choice of colour and aid their understanding of the concept in question or when they join the teacher in the dramatisation of an event or a process.

6. **Individualising instruction**: Sandra and Doorsuur (2013), stressed that audio-visual materials provide a means of individualising instruction. This is possible

through programmed learning and tapes which enable learners to learn at their pace and also to work on their own. Moreover, according to Dike (1993) in Sandra and Doorsuur (2013) the machine frees the teacher to work with individual students, since he or she is not now required to carry out routine drills. Production of resources by students is another way of individualising instruction.

2.6 Practical activities in basic science.

Practical work may be considered as engaging the learner in observing or manipulating real or virtual objects and materials (Millar, 2004). The Basic Science laboratory consists of all the various tools and equipment used by scientists or science students, either for finding new knowledge or to ascertain previous findings. Godwin et al 2015). A Basic Science laboratory is a place where different types of experiment and research concerning all the disciplines of Basic Science take place. Nzewi (2008), asserted that practical activities can be regarded as a strategy that could be adopted to make the task of a teacher (teaching) more real to the students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters. Nzewi maintained that practical activities should engage the students in hands-on, mind-on activities, using varieties of instructional materials and equipment to drive the lesson home.

Appropriate practical work enhances pupils' experience, understanding, skills and enjoyment of science. Practical work enables the students to think and act in a scientific manner. Practical work creates motivation and interest for learning Basic Science. Students tend to learn better in activity based courses where they can manipulate equipment and apparatus to gain insight in the content. Millar (2004) has suggested that practical work should be viewed as the mechanism by which materials and equipment are carefully and critically brought together to persuade the Basic Science learner about the veracity and validity of the scientific world view. The scientific method is thus emphasised. Practical work indicates scientific attitudes, develops problem solving skills and improves conceptual understanding (Amadola, 2012).

For most students, practical work provides the most effective means by which an understanding of Basic Science can develop.

Teaching is far more than transmitting facts and information. For it is said that: “A poor teacher tells; an average teacher informs; a good teacher teaches; an excellent teacher inspires” (Ukeje, 1979). To evaluate the job of teaching is to evaluate the extent to which the students have been inspired to think and create ideas. This can be achieved through practical activities which make students to be active in the teaching-learning process. Hence, there is a need for teachers to teach Basic Science using the activity-based approach.

Goals for activity-based instruction in Basic Science

a. **Enhancing mastery of subject matter.** Laboratory experiences may enhance student understanding of specific scientific facts and concepts and of the way in which these facts and concepts are organized in the scientific disciplines.
b. **Developing scientific reasoning.** Laboratory experiences may promote a student's ability to identify questions and concepts that guide scientific investigations; to design and conduct scientific investigations; to develop and revise scientific explanations and models; to recognise and analyse alternative explanations and models; and to make and defend a scientific argument. Making a scientific argument includes such abilities as writing, reviewing information, using scientific language appropriately, constructing a reasoned argument, and responding to critical comments.
c. **Understanding the complexity and ambiguity of empirical work.** Interacting with the unconstrained environment of the material world in laboratory experiences may help students concretely understand the inherent complexity and ambiguity of natural phenomena.
d. **Addressing Challenges.** Laboratory experiences may help students learn to address the challenges inherent in directly observing and manipulating the material world, including troubleshooting equipment used to make observations, understanding measurement error, and interpreting and aggregating the resulting data.

e. **Developing practical skills.** In laboratory experiences, students may learn to use the tools and conventions of science. For example, they may develop skills in using scientific equipment correctly and safely, making observations, taking measurements, and carrying out well-defined scientific procedures.
f. **Understanding the nature of science.** Laboratory experiences may help students to understand the values and assumptions inherent in the development and interpretation of scientific knowledge, such as the idea that science is a human endeavour that seeks to understand the material world and that scientific theory, models, and explanations change over time on the basis of new evidence.
g. **Cultivating interest in science and interest in learning science.**As a result of laboratory experiences that make science 'come alive', students may become interested in learning more about science and see it as relevant to everyday life.
h. **Developing teamwork abilities.** Laboratory experiences may also promote a student's ability to collaborate effectively with others in carrying out complex tasks, to share the work of the task, to assume different roles at different times, and to contribute and respond to ideas.

Source: (America's Laboratory Report: (2006), Investigations in High School Science).

2.7. Goals of practical work in activity-based learning in Basic Science

Petress (2008), reflects that the traditional lecture method, where students or learners sit passively (as notes are distributed) and the lecturer/teacher talks have dominated in education and science. However, he reveals further that science cannot use the teachers' domination technique. He identified typical characteristics of activity learners as follows: they ask questions for clarification; challenge ideas; procedures and content; connect current learning to past learning; attach what is learned with skill development; discuss what is known with others; and remain enthusiastic about learning.

Fallon (2013), proposed the following seven principles which promote activity based teaching strategy: (a) Itencourages student faculty contact; (b) encourages co-operation amongst students/learners; (c) encourages active learning; (d) provides prompt

feedback; (e) communicates high expectations; (f) respects diverse talents; and (g) emphasises the need for learners/students to be time-conscious in the execution of tasks.

A principal goal of activity-based learning method is that learners are turned into active investigators of their environment; the learners ultimately strive to make sense of the world around them. In these circumstances, these learners are bound to experience, understand and master a variety of phenomena.

As learners need to be provided with data and materials necessary to focus their thinking and interaction in a given lesson for the purpose of analysing information, they are encouraged to engage in active problem-solving in finding patterns in given information through their own investigation and analysis.

Through a commitment to active-learning processes, student not only learn and study content structures but also develop a variety of skills which are intrinsic in content-mastery. A number of these skills include:- (a) enhancement of the creative aspect of experience; (b) provision of the reality which is rooted in learning; (c) the provision of varied experiences by way of variegated resources designed to facilitate learners' acquisition of vast knowledge structures, experiences, multitudinal attitude dispositions, and a variety of skills and values; (d) and building students' confidence and developing understanding through work in his/her activities in a given group. In addition, the group work orientation and habit/culture developed in activity-based learning designs enhance happy relationships between students and their fellow-students, and between students and their teachers. This frame of thought enables students to build and cultivate a positive and favourable disposition between themselves and the societies outside the school; in other words, the social relationships cultivated in the school framework provide students with opportunities to mix with others in the larger society.

Zepke (2001), suggested a number of development designs which are intrinsic in the goals of activity-based learning styles in the lives of students engulfed in it. These development designs are reflected thus: (a) promoting and enhancing of students' self-belief among themselves; (b) enabling students to work autonomously, promoting the enjoyment of working and learning relationships with others and developing the feeling of

competence to achieve their own objectives in societal situations; (c) fostering the enthronement and sustenance of collaboration and cooperation amongst students and the others, a development which is designed to foster the enhancement of social relationships; (d) fostering the enablement of students in becoming active citizens who are expected to play responsible roles in nation-building and national development; and (e) fostering the enablement of students to build and develop their social and cultural capital.

2.8 Students academic achievement in Basic Science

It is advanced in this study that in spite of the central and important position of science amongst other subjects and disciplines taught in schools, literature is replete with findings that student academic achievement in science at secondary schools level has been consistently very poor and unimpressive (Usman, 2000; Musa, 2002; Bello, 2001; Njoku, 2005; Obeka, 2009; Nwagbo, 2006; & Sabiru, 2011). In view of these, several studies (Dabar & Faize, 2011; Isola 2010; Onasanya & Omosewo, 2011) have indicated that audio-visual materials favorably influence students' interest and achievement in science.

2.9 Students interest and their academic performance in Basic Science

Interest is defined as a specific relationship between a person and an object. This relationship is characterised by feelings and values as well as cognitive-epistemic component: a person associates positive feeling with an object of interest, considers it as significant for itself and has a great knowledge in terms of the object, while still being able to critically reflect about it (Krapp, 2003). A study conducted by Wale revealed that student's interest in Basic Science as well as individual interest in Basic Science declined significantly across school. According to Esiobu (2005), students form opinions about Basic Science in the early years of secondary school, and those beliefs become less favourable as students get older. This is because they perceive the subject as too difficult, and it involves a great deal of calculation.

Generally, a negative attitude toward a given subject leads to lack of interest and, when students lack interest in the subjects, they tends to avoid the subject or show less

concern in it. Furthermore, a positive attitude toward science “leads to a commitment to science that promotes lifelong learning” (Esiobu, 2005).

2.10 Some critiques of activity-based learning methodology in Basic Science

Unlike the subject-centred curriculum, the activity-based curriculum has no set subject-matter for study and no orderliness of procedure or knowledge barriers within a certain content range. It simply contains things to be done, not necessarily things to know. The claim that the activity-based learning methodology should be constructed by reference to the needs, wants and interests of the learner may be accepted if that is taken to mean that the curriculum should not ignore a learner’s needs, wants and interest. But if it is translated to mean that the curriculum should be based on the interests of the learner, some serious questions may be raised such as:- (a) What are the learner’s real needs? (b) How are these needs determined? (c) Which interests? (d) What wants? Any serious attempts, to answer these questions may lead to drawing a long list of learner’s needs, wants and interests, many of which would either be boring or trivial. A list of this nature may not help any curriculum planner to any marked extent.

In addition to the narrowness of the curriculum which derives from the activity-based learning method, critiques have observed a number of flaws which are intrinsic in this methodology. There is the danger that learners would select only manipulative activities, many of which tend to remain at relatively low cognitive levels in contrast to higher-level purposeful intellectual inquires. There is also the danger of over-emphasis on individualism i.e. - selecting activities that are not related to a common purpose and ignore the socialisation process. There is also the difficulty of obtaining materials that bear directly on a given issue or problem. There is also the danger of neglecting to extrapolate general Ideals from activity experiences-this failure could degenerate into a relegation of the power of effective thinking to the background. The biggest danger of the activity-based methodology is its association with child-centredness. This frame of thought could degenerate into turning learners loose to make their own decisions and to decide their own course. The activity-based learning design could degenerate into a purposeless activity which is devoid of wise guidance.

The work-ability in activity-based learning method necessarily depends on putting a number of criteria in-place; otherwise the method may not hold any purposeful advantage. These criteria include: (a) the necessary learning materials and resources must be readily available in the classroom or outside the classroom where the learning is to take place; (b) the classrooms must be large enough to be arranged into work areas so as to cater for the needs required in individually-based instruction and learning;(c) learners may not only be permitted to choose their own learning activities, they may also be permitted to interact freely with each other; and (d) the teacher must necessarily act as a guide, a catalyst or resource person between learners and the learning materials.

2.11 Gender and academic achievement in Basic Science

The influence of gender on students' academic achievement has for a long time been of concern to many researchers but no consistent result has been established. In other words, the difference in gender as it affects students and academic performance is inconclusive (Buadi, 2000). This development has necessitated the need to determine whether there is any significant difference between male and female students as reflected in their academic performance in Basic Science.

Some studies have revealed negligible but consistent differences between the performance of males and females in science achievement task. Ukwungwu (2002), observed a significant superior achievement of boys over girls in school Science. However, a few studies have reported better performance by female students than males in Science (Obodo, 1990;Ezeliora, 1994). Some studies on gender dimension to academic performance are of the view that gender does not affect the academic achievements of Science students (Aluko, 2005; Abubakar & Dokubo, 2011). However, the research on gender differences with respect to academic performance is still not conclusive.

On the other hand, in his research on test anxiety amongst Science students in secondary schools, Muhammad (2013), revealed that female students have higher levels of test anxiety than male students. In the same vein, a study was conducted by Woodward (2014) on the relationship between Mathematics test anxiety scores and Mathematics

achievement tests on gender differences.It was revealed that female students were significantly more anxious than their male counterparts. Tobias (2001) and Tapsak (2002) opined that female students exhibited higher levels of Mathematics test anxiety, thus have lower confidence in their mathematical ability that the male students.

2.12 Predicaments of women at junior science levels.

The approaches employed in the teaching of science education at the junior secondary school have been a source of concern in Nigeria. In spite of the central and important position of Science education in this country, literature is replete with the findings that students' achievement in Science at the junior secondary school level has been consistently poor and unimpressive (Njoku, 2005; Akpan, 2012). Many factors have been considered as contributing tostudents' poor achievement in Science. These have already been highlighted earlier in this study. These problems are related to the following: (a) inadequate laboratory infrastructure and paucity of necessary equipment; (b) poor teaching methods which capitalise on the use of the lecture approach; (c) lack of inadequate practical equipment; and (d) the mathematical nature of science concepts and laws accounting for students' poor performance. Shuaibu (1993), revealed that the lack of understanding of the nature and epistemological base of science teaching has militated against students' mastery of science generally.

Akpan (2012), reflects that our young learners are confronted with a number of psycho-social problems. The author expatiates further that the issue of learning science is very new to us; thus science educators today are experiencing difficulty in keeping their profession equipped with the knowledge and skills necessary to make their students' learning enjoyable, interesting, competitive and effective. The author reveals that our science teaching in this country is characterised by overcrowded classrooms and an inadequate supply of material resources and equipment. The author noted that the quest for scientific knowledge and literacy cannot be achieved when most pupils who reach the secondary schools have not been offered Science in the primary schools. The pupils come with little or no knowledge of Science and this has become a cause for concern for many science educators.

Adewumi (2005), advances the opinion that the teaching of science at the primary level in this country is still at the infancy stage. Akpan (2012), generally recorded that the teaching of science in Nigerian secondary schools is poor; science teaching is still mostly teacher-centred with over-emphasis on content delivery based on the use of the "chalk and talk" method.

Apart from the question of putting in place effective instruction strategies to boost science education in our secondary schools, we are also faced with the issue of attracting girls to science. As mentioned earlier, the problem of gender differences and achievements, particularly in schools, is far from being resolved. This predicament is said to be related to a number of cultural factors, including firstly,:- the gender role model orientation of society; secondly, the poor educational background of parents; and thirdly, poor group expectations (Jegede, 1992). One of the main objectives of this study is to determine the extent to which the employment of the activity-based instructional method would enhance the academic performance of students, including girls, in themastery of science concepts at the level of junior secondary education. The study is also aimed at finding out whether the use of the activity-based method of teaching science produces differential effects on males and females.

A number of studies have focused attention on the effects of methods of teaching science in schools (Sabiru, 2011; Garba, 2012). Based on this development, this study is centred on exploring the relevance of the activity-based method, as a learner-centred approach, for the effective teaching of science at the level of junior/secondary education.

The activity-based learning approach, despite its acceptability as a method of teaching science, has its critics. The main critique of student-centred learning is its focus on the individual learner. In addition, there are some difficulties in their implementation styles in the area of resources and materials needed for implementing them. The view is often entertained by the belief systems of both staff and students about learner-centred learning being variant, and there is also the predicament that students' lack of familiarity with the methods could weigh against the relevance of these instructional designs (Barr &Tagg, 1995).

Sabiru (2011), submits that activity-based methods might constitute a problem to implement in developing countries like Nigeria. This is because most developing countries have limited resources in education.

The approach may not be economical in large science classes which are currently common in many secondary schools in Nigeria.

2.13 Review of empirical related literature

A number of research studies which have relevance to the employment of activity-based method of teaching are recounted below. The study generally gave credence to the efficacy of the use of the activity-based method in classroom pedagogy.

Sabiru's (2011) research capitalised on theactivity-based method to execute the following: how students are learning what they experience and how to engage on the learning process. He explored the relevance of cooperative and inductive learning methods within the frame work of activity-based learning procedure to promote the learning of science amongst students. The author confirmed that the activity-based learning procedure possesses superiority over the traditional teacher-centred approach to instruction.

In addition, Dahiru (2010) demonstrated in practical terms that an activity-based teaching strategy has impacted positively on students' academic achievements. He conducted research on the impact of the activity-based teaching method on students' achievements in Basic Science amongst remedial students in the Federal College of Education Katsina, Nigeria. Using a sample of 202 students from the parent population of 269, he administered a Basic Science Concept Achievement Test (BSCAT) to two groups of students(experimental and control groups) that featured in the research study. T-test statistics were used to determine whether the activity-based teaching method impacted more positively on students as against the use of the lecture method. His findings revealed that students taught through the use of the activity-based method performed significantly better than those taught using the lecture method.

However, his critique of the approach focuses on the view that it does not meet the needs of the individual differences which prevail amongst learners. The approach also requires a vast array of instructional materials and laboratory resources for curriculum implementation.

Fallon, Walsh and Prendergast (2013) executed a project at the Dublin Institute of Technology which centered on the development of a research methods module that embraces an activity-based approach to learning amongst 82 undergraduate students in a group environment, with a view to determining the extent to which the module improved students' engagement in their studies.

The research method module was previously taught through a traditional lecture-based format. Anecdotally it was felt that the students' engagement was poor and learning was limited. It was established that successful completion of the development of this module would equip students with a deeply learned battery to research skills to take into their further academic and professional careers. In order to encourage engagement of students, a wide variety of activities were used.

The activities included workshops, brainstorming, mind-mapping, presentations, writtensubmissions and peer critiquing. Students' engagement was measured through a survey based on a U.S. National Survey of Student Engagement(2000). A questionnaire was devised to establish whether, and to what degree, students were engaged in the materials and resources they were learning, while they were learning them. The results of the questionnaires were very encouraging with between 63 per cent and 96 per cent of the students answering positively to a range of questions concerning engagement. The module was successfully developed and continues to be delivered, based upon this new and significant level of students' engagement.

Garba (2012), investigated the effects of the activity-based approach and lecture method of teaching on academic performances of Junior Secondary III students. A pre-test/post-test experimental-control group research design was used. A total of 100 Junior Secondary III students who were randomly selected from a secondary school in Sabon-Gari educational zone constituted the subjects in the study. The experimental group was

taught using the activity-based approach while the control group was taught using the lecture method. The instrument used for data collection was the “Basic Science Achievement Test” (BSAT) while its reliability indices were put at 0.79. Data obtained were analysed using t-test statistics at the 0.05 level of confidence. The results revealed that students in the experimental group performed significantly better in academic performance and retention ability than those in the control group.

Iqbal and Tayyaba (2014), conducted a study in Islamabad, Pakistan to determine the effectiveness of the activity-based teaching method on the learning of science students. The purpose of the research was also to explore the linkage between teaching techniques and student learning. The measuring instrument used for the learning was an achievement test (post-test). Students were divided into two groups; the experimental and the control group. Each group consisted of 25 students. These groups were equated based on marks achieved by students in a test of 4th class Science conducted by district teacher educator (DTE). The control group was taught by the lecture method while the experiment group was taught by an activity-based method. The duration of the teaching for both groups was 30 minutes per day for one month (30 days). At the end of one month, the post-test was administered. The data of study comprised the scores of the experimental as well as the control grouped obtained on the post-test. The study revealed the performance of the experimental group was better than the performance of the control group: there was a significant difference between the performance of the experimental group as compared to the control group with reference to knowledge, comprehension and application skills. The findings revealed that the activity-based method was more effective than the lecture method of teaching science at the elementary level.

Prabha (2011), investigated the educational experiences and attainment of learning outcomes of students who were taught through activities for a majority of students. However, she revealed that certain social, emotional and psychological aspects of classroom behaviour were positive in activity-based learning classes, although some problems were also seen consistently. Students with disabilities who were included in the regular activity-based learning classes showed improvements in communication and certain life skills but not in cognitive skills. Learning achievements were seen to be

moderate for basic language and mathematical skills and low for advanced language and mathematical skills. Furthermore, the levels of learning outcomes of public school students were found to be significantly lower than those of private school students, even at basic levels of skills.

Azuka (2013), in her study of activity-based learning strategies in mathematics classrooms found that students understood mathematics concepts and had higher retention rates when they actively participated in lessons. She stresses that teachers should move away from the “telling method” and select strategies which will promote active learning in the classrooms.

Hake (1998), his research on interactive engagement versus traditional method, found that an activity-based teaching strategy significantly improves the conceptual understanding of students in science classes.

Dawaki (2012), conducted research on the “effects of activity-based instructional strategy and traditional method” on the academic performance of students in Integrated Science in junior secondary schools, in Kaduna North Local Government Area, Kaduna State, Nigeria. She employed a quasi-experimental research design, where pre-tests and post-tests were administered to the population. A sample of 218 junior secondary school students from two government schools comprised the study. The finding revealed that the students who were exposed to activity-based learning performed better than their counterparts who were taught through the use of expository methods.

Theodora (2011), conducted a research on“the effect of group instructional strategy on student performance in selected science concepts”. He used a purposive sample of 365 senior secondary science students who were selected from a School of Science in Ile-Ife, Osun State, Nigeria. His study revealed that those exposed to a group instructional strategy performed better than those who were subjected to individual learning treatment; the below-average students exposed to the group instructional strategy registered‘gain-scores’ over what they scored when they were not exposed to the method. This development revealed that there was an improvement in their performance; hence they registered more understanding of science concepts. Also,

there was a significant difference in the collective work done by students exposed to the group instruction; their performances on individual basis revealed that the students gained better academically when they worked on assignments together than when they executed assignment tasks individually.

Daluba (2013), carried out research on “the effects of demonstration method ofteaching on students’ achievement in Agricultural Science in secondary schools in Kogi East Education Zone, Kogi State, Nigeria.” He employed a quasi-experimental research design; the population of the study consisted of 18225 Senior Secondary Two (SS II) students from 195 secondary schools. Six secondary schools were purposively random-sampled for research study. Four hundred and eighty students (480) in twelve intact classes were sampled for this study. A 30 item Agricultural Science Achievement Test (ASAT) was used for data collection. Means, standard deviations and analyses of covariance (ANCOVA) at 0.05 level of significance were employed to address the research questions raised in the study. The findings revealed that the use of the demonstration method in classroom pedagogy had a more significant effect on students’ achievements than those who were taught through the conventional lecture method.

2.14 Summary

This chapter has reviewed a number of items of literature which bear relevance to the issues at stake in this study. The thrust of this research hinges on the exploration of the activity-based learning methodology at the level of junior secondary education as a major efficacious and advantageous learning strategy for teaching science to young persons.

The chapter includes not only a discussion of the relevance of science at the level of junior secondary school education, but also a reflection on the ideals that are rooted in basic science at that level of education. Expatiations have been rendered on a number of strategies which are vital for promoting students’ learning of Basic Science in junior secondary schools.

A vital feature of this review centres not only on the attention it has devoted to the goals of practical work in activity-based learning: it has also emphasised the need for

exploring the relevance of employing teaching aids and resource materials in promoting the mastery of science at the level of junior secondary education. While endorsing the assets that are rooted in the use of the activity-based learning style, it has portrayed some of its lapses, which a skillful teacher can easily overcome during classroom pedagogy.

Attention has been devoted not only to the place of gender in regard to academic achievement in Basic Science, but the predicaments in which women fine themselves in the course of pursing science education in our schools have also been considered. It is in the context of the predicament of women in the pursuit of science education that this study intends to make a contribution. Thus a number of related empirical sources of literature have been reviewed to reinforce the need for exploring the relevance of an activity-based learning strategy in improving science teaching in schools.

However, the review of these sources of literature hasoffered little or no discussion on the need for fostering and promoting science learning amongst women, who appear to be disadvantaged, especially in the pursuit of science learning. It is in the need to promote science learning amongst youngsters, particularly the girls,that this study intends to make a contribution.

CHAPTER THREE

THEORETICAL FRAMEWORK

3.1 Introduction

This chapter presents the theoretical framework that guided the study.

3.2 Constructivist theory of learning

The constructivist theory of learningrelates to learners learning by constructing their own understanding through experience, and knowledge that argues that humans generate knowledge and meaning from interaction between their experience and ideas. Constructivism is often associated with the pedagogic approach that promoted active learning or learning by doing. Active learning is a model of instruction that focuses the responsibility for learning on learners. Njoku (2007), as cited in Shittu (2013) said that the learning environment should be learner-centred rather than teacher-centred, especially at secondary education level; this is because the learners master what they gets from ABTS in science education so as to enhance the teaching and learning process; this forms the theoretical framework upon which this study depends on.

3.3 Epistemological and ontological perspective of constructivism theory

This has bearing on the knowledge structures involved. These knowledge structures encompass subject matter areas that describe the sciences (physics, chemistry, biology). The epistemological approach considers these sciences as a totality and not in their compartmentalised form.

In terms of the ontological perspective constructivists were concerned with the nature of basic science. The nature of basic science is highly empirical in approach and founded on a number of laws and theories which have a scientific derivation implying that whatever is the result of any finding or discovery must be tested through the scientific method and confirmed to be valid.

Teaching science implies using many and varied series of activities. Yusuf (2003) opined that to learn science is to do science, and doing science by students entails more

than providing opportunities for them to interact with the environment. Therefore, the underlying philosophy of this study lies in the theories of cognitive science, particularly that of Vygotsky's social constructivism. The social constructivist theory states that learning takes place in a social context and in interaction with others (Vygotsky, 1978).To Mahoney (2004), constructivist theory emphasises that students learn when they construct their own meaning, and deep learning takes place when students are engaged in active learning. Focusing on a more educational description of constructivism, meaning is intimately connected with experience.

Cognitive theories believe the role of the teacher is to provide learners with opportunities and incentives to learn, holding that among others:

1. all learning, except for simple rote memorisation, requires the learners to actively construct meaning;
2. students' prior understandings and thoughts about a topic or concept before instruction exert a significant influence on what they learn during instruction;
3. the teacher's primary goal is to generate a change in the learner's cognitive structure or way of viewing and organising the world; and
4. learning in co-operation with others is an important source of motivation, support, modelling, and coaching (Feden, 1994)

Principles of constructivist theory: The constructivist theory derives its basis from the following criteria, namely:

1. instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).

2. instruction must be structured so that it can be easily grasped by the student (spirit organisation).

3. instruction should be designed to facilitate extrapolation and fill in the gaps (going beyond the information given).

Based on the above principles, constructivism is a learning theory and epistemology that has influenced much of science education lately states that students

construct their knowledge of the world through their past experiences. Students do not learn much by sitting in class listening to the teacher, memorizing,assignments and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, and apply it to their daily lives. They must take what they learn as part of themselves. Rogers (1969 p.162), argues that "much significant learning is acquired by doing" and that learning is facilitated when the student is a responsible participant. Christensen (2003), argues that a theory of instruction should address four major aspects: (a) predisposition towards learning; (b) the ways in which a body of knowledge can be structured so that it can be most readily grasped by the learner; (c) the most effective sequences in which to present material; and (d) the nature and pacing of rewards and punishments. Good methods for structuring knowledge should result in simplifying, generating new propositions, and increasing the manipulation of information.

Students are encouraged to say and do when working with audio-visual materials. Teachers who are concerned with students' emotional, social and academic needs have been found to encourage more student involvement in lessons. Active learning offers a paradigm for student learning that differs from the traditional lecture method-based.(Johnson, Roger & Karl, 2006).

According to Edgar Dale’s (1969) cone of learning experience, differences in the provision of learning and the amount of learning is obvious. The cone of learning shows that learners only remember 10 per cent of what they read, 20 per cent of what they hear, 30 per cent of what they see, 50 per cent of what they hear and see, 70 per cent of what they say and 90 per cent of what they say and do. Therefore, it is clear that audio-visual materials are part of learning and proper use of them makes learning easier, therefore the constructivist theory as a learning theory and Dale's cone of learning experience are suitable for this research in which an activity-based teaching strategy will be adopted using instructional materials. The essence of the study is therefore to examine whether instructional materials have any influence on students' academic achievements and anxiety in Basic Science in junior secondary schools.

3.4 Summary

The major issues discussed in Chapter 3 embraced the following: the theoretical framework which guided the study which bears the constructivist theory of learning; the epistemological and ontologicaldimension of constructivism;and the principles of constructivist theory.

The following chapter include: research methodology, outlines the sampling procedure, participant selection and research ethic.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

The research is meant to determine the extent to which the use of activity-based methodology could enhance the learning of Basic Science amongst students in junior secondary schools in Katsina Metropolis, Katsina State, Nigeria. This section describes the procedures employed in addressing the research questions and testing the hypotheses raised in the study.

4.2 Research design

This research study hinges on the exploitation of the use of the activity-based teaching method in determining the extent to which it positively enhanced students' academic performance in Basic Science at junior secondary schools in Katsina Metropolis, Nigeria using a quasi-experimental design (McMillan & Schumacher, 2014). Quasi-experimental designs identify a comparison group that is as similar as possible to the treatment group in terms of baseline (pre-intervention) characteristics.

A quasi-experimental design approximates the true experimental type. The purpose of the method is the same to determine cause and effect – and there is an intervention controlled by the experimenters. However, there is no random assignment of subjects. A common situation for implementing quasi-experimental research involves several classes or schools that can be used to determine the effect of curricular materials or teaching methods. The classes are intact or already organised for an instructional purpose. The classes are not assigned randomly and have different teachers. It is possible, however, to give an intervention to some of the classes and treat other classes as the "control group". The study is based on a comparative analysis of the performance of two groups of students.

The idea/objective is to determine the efficacy of employing two different teaching methods in order to establish the superiority of one method over the other in terms of enabling students to learn science more effectively. As this is the case, the researcher is

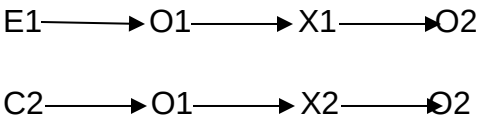
required to establish the academic status of each of the groups before the treatment face is started. After the two groups have been subjected to the two teaching or pedagogical methods respectively, a performance evaluation procedure or test is administered to the two different groups of students. This evaluation device is designed to establish which group has superior performance when compared to the other in terms of mastering the contents that have been taught by the teacher. This procedure and processes demand that the research should be a quasi-experimental one and this has informed why the researcher is conducting this experimental quasi-researchwork.

In the dimension of experimental research design, the pre-test and post-test experimental control groups were used to address the purpose of the study. As a descriptive research, the study was geared at analysing the existing conditions regarding the extent to which junior secondary school students are sufficiently exposed to the activity-based teaching strategy with the purpose of improving their mastery of the curriculum content enshrined in Basic Science at the level of junior secondary school certificate (JSSC).

The descriptive research design was employed in this investigation; it enabled the researcher to have in-depth and comprehensive information regarding the problem of study. In other words, the survey research design enabled the researcher to study the population of the study area (parent population) through a representative sample drawn from this parent population by the randomisation process so as to discover the relative incidences, distributions and interrelationships of pedagogical, sociological and psychological variables (Kerlinger, 1973) intrinsic in the problem of study.

The descriptive research design provided the basis for the random selection of the two groups of population (experimental and control groups) that were subjected to test questions deriving from the Basic Science Achievement Test. The students' scores emanating from this test constituted the basis for addressing the research questions and the hypotheses raised in the study.

The experimental-control research design is illustrated thus:



where:- E1 = Experimental group

C2 = Control group

X1 = Activity-based method of instruction

X2 = Lecture method of instruction

O1 = Pre-test

O2=Post-test

The advantages of this type of design are the following:

The average gain can be compared and subjected to a test of significance of the differences between the mean scores for the two groups; also the assumption in this design is that uncontrollable events act equally on both groups, so that any gain recorded is expected to be as a result of the treatment applied.

It helps in showing whether one particular treatment and teaching strategy are superior to the other.

It can be used to give an indication of gain in understanding the selected Basic Science concepts as a result of the application of the treatment (Musa, 2000).

4.3 Study population

The population of this study consists of all the junior secondary three (JSS III) students located in Katsina Metropolis. Katsina Metropolis is classified into three zones:

Zones A, B, and C.

Eleven junior secondary schools are considered effectively functional in this study area. The basis for the classification of the schools derives from their respective locations in a homogeneous urban environment of Katsina Metropolis. In other words, the homogeneous peculiarities in the three zones of this study informed the reasons for the schools' classification in the area of study.

The eleven junior secondary schools in the study area have a student population of nine thousand and six (9,006). This population consists of all the JSS III junior secondary school students studying Basic Science in all the eleven junior secondary schools that make up the study area.

Table 4.1: List of eleven junior secondary school III (JSS III) in Katsina Metropolis

S/No	Name of Schools	Total Boys	Total Girls	Total for Boys and Girls
1	GJSS KofarKaura	580	540	1,120
2	GJSS KofarYandaka	1,136	1,082	2,218
3	GJSS KofarSauri	400	150	550
4	GJSS Batagarawa	327	165	492
5	GJSS Natsinta	227	107	334
6	GJSS Kambarawa	350	174	524
7	GJSS Dandagoro	301	204	505
8	GCK Junior Sec. Sch.	720	567	1,287
9	GJSS Dutsin Safe	270	270	540
10	Family Support JSS	41	45	86
11	Katsina College Junior	690	660	1,350
Total		5,042	3,964	9,006

Source: Department of Planning, Research and Statistics, Ministry of Education, Katsina, Katsina State (2014)

The population is made up of five thousand and forty-two (5,042) boys and three thousand nine hundred and sixty-four (3,964) girls. Zone A is made up of three schools; Zone B consists of four schools while Zone C also has four schools.

Table 4.2: (Zone A)

S/No	Name of School	Population Boys	Population Girls'	Population of Boys and Girls
1	Government Junior Secondary School Kofar Yandaka	1,136	1,082	2,218
2	Government Junior Secondary School Dutsin-Safe	270	270	540
3	Government Junior Secondary School Natsinta	227	107	334
Total		1,633	1,459	3,092

Table 4.2: (ZONE B)

S/No	Name of School	Population Boys	Population Girls'	Population of Boys and Girls
4	Government Junior Secondary School Kofar Kaura	580	540	1,120
5	Katsina College	690	660	1,350
6	Government College (GCK), Junior Secondary School	720	567	1,287
7	Family Support Junior Secondary School	41	45	86
Total		2,031	1,812	3,843

Table 4.2: (ZONE C)

S/No	Name of School	Population Boys	Population Girls'	Population of Boys and Girls
8	Government Junior Secondary School Kofar Sauri	400	150	550
9	Government Junior Secondary School Kambarawa	350	174	524
10	Government Junior Secondary School Dandagoro	301	204	505
11	Government Junior Secondary School Batagarawa	327	165	492
	Total	1,378	693	2,071

Source: Department of Planning, Research and Statistics, Ministry of Education, Katsina, Katsina State (2014)

4.4 Study sample and sampling procedure

A sample consists of a group of elements in a research study from which data is generated. It is a small proportion of the population that is selected for observation and analysis for research (Ndagi, 2002). Eleven junior secondary schools from the three zones of the study, consisting of nine thousand and six (9,006) students represent the target population of the study area (that is Katsina Metropolis). This population is made up of five thousand and forty-two (5,042) boys and three thousand nine hundred and sixty-four (3,964) girls. Each of the students in the eleven junior secondary schools in Katsina Metropolis is an element of the research procedure. Because of the large population (9,006 students) studied, it was necessary to examine a part or fraction of this population which is the sample. The sample comprises the number of elements on whom measurements are actually made and from which inferences are also drawn.

Three junior secondary schools were randomly and selected from the eleven schools in all three zones that featuredin the study (one school was randomly selected from each of the three zones). Based on the identified population of 9,006 junior secondary three (JSS III) students, about four hundred (400) were sampled from the eleven junior secondary schools in Katsina Metropolis: this number approximately constitutes the sampled population of the study. The basis of sampling the entire population of the study (9,006 students) was derived from Krejcie and Morgan's (1970)

recommendation that three hundred and eighty four (384) subjects could constitute a minimum sample of up to one million respondents (see Table 6). It is estimated thatbetween a hundred and one hundred and thirty (100-130) randomly selected subjects constituted the research study in each of the three zones of Katsina Metropolis. Because of the experimental nature of the study, each of the sampled schools in each of the three zones was divided into two through randomisation. These two groups constituted the experimental and control groups. Each of the group was constituted into fifty-five students. Three groups were constituted into the experimental groups while the other three groups made up the control groups. Therandomly selected students featured both male and female students. This selection was executed with the use of class registers of the affected classes and schools that featured in the study.

A part from the students (respondents), teachers and principals also featured in the research. Three (3) principals were available in each of the eleven (11) schools; this implies a total of 33 principals. Out of this total, 10 per cent of them were randomly sampled which gave a total of four (4) principals.

Ten (10) science teachers featured in each of the schools; this gave a total of 110 teachers in the eleven (11) randomly selected schools. Of this number 10 per cent ofthis numbers were randomly sampled, giving a total of ten (10) teachers for the research. This selection conforms with the recommendations of Awotunde and Ugodulunwa (2004).

4.4.1 Participant selection

In terms of this study, three hundred and sixty-eight (368) respondents, according to Krejcie and Morgan (1970), should constitute the minimum population selected to represent the entire population of the study which stands at nine thousand and six (9006) students. Thus the randomisation method was used as the sampling technique for selecting the respondents who featured in the study. This method, according to Ndagi (2002), gives every member of a given population an equal chance of being selected without any bias. In this process ofbuilding the sampled population of this study, Gray's (1980) recommendation, as cited in Abiola (2007: 83), endorses that percentages ranging from 10 per cent to 15 per cent and 20 per cent could be used to select a sample size

from a given population of over five thousand. Through this procedure, it was envisaged that a sampled population of about 400 male and female students could be raised for the study. Each of the sampled school in the three zones of the study could be constituted into a sampled population ranging between a hundred to about one hundred and thirty (100-130).

The population organised for any of the schools represented in each of the three zones was divided into two to constitute both the experimental and control groups for the study.

These two groups were sorted out into classes of 55 students each in each of the three zones of the study. In other words, each of the zones of the study was constituted into 165 students and these were categorised as control and experimental groups (165 students each) (see Appendixes O and P).

4.5 Document collection

The types of document collected include:classroom registers of students and; past examination question papers in Junior Secondary Certificate Examination questions in Basic Science. These documents were obtained from the principals of the various secondary schools in Katsina Metropolis. The documents collected aimed at shedding more light on the issues and problems at stake such as gender differences, and the nature and structure of the past questions to which students had been exposed.

4.5.1 Focus groupinterview

The size of each group was 55; the groups were classified the experimental groups and the control groups.The total of 55 students sampled for each experimental group and control group respectively were deemed adequate because (Gray 1960), cited in Abiola (2007), suggested that in the process of building a sampled population of this kind of experimental research, percentages ranging from 10 per cent to 15 per cent and 20 per cent could be used to select a sample size from a given parental population of over 5,000. The 55 students selected for each of the group met this criterion approximately.

Besides, these 55 students that constituted a sample population of control and experimental groups made up over 11 per cent of the 495 students constituted in the three zones that featured in the study.

Also, the choice of 55 students as a sample size for both the experimental and control groups for the study is in line with “central limit theorem” which recommended a minimum of sample size of 30 as noted by Tuckman (1975). This suggests that the minimum of sample size of 30 is viable for experimental research.

About nine interviews were held, namely:- three different interviews with the three teachers from each of the schools whose students featured in the research,and six different interviews with the six groups of students that featured in the research study.

The interviews with the teachers were held in their various offices; the sites of the interviews with the groups of students were in their six differentiated classrooms so as to afford the researcher environmental structures that are conducive to the research being conducted.

The school teachers and selected groups of students who featured in the research were interviewed. These focus group interviews aimed at enabling the researcher to envisage the results expected in the final analysis at the end of the research.

4.5.2 Observation

The researcher observed the participants’. The students who featured in the research were observed by the researcher. The researcher observed the students’ learning activities during their exposure to the issues at stake in the activity-based approach to a variety of exercises which derived from the various items of the topic designated from the research.

The observation was carried out during the execution of the processes enshrined in the activity-based approach within the framework of various classrooms that were used for pedagogical purposes during the research.

The observations were carried out in three different stages: three observations were carried out in respect of (a) eroded sites, (b) flooded sites, (c) bush burning sites and (d) desertification and deforestation sites.

With regard to the ozone layer depletion site, two observations were carried out. Also, in reference to air pollution two observations were carried out. A total of 19 observations were carried out. These observations were designed to acquaint the researcher with the necessary features and characteristics that are associated with each of these areas of the research study.

4.5.3 Interview

The students who featured in the research were interviewed. Teachers of the schools that featured in the research were also interviewed. The interviews were structured,they were face-to-face type of interview. These interviews aimed at enabling the researcher to envisage what was expected at the end of the research.

The first interview was held at the commencement of the research and the interviews conducted were followed up after a three-week interval.

Two interviews were conducted: one was conducted at the commencement of the research so as to determine the entry behaviour of the people who featured in the research (students, teachers,and principals).

The second one took place after a three-week interval in order to determine whether there were any discrepancies between the results recorded during the second section of the interview.

4.5.4 Scholastic/Performance

The Basic Science Achievement Test (BSAT) was answered by Junior Secondary Schools(JSS III) and was administered in group context .The field worker who possesses a first degree in Science Education and with five years' experience in teaching in secondary school assisted. All the information gathered satisfied the requirements they

were designed to meet. The information gathered was meant to advance and achieve the purpose of the research.

The various data were collected without hitches; the collections were prompt and executed promptly. The required analysis was carried out and the results were also determined.

4.5.5 Self-reports/Diaries

Reports on field observation which bear on erosion, pollution, deforestation, flooding, desertification, ozone layer depletion and bush burning, during treatment administration of the experimental group. The reports were derived from the respective sites namely: erosion sites; polluted sites; deforestation sites.

The self-reports and diaries from the respondent were collected before the research was executed. These reports were meant to help the researcher to emerge with holistic perspective of what this research work was meant to reveal.

4.5.6 Photographs

The researcher, research assistants and students took the photographs on erosion sites, deforestation sites, polluted sites, bush burning sites and flood plains.

The researcher kept the photographs that were taken to ensure privacy. The various scenarios portrayed in the photographs were all documented and they enabled the researcher to emerge with a meaningful evaluation regarding the answers that students' demonstrated in the Basic science achievement test.

4.5.7 Video

The video was recorded by the researcher and research assistant. The following sites were videoed: (a) the interview between the researcher and various groups of the students in their six differentiated classrooms; (b) the sites of locations where field observation took place in respect of the following:- erosion sites, pollution sites, deforestation sites, bush burning sites, desertification sites, and land deforestation sites.

The anonymity and privacy of the research are protected in the sense that only the researcher has access to the sensitive issues and materials which have bearing in this research study. The researcher is very conscious of the principles of anonymity and privacy of any research executed under the umbrella of University of South Africa (UNISA) and she is prepared to abide by these principles in absolute terms. All the statements that featured are authentic and designed to portray the research work as a genuine study. The sensitive materials were collected immediately afterwards.

4.6 Reliability coefficient of test instrument and pilot study

The determination of reliability coefficient of test instrument necessitated a pilot study. Fifty students (50) were randomly selected from Government Day Junior Secondary School, Dutsinma. The selected school was similar to those that featured in the main study in terms of the location and status. Similarly, these selected students are similar to the subjects of the study in respect of age and exposure to instructional resources and learning of the Basic Science. Also, the same basic science curriculum is what is used across Katsina State junior secondary schools.

The teaching facilities and environmental conditions were similar to those that featured in the main study. The students were tested and re-tested to determine the reliability coefficient and dependability of the test instrument. The tests were carried out within an interval of ten (10) days. The Pearson product moment coefficient (PPMC) method was used to determine the reliability coefficient of the Basic Science test instrument. The result was 0.98 and this reliability coefficient was considered adequate with regard to the internal consistencies of the test instrument. It was entertained that the closer the calculated reliability coefficient is to 1, the more reliable the instrument is. Details of the results of the reliability analysis are displayed in Appendix N.

4.6.1 Validity of research instrument

The validity of the research instrument has been authenticated by the research scholars in the three local universities in Katsina Nigeria (Umaru Musa Yaradua University; Federal University Dutsinma and Ahmadu Bello University Zaria).

4.6.2 Facility level of test items

The facility level of test items was proved to be quite high through the process of the test re-test procedure which revealed 0.98 coefficient of reliability (see Appendix N).

4.7 Treatment procedure/process of data collection

In order to remove possible teacher effects and bias, the researcher conducted the teaching of both the experimental and control groups with strict adherence to the lesson plans prepared for the study. The contact sessions for both experimental and control groups took nine (9) weeks. The first week was used for the pre-test; before the commencement ofthe experiment to determine the equivalence of the two (2) groups; week two to week seven(7) were used for the teaching of both the experimental and control groups; and the eighth week was used for the post-testing of both the experimental and the control groups.

The experimental group was taught using a variety of instructional materials and resources, including drawing materials and equipment, cardboard drawings, diagrams, pictures and photographs, and various forms of visual materials. These treatment materials were withheld from the control group which received the same Basic Science instructions as the experimental group but using the lecture method.

A post-test was administered at the end of the treatment. A pre-test, however, was given before the commencement of the experiment to determine the equivalence of the two groups (see Appendices O and P).

The instrument that was used for this study is the Basic Science Achievement Test (BSAT). The instrument comprised 60 multiple choice items which were obtained from a collection of National Examinations Council for Basic Education Certificate Examinations for Junior Secondary School Certificate. These assessment items are available at the Ministry of Education, Katsina, Katsina State, Nigeria. These National Examination

Council (NECO) test items meet a number of measurement criteria and are pronounced adequate by expert and experienced science teachers in the secondary schools. These NECO test instruments met the following prerequisites:

(i) They have earned the recommendations of a variety of academic and scholar judges;

(ii) The instruments generally possess appropriate facility indices ranging from 0.30-0.70; and

(iii) The items of these instruments reflected the four (4) cognitive levels of Bloom's Taxonomy for the cognitive domain (Bloom,1986, in Musa, 2000).

These four levels include the following:

- Level A: functional information, mainly recall.
- Level B: understanding (ability to use knowledge in a familiar situation).
- Level C: application (ability to select appropriate knowledge and apply it to problem-situations).
- Level D: high processes (this involves analysis, synthesis and evaluation).

The 60-item test of the instrument for this study (Basic Science Achievement Test) was distributed according to the foregoing cognitive levels made authentic by Bloom as follows:

i. 25 questions for Level A;
ii. 15 questions for Level B;
iii. 15 questions for Level C;
iv. 5 questions for Level D.

The researcher adopted the test items of the instrument after consultations with science lecturers in the Science Departments of the two universities in the vicinity of Katsina Metropolis, namely:-Umaru Musa Yar'adua University, Katsina, and Federal University, Dutsinma. The researcher also used secondary school science teachers because of their vast experience: these cadres of teachers contributed in making the research instrument authentic for the study. Ten lesson plans the topics of which were

derived from variations of the topic, “Environmental management and sustainability”, has bearing on the following issues: (a) erosion; (b) pollution; (c) de-forestation; (d) bush burning; (e) desertification; flooding; and (f) ozone layer depletion. Lessons on these topics were taught to the experimental groups using an activity-based instructional method, while the control groups were taught using the lecture method.

4.8 Administration of the research instrument/treatment

The treatment administered to the subjects involved teaching the following Basic Science concepts: erosion; (b) pollution; (c) de-forestation; (d) flooding; (e) desertification and bush burning; and (f) ozone layer depletion. The following methods were used: (a) activity-based teaching method (ABTM); and (b) traditional method.

Lesson plans were prepared beforehandto teach the foregoing selected Basic Science concepts (see Appendices B and C). The activity based teaching method (ABTM) was based, among others, on the theory of constructivism which lays emphasis on learning by doing. The researcher adopted the “5E” model of ABTS developed by Bybee, Taylor, Gardner, Scoter, Powell, Westbrook, and Landes (2006) as illustrated in Figure 4.1 below:

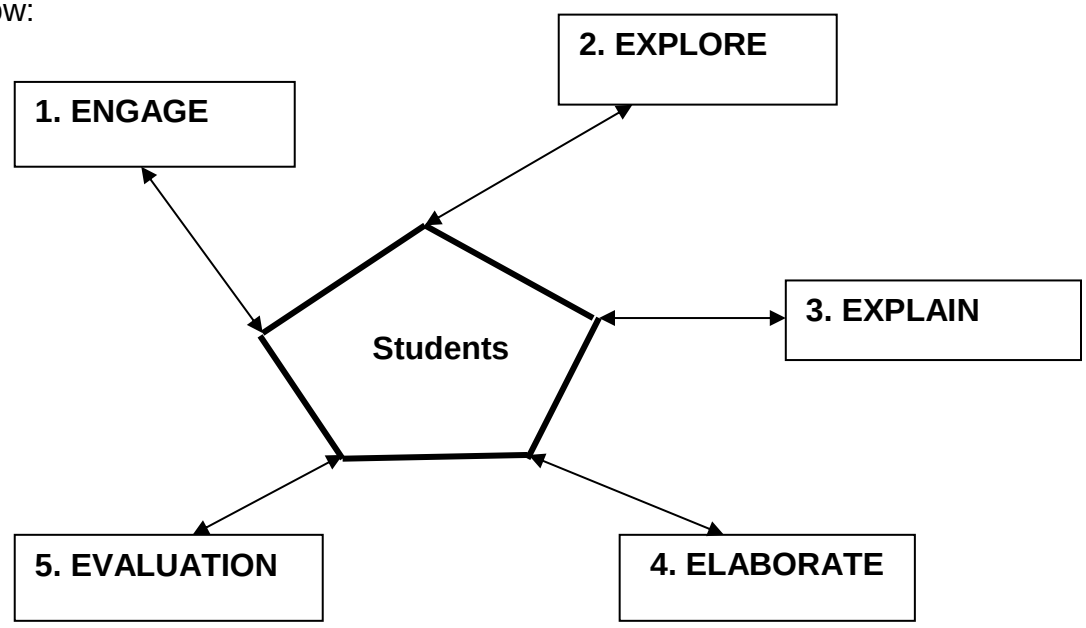


Figure 4.1: The 5Es instructional Model (Source: Bybee, 2000)

The model has five (5) phases. These include: engage, explore, explain, elaborate and evaluate. The first phase (engage) involves the employment of activities that mentally

engage students with an event or questions. Engagement in activities induces students to make connections with what they know and can do. Thus students are made to commit themselves to use their prior knowledge in order to understand and master new concepts.

In the second phase (explore) students are committed to work with one another to explore ideas through hand-on activities in the classroom or laboratory. This exploration stage provides a set of common experiences for all students and learners. Thus students learn many skills such as making observations while performing classroom activities; they cooperate with their mates to execute some skills; they entertain respect for others' viewpoints;and they demonstrate tolerance for colleagues in such activities as date collection, and data evaluation. In this phase the teacher's role is focused on guiding students. In the third stage, students are engaged in a variety of classroom activities: they construct and explain a variety of concepts they have learned. In the fourth stage of the 5E model, students are made to apply what they have already learned to new situations, new topics and concepts. The last stage relates to evaluation. The evaluation stage enables students to assess their understandings, strengths and abilities and provides them with the opportunity for interaction with their teacher and fellow students. In this stage, the teacher also evaluates the progress registered by students.

In each of the zones covered in the study, students (the experimental group) were sub-divided into small groups, and each group was made up of six to seven students. This development made it possible for students to be involved in classroom operations. With reference to students in the control groups, they were taught through the employment of the traditional method, that is, the "talk and chalk" method with little or no activities by the students.

As mentioned earlier, before the commencement of the treatment, the students in the two groups (experimental and control) were oriented in order to become familiar with the researcher during the first week. They were also pre-tested with the Basic Science Achievement Test (BSAT) in order to determine group equivalence. The subjects in the experimental group were taught the identified Basic Science concepts using ABTM while those in the control group were taught the same content using the traditional method. The treatment lasted for nine weeks. Five-double periods of eighty (80) minutes were used in

the whole exercise. During the last week, a post-test was administered to the two groups of students(see Appendices O and P).

With reference to the experimental group, the students were arranged in a number of small groups, ranging between five and seven students. They were provided with topics that are rooted in environmental management and sustainability (derived from such components as erosion, pollution, bush burning, flooding, desertification, deforestation and ozone layer depletion). Relevant content resources and materials which bear on Bloom's Taxonomy for the mastery of the issues in these topics with reference to the cognitive domain were supplied to the students. In other words, selected items and resources were reflected in the four cognitive levels of Bloom's Taxonomy for the cognitive domain. Students were required to engage in the following tasks relating to the topics they were studying: (a) recalling functional information; (b) employing relevant knowledge in familiar situations; (c) selecting appropriate knowledge and applying it to a problem situation; and (d) analysing and evaluating problem situations. Forums were created for the students to be involved in the use of a variety of instructional materials and resources and a number of test questions were supplied to them. The students were required to execute these tasks with the guidance of the researcher and her research assistants. At the end of the exercise, students' academic performances were assessed and corrections effected. With reference to the control groups, the researcher conducted classroom lessons using the instructional plans that had been prepared. The lesson plans were based on the topics that are rooted in environmental management and sustainability as mentioned earlier. Each lesson lasted forty minutes; over a period of eight weeks. After each lesson, students were allowed to ask questions; they were required to answer some questions; and at the end the answers they had given were assessed and corrections were also affected.

4.9 Procedure for data collection

After the necessary permission had been obtained toconduct this research, the documents were presented to the various junior secondary schools covered by the

researcher for the purpose of conducting the study. The researcher administered the instruments to the subjects through face-to-face contact with the help of research assistants and a number of classroom teachers. A pre-test was administered initially to determine the equivalence of the experimental and control groups. After treatment, a post-test was administered to both groups. The necessary instructions required for a hitch-free completion of the tests were clearly stated and explained. Personal information such as class registers, names of schools and gender were requested and the reasons for these were clearly stated and explained. After the treatment, both experimental and control groups were subjected to the 60 - item Basic Science Achievement Test (BSAT). The results obtained from this test were used in answering the research questions and testing the research null hypotheses.

4.10 Procedure for data analysis

The results of the Basic Science Achievement Test (BSAT) were analysed. Each correct answer has been scored 1 mark with a maximum of 60 marks (see the totality of the raw scores computed for both the experimental and control groups as in Appendices N-V). The scores obtained from the Basic Science Achievement Test (BSAT) provided the data for answering the research questions and testing the null hypotheses. The research questions were answered using mean and standard deviation of the students' deviation post-test scores while the null hypotheses were tested using t-test independent sample statistics at 0.05 significance level.

4.11 Ethical considerations

Amongst ethical considerations this study adapted the contextualised-consequential model as described by Denzin and Lincoln (2011). Participation was purely on a voluntary basis and participants were free to withdraw at any time. They were approached and the purpose of the study explained to them, with a consent form provided for them to sign.(see Appendix F (i-ii))

The research complied with the University of South Africa's (UNISA) ethical guidelines, as well as the Katsina Ministry of Education, Nigeria requirements for conducting research in public schools in the country. The research proposal and its tools

went through the ethical research process of UNISA and permission to conduct research was granted (Appendix B). Appropriate security measures for storing raw data collected from the participants were also followed.

4.12 Summary

In this chapter a number of salient issues are discussed including the following: research design, details about the population of the study, sample size and sampling procedure. Participant selection with reference to the population was also discussed. The chapter also included a variety of media for data collection such as the following: document collection, focus group participation, observation designs, and interview techniques. Also in this chapter the reliability coefficient of test instrument and pilot study design arte explained. The validity of the test instrument is also shown. The chapter also discloses the modalities for the administration of the research entrustment, procedure for data collection and data analyses. Some element of ethical consideration governing the whole study has also been presented.

The following chapter will focus on data presentation, analysis and discussion of the study.

CHAPTER FIVE

DATA PRESENTATION, ANALYSIS AND DISCUSSION

5.1 Introduction

This chapter includes the presentation of data and analysis of results of the study including discussions which derive from the results. Data related to academic achievement were collected from the Basic Science Achievement Test (BSAT). The analysis essentially involved addressing the research question and testing the research questions raised in the study, using the Statistical Package for Social Science (SPSS).

The level of significance used is 0.05. This level of significance formed the basis for retaining or rejecting the hypotheses. T-test statistics were used to test the hypotheses formulated for the study.

This chapter is discussed in terms of the following broad-headings: Data presentation/analysis in terms of the research questions; Testing of hypotheses; summary of the findings and discussion of results.

5.2. Data Presentation/Analysis According to Research Questions

Research Question One:

What is the difference between the academic performance of students taught using an activity-based method and those taught using the lecture method?

The post-test scores collected from the two groups (Experimental and Control) were analysed and presented in Table 5.1.

Table 5.1: A comparative analysis of the academic performance of experimental group and Control Group

Groups	N	Mean	Standard Deviation	Standard Error Mean
Experimental	165	43.91	4.90497	.38185
Control	165	39.82	2.40242	.18703

Source:Statistical Package for the Social Studies (SPSS) output as Contained in Appendix W

Table 5.1 shows a mean difference of 4.09 in the post-test scores of the two groups (Experimental and Control). The experimental group recorded higher academic performance in the mean score of 43.91 than the control group counterpart with a mean academic performance of 39.81.

This means that Basic Science students taught using an activity based teaching method tended to achieve higher scores than those taught using the traditional lecture method. The standard deviations for the two groups are 4.90947 and 2.40242 respectively.

Research Question Two:

Is there any difference between the academic performance of boys and girls when taught science concepts using an activity based method?

In answering the above research question, the post-test scores of male and female Basic Science students in the experimental group were analysed and presented in Table 5.2.

Table 5.2: Mean scores of male and female in the Experimental Group

Gender	N	Mean	Standard Deviation	Mean Diff.
Male	86	42.55	2.38454	3.55
Female	79	39.00	.90045	

*Source:*Statistical Package for the Social Studies (SPSS) output as Contained in Appendix X

Table 5.2 showed a mean difference of 3.55 between male and female students exposed to ABTM. The male students performed better than their female counterparts, having a higher score profile of 42.55 while the female students registered 39.00.

Research Question Three*:*

What is the effect of an activity-based method on students' retention of science concepts at the junior secondary school level?

As in the case of Research Question 1, the post-test scores collected from the two groups (Experimental and Control) were analysed and employed in addressing Research Question Three, as presented on Table 5.3

Table 5.3: Students retentive ability in experimental and control groups

Groups/Student	N	Mean	Standard Deviation	Standard Error Mean
Experimental	165	43.91	4.90497	.38185
Control	165	39.82	2.40242	.18703

Source:Statistical Package for the Social Studies (SPSS) output as Contained in Appendix W

Table 5.3 demonstrates a mean difference of 4.09 in the post-test scores of the two groups (Experimental and Control). This mean difference (4.09) constitutes a quantified retention ability indices registered by the experimental group when compared to the control group. These retention ability indices have cumulatively demonstrated that the experimental group recorded a higher academic performance in the mean score of 43.91 when compared to her control group counterpart, with a mean academic performance score of 39.82. This means that Basic Science students taught using ABTM tend to

achieve higher academic performance including retention propensity, than those taught using the traditional lecture method.

As the activity-based teaching method endorses learner-centredness, the experimental group of students explored the assets intrinsic in this pedagogical design in registering higher retention ability in the learning of Basic Science concepts in junior secondary schools.

5.2.1 Data presentation/analysis based on research hypotheses

Hypothesis 1: There is no significant difference in the academic performance of students taught Basic Science concepts using an activity-based teaching strategy and those taught using the lecture method.

This hypothesis was tested with data collected from the two groups of Basic Science students (Experimental and Control). T-test independent sample statistics were used in comparing the performance of students in the experimental and control groups at 0.05 significance level. The summary of the findings is tabulated in Table 5.4.

Table 5.4: t-test Analysis of differences in the academic performance of experimental and control groups

Groups	N	Mean	Std. Dev.	Df	t	P	Decision
Experimental	165	43.91	4.9097	328	9.621	.000	Significant
Control	165	39.82	2.40242				

*Source:*Statistical Package for the Social Studies (SPSS) output as Contained in Appendix W

From the Table above, there is (t = 9.621; df = 328 and p = 0.000) is obtained. Now since the p-value (.000) is less than the alpha- value (.05), the null hypothesis is rejected and the alternate hypothesis is adopted. Therefore, it can be concluded that there is a significant difference in performance between experimental and control groups. This difference is in favour of the experimental group. This shows that those Basic Science students taught using ABTM tend to achieve significantly higher score than those Basic Science students taught using the traditional method. Hence, the null hypothesis was rejected.

Hypothesis 2: There is no significant difference in the academic performance of male students and their female counterparts when taught Basic Science concepts using an activity-based teaching strategy.

In hypothesis two, only students in the experimental group were exposed to an ABTM. Therefore this hypothesis is tested with data collected from male and female students exposed to an activity based teaching method so as to determine the impact of gender on the use of an ABTM. The finding is tabulated on Table 5.5.

Table 5.5: t-test Analysis of male and female students in experimental group

Groups	N	Mean	Std. Dev.	Df	t	P	Decision
Male	86	42.55	2.38454	163	12.319	.000	Significant
Female	79	39.00	.94045				

*Source:*Statistical Package for the Social Studies (SPSS) output as Contained in Appendix X

From the above table, there is (t = 12.319; df = 163; p = .000) is obtained. Since the p-value (.000) is less than alpha - value (.05), the null hypothesis is rejected and the alternate hypothesis is adopted. Therefore the researcher concludes that there is significance difference in academic performance between male and female students in the experimental group. This difference is in favor of male students.

Hypothesis 3: There is no significant difference in the retention ability of the knowledge of Basic Science concepts between students taught using an activity-based method and those taught using the lecture method.

As in the case of Research-Question Three, the post-test scores derived from the two groups (Experimental and Control) were analysed and employed in addressing Research Hypothesis Three, as presented on Table 5.6.

Table 5.6: A comparative analysis of students' retentive ability in control and experimental and Groups

Groups	N	Mean	Std. Dev.	Df	t	P	Decision

Experimental	165	43.91	4.90497	328	9.621	.000	Significant
Control	165	39.82	2.40242				

*Source:*Statistical Package for the Social Studies (SPSS) output as Contained in Appendix W

From table 5.6 above, there is (t = 9.621; df = 328; and p = .000) is obtained. Since the p-value (.000) is less than the alpha value (.05), the null hypothesis is rejected and the alternate hypothesis is adopted. Therefore the researcher concludes that there is a significant difference in academic performance between experimental and control groups. This difference is in favour of the experimental group. This shows that those Basic Science students taught using an ABTM tend to achieve significantly higher scores than those taught using the traditional method. Hence the null hypothesis was rejected.

In table 5.6, the mean academic difference of 4.09 in the post-test scores of the two groups (experimental and control) constitutes quantified retention ability indices registered by the experimental group, when compared to the control group counterparts. These retention ability indices have cumulatively demonstrated that the experimental group recorded a higher academic performance with a mean score of 43.91 when compared to the control group with a mean academic performance score of 39.82. This means that Basic Science students taught using an ABTM tend to achieve higher academic results, including retention propensity, than those taught using the traditional lecture method.

As the ABTM endorses leaner-centredness, the experimental group students explored the assets intrinsic in this pedagogical design in registering higher retention ability in the learning of Basic Science concepts in junior secondary schools.

CHAPTER SIX

Discussion of Results

6.1 Introduction

The study investigated the impact of using an activity-based teaching method (ABTM) in learning Basic Science on students in junior secondary schools in Katsina Metropolis.

6.2 Discussion

The data for the study was derived from a post-test administered to students. These scores were analysed through the employment of t-test statistics at $p < 0.05$ significant levels.

The significant differences found between the two groups of learners were due to the use of an activity-based teaching method with the experimental group. If the treatment administered on the students had no impact on them, the two groups could have registered parity in performance. Since the experimental group performed significantly better than their counterparts, there is the implication that the use of an activity-based teaching strategy is very effective in the teaching and learning of Basic Science at junior secondary schools in Katsina Metropolis. As revealed on Tables 5.4 and 5.6, the p-value of 0.000 was less than p –value of 0.05 significant levels. Thus the two hypotheses involved were rejected. This development indicates that there is a significant difference in the academic performance of Basic Science students taught using the ABTM and those taught using traditional methods.

Binta (2014), conducted a research study on the influence of a cooperative teaching strategy on academic achievement of Basic Science Students in Soba, Kaduna State, Nigeria. Her findings revealed that the academic performance of students exposed to a lecture method of instruction was lower than those who were exposed to cooperative teaching strategy. Similarly, Azuka (2013) in her study of activity-based learning strategies in Mathematics classrooms found that students understood Mathematics concepts and registered higher retention rates when they actively participated in lessons.

She stressed that teachers should move away from the telling method and select strategies which will promote active learning in the classrooms.

Along similar lines Dawaki (2012), conducted research on the effects of an activity-based instructional strategy and the traditional method on the academic performance of students in Integrated Science in junior secondary schools in Kaduna North Local Government Area, Kaduna State, Nigeria. As in this current study, Dawaki employed a quasi-experimental research design, where pre-tests and post-test were administered to the population. His finding revealed that students who were exposed to an activity-based learning design performed better than their counterparts who were taught through the use of expository methods.

Similarly, Theodora (2011) conducted a research on the effects of group instructional strategy on students' performance in selected science concepts. His study revealed that those who were exposed to group instructional strategy performed better than those who were subjected to individual learning treatment: the below-average students exposed to group instructional strategy registered gain scores over what they had scored when they were not exposed to the method. This revealed that there was an improvement in their performance, hence they registered more understanding of science concepts.

The foregoing findings of Azuka (2013), Binta (2014), Dawaki (2012) and Theodora (2011) are in consonance with the revelation of Mundi (2006) who endorsed the superiority of the activity-teaching strategy as a method when compared to the use of the traditional "talk and chalk" method. Similarly, Nzewi (2008) submits that the use of an activity-based teaching strategy (ABTS) for Biology courses is associated with students' improvements in their academic achievement.

On the issue of gender in relation to academic performance in Basic Science, Table 5.6 demonstrates that male students registered better achievement than their female counterparts. This finding is in consonance with those who found the performance of male students to be better than those of the females. Ukwungwu (2002), observed a significantly superior achievement of boys over girls in school science. These results are

in conformity with the revelations of Shittu (2013) in his research on the effects of guided inquiry strategy on learning outcomes of low achieving senior secondary school Physics students.

Shittu (2013), maintains that there is a statistically significant difference in academic achievement between male and female physics students in the experimental group. He, however, reported that while statistically significant differences occur in favour of the experimental group, male students performed better than their female counterparts. However, a number of studies have reported better performance in scienceby female students than males.Obodo (1990), in his research on the differential effects of three teaching models on the performance of junior secondary schools students in some Algebraic concepts revealed that females performed better than males.

Ezeliora's (1994) studies on the role of science and technology education in rural Nigeria revealed the superiority of females over their male counterparts in academic performance in Science. Saleh (2017), in his research on the impact of an activity-based teaching strategy on students' academic achievement and anxiety in physics at senior secondary schools in Katsina Metropolis revealed that female students who were exposed to an activity-based teaching method (ABTM), like their male counterparts, performed better than these males academically. This finding is in keeping with those of Muhammad and Omer (2012) and those of Daluba (2012). These findings are also in consonance with that of Dahiru (2014) in his research on effects of collaborative learning on Chemistry students' academic achievement and anxiety level in balancing chemical equation in senior secondary schools in Katsina. Dahiru reported that there was a statistically significant difference between male and female students' academic achievement in the experimental group in favour of the females.

On the other hand, research by Tobais (2001) and Muhammad(2012) confirmed the prevalence of science anxiety amongst females and this is said to constitute a major barrier in terms of registering a high level of performance when compared to their male counterparts. Thus Tobais (2001), submitted that female students exhibited higher levels of science anxiety, and therefore displayed lower confidence in Mathematics than their male counterparts. This revelation confirmed the findings of Muhammad (2012) who

revealed that there was a significant difference in the anxiety level between male and female Physics students taught using an activity-based methodology (ABM) and those taught without an activity based method (ABM). From the analysis of male and female anxiety towards learning Chemistry, Kaula, Peter and Ndunge (2014) revealed that the female students showed significantly higher difference in anxiety towards the learning of Science in secondary schools than male students.

However, studies carried out by other researchers such as Moeller, Salmela-Aro, Lavonen and Schneider (2014) and Devine, Fawcett and Dowker (2012) suggested that previously identified gender differences in Mathematics and Science anxiety might be due to biases in the applied measures, and these have important theoretical and practical implications for the assessment and interpretations of gender differences in science classrooms. This means that gender differences that derive from anxiety may be due to factors such as the application of ideas and concepts. More so, Saleh (2017) in his study of the impact of activity-based teaching method on students' academic achievement and anxiety in Physics at senior secondary schools in Katsina Metropolis revealed that male students exposed to an activity-based teaching strategy have higher levels of anxiety in their mean scores than the female counterparts.

Furthermore, Buadi (2000) endorses that the influence of gender on students' achievement has for a long time been of concern to many researchers, but no consistent result has been established. He submits that the difference in gender, as it affects students and academic performance is inconclusive. Some studies on gender dimension in academic performance (Aluko, 2005; Abubakar & Dokubo, 2011) are of the view that gender does not affect the academic achievements of science students. Nonetheless, Muhammad (2013) reflects that research on gender differences with respect to academic performance is still not conclusive.

On the issue of the retention ability of knowledge of Basic Science concepts between students taught using an activity-based method and those taught using lecture methods, Table 5.6 reveals that the mean academic difference of 4.09 in the post-test scores of the experimental and control groups constitutes quantified retention ability indices registered by the experimental group when compared to the control group

counterparts. These retention ability indices have cumulatively demonstrated that the experimental group recorded higher academic performance in the mean score of 43.91 when compared to the control group, with a mean academic performance score of 39.82.

This development means that Basic Science students taught using an ABTM tend to achieve higher academic performance, including retention propensity, than those taught using the traditional teacher-centred lecture method. As the activity-based teaching method endorses learner-centredness, these experimental group students explored the assets intrinsic in this pedagogical design in registering higher retention ability in learning Basic Science concepts in secondary schools. These students were oriented to committing themselves to the assets in the constructivist theory which places emphasis on learning by doing. These students were introduced to adopting the 5E model intrinsic in ABTM developed by Bybee et al. (2006) whose five-phases model endorses the relevance of:- engagement, exploration, explanation, elaboration and evaluation. Thus the engagement phase enabled students to employ their prior knowledge to understand new concepts; the exploration phase enabled students to learn a variety of skills such as “making observations while performing task-activities”, “cooperation”, “respect for others’ viewpoints”, “tolerance”, and “group collection of data”. The teacher’s role essentially constitutes guiding students while the students are involved in constructing explanations as to what they have learnt. Students are also enabled to apply what they have already learnt to new situations and new topics.

The evaluation stage enables students to assess their understanding, strengths and abilities and they are provided with opportunities for interaction with the teacher and amongst themselves.

The exploration and employment of the ABTM endorses the need for subdividing students into small groups of five or six students: this design is tailored to committing students in any given lesson. The components enshrined in the ABTM are tailored to enhancing mastery and engendering retention of learned concepts and resources.

The advocates of the exploration and employment of an ABTM in the enhancement of academic learning by students in teaching-learning situations (Binta, 2014; Ukwungwu,

2002; Mundi, 2006; Bybee et al., 2006; Nzewi, 2008; Theodora, 2011; Dawaki, 2012; Azuka, 2013; Daluba, 2013; Muhammad, 2013; Dahiru, 2014; and Saleh, 2017) generally endorse that the ABTS generally enhances the mastery of learned materials and also engenders retention of learned resources by students.

6.3 Summary

This chapter provided the discussions of results. These results have generally endorsed the view about the potency and advantages of using an activity-based teaching methodology in teaching Basic Science amongst students in junior secondary school generally, not just in Katsina metropolis.

The chapter indicates that research revelations of Nigerian scholars and scientists have also confirmed the efficacy of the activity-based instructional methodology over the teacher-centred procedures in teaching Basic Science at junior secondary school.

The chapter that follows, summary of the findings. It also endorses and reflects on the various findings which have accrued as a result of the answers that were provided in respect of the research question and the result that were derived as a result of testing and analysis of the research hypothesis.

CHAPTER SEVEN

SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 INTRODUCTION

This study examined the impact of using an activity-based teaching method (ABTM) on students' performance in Basic Science in junior secondary schools in Katsina Metropolis. This chapter discusses a number of issues in terms of the following subject headings: summary of the study, summary of findings, conclusion, contribution to knowledge, limitation of the study, and suggestions for further studies.

7.2 Summary of findings

The purpose of this study was to determine whether the use of an activity-based instructional method (ABTM) in teaching Basic Science exerted any impact on improving students' academic performancein the learning of Basic Science.

Based on the data collected and analysed in the study, the findings can thus be summarized:

A major finding of this study disclosed that the use of the ABTM has a positive impact on students' academic performance towards studying and learning Basic Science in junior secondary schools in Katsina Metropolis. This is because the results of the findings revealed that there is a significant difference in the post-test mean scores obtained by students who were taught a variety of concepts in Basic Science (desertification, deforestation, ozone-layer depletion, soil erosion, flooding, bush burning and pollution) using an activity-based learning method, as compared to their counterparts who were taught the same content using the traditional teacher-centred methodology.

The finding also revealed that there was a significant difference in the post-test mean scores obtained between male and female Basic Science students exposed to the activity-based teaching method (ABTM), and this difference was in favour of male students. This was because the male students achieved significantly better mean scores than their female counterparts.

The findings also revealed that the teaching of Basic Science concepts using an activity-based teaching method (ABTM) promoted students' retention ability indices more significantly than when using the traditional teacher-centred methodology. This was because the students exposed to the activity-based teaching strategy registered higher mean scores towards studying and learning Basic Science concepts. Thus, the learner components intrinsic in activity-based teaching methods (ABTM) are more effective in fostering learning in Basic Science and therefore engendering the enhancement of students' retention ability indices in the subject.

The findings of the study also revealed that the application of the employment of the activity –based teaching strategy has a positive impact on students' academic performance/. This is because the result of the findings showed that there is a significant difference in the post-test scores obtained from students taught using the ABTM who performed significantly better than the control group taught through the traditional teacher-centred methodology. This implies that the activity-based teaching methods (ABTMs) have an impact on students' academic performance.

7.2.1 Research Question One:

What is the difference between the academic performance of students taught using an activity-based method and those taught using the lecture method?

Table 5.1 shows a mean difference of 4.09 in the post-test scores of the two groups (experimental and control). The experimental group recorded higher academic performance with a mean score of 43.91 than the control group counterparts with a mean academic performance of 39.81.

A summary of the first research question confirms that students in the experimental group who were exposed to the activity-based teaching method performed but than those in the control group who were only exposed to the teacher-centred traditional methodology.

7.2.2 Research Question Two:

Is there any difference between the academic performance of boys and girls when taught science concepts using an activity-based method?

Table 5.2 showed a mean difference of 3.55 between male and female students exposed to activity-based teaching methods (ABTM). The male students performed better than their female counterparts, having a higher score profile of 42.55 while the female students registered 39.00.

Research question two confirms that male students have generally performed better than their female counterparts in Basic Science in the selected schools.

7.2.3 Research Question Three:

What is the effect of activity-based methods on students' retention of science concepts at the junior secondary school level?

As the activity-based teaching method endorses learner-centredness, the experimental group students explored the assets intrinsic in this pedagogical design in registering higher retention ability in the learning of Basic Science concepts in junior secondary schools.

Research question three confirms that the students who formed part of theexperimental group have more retention ability in learning Basic Science than the students in the control group because the former were exposed to the activity-based teaching strategy.

7.2.4 Hypotheses 1: There is no significant difference in the academic performance of students taught Basic Science concepts using an activity-based teaching strategy and those taught using thelecture method.

This null hypothesis was tested with data collected from the two groups of Basic Science students (experimental and control). T-test independent sample statistics were used in comparing the performances of students in the experimental and control groups at 0.05 significance level. The summary of the findings is tabulated in Table 5.4.

By way of summary, hypothesis one reveals a significant difference between the experimental group when compared to the control group. This accounts for the rejection of this hypothesis and the acceptance of the alternative hypothesis that states “there is significant different in the academic performance of students taught basic science concepts using activity-based teaching strategy and those taught using lecture method”.

7.2.5 Hypothesis 2: There is no significant difference in the academic performance of male students and their female counterparts when taught Basic Science concepts using an activity-based teaching strategy.

In null hypothesis two, only students in the experimental group were exposed to an activity-based teaching method (ABTM). Therefore this hypothesis is tested with data collected from male and female students exposed to an activity-based teaching method so as to determine the impact of gender on the use of an ABTM. The finding is tabulated on Table 5.5.

By way of summary, male students have performed better than female students. This accounts for the rejection of the null hypothesis and therefore, the alternative hypothesis that states “there isa significant difference in the academic performance of male students and their female counterparts when taught Basic Science concepts using an activity-based teaching strategy” is accepted.

7.2.6 Hypothesis 3: There is no significance difference in the retention ability of the knowledge of Basic Science concepts between students taught using an activity-based method and those taught using the lecture method.

As in the case of Research-Question Three, the post-test scores derived from the two groups (experimental and control) were analysed and employed in addressing Research Hypothesis Three, as presented on Table 5.6.

This shows that the students that in the experimental group tend to display more retentive ability than the students in the control group. This development accounts for the rejection of the third hypothesis and the acceptance of the alternative hypothesis which states that “there isa significance difference in the retention ability of the knowledge of

Basic Science concepts between students taught using an activity-based method and those taught using the lecture method".

7.3 Implications for Science teacher training and professional development

The current trend in science education worldwide 'requires teachers to adopt learner-centredness as a pedagogical design in all teaching situations'. This style of classroom pedagogy should derive a good degree of its authenticity from laboratory support where the activity-centred teaching method must necessarily be adopted, in order to enhance 'the learners' successful mastery of science in science'.

The emphasis in current science teaching, as advanced by researchers and scholars all over the world, is that in the science classroom teachers are only expected to play the role of facilitator in science learning.

7.3.1 Limitations

There were a number of limitations to the study that have become a feature of this study. However, the generalisations made in respect of this study are, subject to the following limitations:

a) The study covered six aspects of Basic Science, if more or other aspects of basic science were taught or learned by students this could produce more data for improving teaching and learning of the subject.
b) The study was restricted to three junior secondary schools in Katsina Metropolis. It was considered that the scope of the generalisations made in the study was fairly narrow. Perhaps a wider coverage of schools in this study could furnish more comprehensive results.

The study was not exhaustive in the use of all the requisite resource materials needed for effective teaching of the selected topics in Basic Science.

7.3.2 Contributions of the study to knowledge

Based on the findings of the study, there are a number of contributions to the body of knowledge in the following dimensions:

Policy makers and curriculum planners in Nigeria could capitalise on the literature covered in this study to advocate and emphasise that the teaching and learning of science in secondary schools should be based on the use and exploration of activity-based teaching methods(ABTMs) as a pedagogical design.

The study established that the employment of an activity-based instructional strategy can help in improving the academic performance of students in Basic Science and consequently help in addressing the challenges of the failure rate of science students at the junior secondary school levels.

The study established that the use of ABTMs can help in improving the interest of students towards learning science, and as such science anxiety could be reduced among students.

The following model illustrates students carrying out activities to demonstrate the concepts of flooding and erosion by employing ABTM.

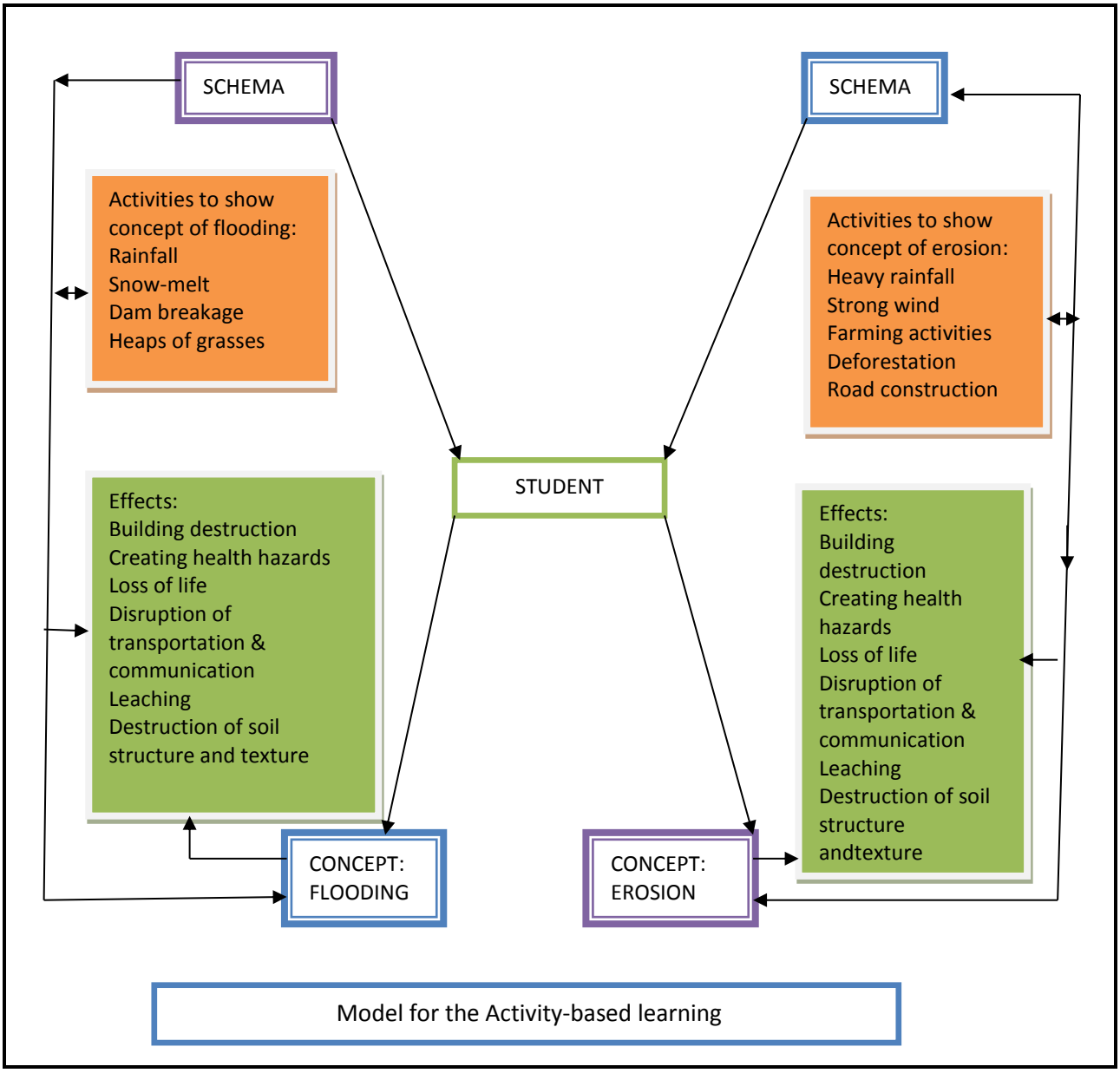


Figure 7:1 Model for Activity-Based Learning

Figure 7.1 above shows an activity based learning method. The method is rooted in the view that learners have the capacity to learn through personal actions and experiences. It is believed also that learners can interpret things according to their own thoughts and experiences. In other words, a child is capable of learning best by doing

and getting involved in a variety of experiments or activities. In this process such a learner is expected to gain the opportunity to think and solve problems on his/her own, using his/her abilities and skills.

The schema in the model plays an activating or facilitating role for effective students' participation in learning the concepts erosion and flooding. The rainfall, snow-melt, dam breaks and heaps of grasses are activities (natural or human-induced) that explain possible causes of flooding. The model also indicates the consequences of flooding to include those of building destruction, health hazards, loss of life, disruption of transportation and communications, leaching, and the destruction of soil structure and texture.

In the same vein, heavy rainfall, strong wind, farming activities, deforestation and road construction are natural and human-induced activities that cause erosion. The model also indicates the relationship between the causative factors and building destruction, health hazards, loss of life, disruption of transportation and communications, and the destruction of soil structure and texture (effects of erosion).

In this sense, the schemas as presented in the model are designed to create awareness and facilitate students' understanding of the factors responsible for flooding, erosion and their effects (concepts) in an area. The position of students in the model is, however, an indication that students in any teaching learning situation are at the centre and should be treated as such, particularly when an activity-based learning approach is applied.

7.4 Conclusion

This study investigates the impact of the use of activity-based teaching methods on students' achievement in Basic Science at junior secondary schools in Katsina Metropolis. From the findings of the study which were based on the statistical analysis of the data collected and presented in Chapter Four, some conclusions were drawn.

Firstly, the use of ABTMs was found to be more effective in enabling students achieve higher levels of performance in Basic Science than the use of the traditional teacher-centred methodology. In other words, the use of the activity-based teaching method (ABTM) has a significant impact on the academic performance of students in Basic Science. This revelation can be seen in the higher gain scores registered by students exposed to it.

Secondly, it was found in the situation where both male and female Basic Science students were exposed to an ABTM, the males performed significantly better than the females. This was because the results showed there was a significant difference in the academic performance between the two sexes in favour of the males.

Thirdly, it was found that the retention capacity indices of the Basic Science students exposed to an ABTM were higher than those of the students who were restricted to the traditional lecture methods. This can be seen from the mean scores obtained by students exposed to the activity-based teaching method (ABTM) and those exposed to the traditional method.

Finally, it was found that the retention capacity indices of females exposed to an activity-based teaching method (ABTM) were lower than those of their male counterparts. This can be seen from the mean scores they registered towards learning Basic Science.

7.5 Recommendations

Based on the findings obtained in the study, the following recommendations are made:

Teachers should ensure that they teach Basic Science with an ABTM because this method enhances students' academic performance.

There should be proper provision of facilities and equipment' which are necessary for the effective use of an ABTM. This is because Basic Science is best taught in well-equipped classrooms and science laboratories. Under these circumstance students learn Basic Science with more ease if taught through activities in the classrooms or laboratories.

In schools where large classes prevail, teacher should endeavor to sub-divide the students into smaller groups to conduct their practical activities. This arrangement could help students to participate fully during a practical lesson.

Teachers should ensure that female students participate actively during the teaching and learning process in order to reap the benefits of an ABTM. A number of researchers endorse that the use of this method reduces anxiety levels towards the learning of sciences.

Professionalism in teaching should be encouraged through the practice of organising in-service training, workshops, seminars and conferences for teachers so as to help them keep abreast of recent developments in the field of educational technology.

7.5.1 Suggestions for further studies

Although the employment of ABTMs has been proved to improve student performance in Basic Science, it is suggested that more research could be conducted to confirm the effectiveness of this method of classroom pedagogy. On this basis the following suggestion are made:

This study should be replicated with different teachers, in different school types and communities, and with various subjects to determine the extent to which this type of instructional design affects students' academic performance.

Further research should be conducted to determine why male students displayed a higher level of retention capacity indices than their female counterparts.

The researcher also recommends that investigations be executed in the use of other learner-centred instructional designs, such as discussion methods and discovery methods to determine their effects on student academic performance in Basic Sciences in comparison with the use of the traditional teacher-centred methods.

References

Abiola, O. (2007). *Procedures on educational research. Kaduna, Nigeria:* Hamiyam Publishers.

Abubakar, R. A. & Dukubu, O. O. (2011).*Age and gender as predicators of academic achievement of college mathematics and science students*. Paper presented at the international conference on teaching, Learning and change. Federal College of (Technical) Omeka: River State.

Adetula, L. O. (2000). Teaching to improve students' problem solving abilities*. African Mathematics Series*, 2(1), 139-144.

Adewumi, T. (2005). Relationship between gender and academic achievement in chemistry.Gobarau Journal of Education. Published by FCE Katsina 5(2), 119-123.

Adeyemo, P.O. (1998). *Principles of education and practice*s. Ado-Ekiti, Nigeria: Omolaye Standard Press

Ajibola, M. A. (2008). Innovations and curriculum development for basic education in Nigeria: policy challenges and priorities of practice and implementation, *Research Journal International Studies*, 8, 51-58.

Akinbobola, A. O., & Afolabi, F. B. (2009). Constructivist practices through guided discovery approach: The effect on students' cognitive achievements in Nigerian senior secondary school science students. *Bulgarian Journal of Science and Educational Policy*, 3, 130-134.

Akinbobola, A.O. (2011a). Visual, auditory and kinaesthetic learning styles and students' achievement in Nigerian senior secondary school physics.*IRCABJournal of Arts and Education,* 1 (1), 140 – 146.

Akinsola, M. K & Igwe, I. O. (2002).The relative effect of meta-cognitive strategy of framing on students' achievement in selected difficult concepts.*Journal of Science Association of Nigeria,* 37 (1 and 2), 42-50.

Akpan, G. E (1998), The effect of student income support on academic performance. *The Nigerian Journal of Economics and Social Studies*. 40 (2) 285, 293

Akpan, J. O. (2012). Effects of study habits mediation on senior secondary chemistry students' achievement and retention in electrolysis concepts in Giwa Education Zone of Kaduna State, Nigeria.

Aktamis, H. (2009). The effects of scientific creativity, science attitude and academic achievement.*Asia-Pacific Forum on Science Learning and Teaching* 9(1).4.

Akuma, N. (2011). Curriculum and the new teacher, *Nigeria Journal of Curriculum Studies,* 18(1), 19-24.

Alebiosu, K. A., and Ifamuyiwa, S. A. (2008).Perspectives in provision for science and technology education in Nigeria: The way forward, *Academic Leadership,Journal* 6 (4), 11.

Aluko, A.Y. (2005). Social factors underlying gender variations of school enrolment in Nigeria.*Ife Psychologia* 13(1), 74.

Amadola, U. (2012). Effect of practical work in physics on girls' performance, attitude change and skills acquisition in the form two-form three secondary schools' transition in Kenya.*Journal of Education*, 2 (2), 90-93.

Ameh, I.E, Daniel, N. P., &Akus, Y. (2007). *Research and methods in the social sciences*, Ankpa: Rowis Press.

Andersen, H. (1969). *Readings in science education for the secondary schools*. London: The Macmillan Company.

Atkins, J. (2010). Creating collaboration.*English Journal*, 99 (5).12-13.

Awotunde, P. O., & Ugodulunwa, C.A. (2004).*Research methods in education*. Jos: Fab Anieh (Nig)

Ayodele, S. T. (2010). Integrating environmental education into junior secondary science, In S.U. Udoh and G. O. Akpa (Eds.) *Environmental education for sustainable development*, pp, 217-228. Jos: Fab Education Books.

Azuka, B. F. (2013). Activity-based learning strategies in the mathematics classroom, *Journal of Education and Practice*, 4,(13), pp 8-14.

Barr, R. B. & Tagg, J. (1995).From teaching to learning: A new paradigm for undergraduate education. Change, 27 (6), 13-15.

Bello, S. A. (2001). Trends in science education and the future of science curriculum in Nigeria, *Journal, of STAN,* 2 (1), 75-95.

Bichi, S. S. (2006). Effect of gender in historically enriched curriculum on academic achievement in evolution concept among senior secondary school students in Kaduna State. *Journal of Education Research and Development*, (1), 20-23.

Binta, M.A. (2014). Influence of cooperative teaching strategy on academic achievement of students in oxidation reduction concept among secondary students in Soba Local Government area of Kaduna State, *Journal of Science Teachers Association of Nigeria*, 1, 173-175.

Bloom, B. S. (1986).*Taxonomy of educational objectives: 1: Cognitive Hand book domain.* New York: David McKay.

Botham, C. N. (1967). *Audio-visual aid for cooperative education and training*, Rome: FAO pp. 63-64

Brown, J. Lewis, R. & Harcleroad F. (1985).Audio visual instruction technology, media and methods (6thedn.) New-York: McGraw Hill,pp 112-113, 118-119.

Buadi, J.Y. (2000). *School and personality as correlates of students' attitudes to the school guidance services in secondary schools*. Ph.D. thesis unpublished, submitted to the Delta State University, Abraka, Nigeria.

Bybee, R. W., Taylor, J. A..Gardner, A., Powell, J. C., Westbrook, A. and Landes, N. (2006).*The BSCS 5E Instructional model: Origins and effectiveness*. Colorado Springs Co: Office of Science Educational National Institute of Health.

Christensen, T.K. (2003). Finding the balance: Constructivist pedagogy in a blended course*,Quarterly Review of Distance Education*, 4(3), 235-243.

Clark, T. M. (2002). A survey of the teaching of integrated science in Kaduna State, Nigeria, *Journal of STAN*, 18(1), 79-85.

Dabar, M., & Faize, F. (2011).*Effect of the availability and the use of instructionalmaterial on academic performance of students in Punjab(Pakistan).*Retrieved from http/www.eurojournals.com

Dahiru, S.Y. (2010).Falling standard of science education in Nigeria: A road map to re-engineering science education for employment and self productivity in Nigeria. *Journal of Academic Excellence*, (2), 2-4.

Dahiru, S.Y. (2014). Effect of collaborative learning on chemistry students' academic achievement and anxiety level in balancing chemical equations in secondary schools in Katsina Metropolis, *Journal of Education and Vocational Research, (*5), 43-45.

Dale, E. (1969). *Audio-visual methods in teaching* 3rd ed. New York: Holt, Rinehart and Winston, p. 108.

Daluba, N.E. (2013). Effect of demonstration method of teaching on students' achievement in agricultural science.*World Journal of Education*, (3), 1-2

Dawaki, J. H. (2012). *Effect of activity- based instructional strategy on the academic performance of students in integrated science in junior secondary school in Kaduna State*, M.Ed. thesis unpublished, submitted to the, Ahmadu Bello University Zaira, Nigeria.

Denzin, N.K., & Lincoln, Y.S. (2011).*Qualitative research* (4th edn.). Los Angeles: Sage.

Devine, A., Fawcett, K, and Dowker, A. (2012). Gender difference in mathematics anxiety and the relation to mathematics performance while controlling for testanxiety. Behavioural and Brain Functions. 8.(1).33-45. D0I 10.1186/1744.9081-8-33.

Dewey, J. (1938). *Democracy and education.*London: Macmillan Education

Dewey, J (1952). *Education today*. New York: Macmillan Publishing

Dike, V. W. (1993).*Library resources in education*, Enugu: ABIC Publishers.

Driver, R. (1986).Reconstructing the science curriculum. Paper presented at Annual Meeting of the AREA, San Francisco.

Esiobu, G.O., (2005). Gender issues in science and technology education development. In: Uvowi, U.M.O.(ed.). *Science and technology education development*, U.M.O. NERDC Press, pp: 137-156.

Ewers, P. (2001).*Why use activity-based learning in the young learner's classroom?* Retrieved from http://iconlineipleiria.pt/bitstream/10400.8/250/1/n 7art3.pdf.(Accessed 20 November 2004).

Ezekwe, I. (1995). Towards technological development in Nigeria.Country Africa Conference Lagos.

Ezeliora, B. (1994). The role of science and technology education in rural Nigeria. *APQEN Publication*. pp 101-113.

Fallon, E., Walsh, S. & Prendergast,T. (2013). An activity-based approach to the learning and teaching of research methods: Measuring student engagement and learning, *Irish Journal of Academic Practice*, (2), (1). Article 2

Faltham, A. K., Quinn, M. E.& Kessler, C. (1992).*Teaching science to English learners*, Grade 4-8 Washington, DC: National Clearing House for Bilingual Education.

Feden, P.D. (1994). About instructions: Powerful and new strategies worth, knowing. *Educational Horizon,* 73 (1), 121 – 140.

Federal Government of Nigeria (2004).*National Policy on Education*. Lagos: Federal Government Press.

Federal Republic of Nigeria (2008) *National Policy of Education*, (Revised).Lagos Federal Government Press.

Fradd, S.H.& Lee, O. (1995). Science for all: A promise or a pipe dream for bilingual students? *The Bilingual Research Journal,* 19 (2), 261 – 278.

Garba, H.M. (2012). *Effect of activity based method on academic performance and retention of senior secondary school students in ecology in Sabon Gari Zone, Kaduna State,* Nigeria. Postgraduate seminar series, Department of Science Education, Ahmadu Bello University, Zaria.

Godwin, D., Robert, L. B.,&Rene, M. (2015):-Breakdown of the brain's functional network, modulatory with awareness*. Proceedings of the National Academy of Sciences*. 2014466 Retrieved from http//doi.org/10.1073/pnas.1414466112.

Gopal, V.P. (2010).*Importance of audio-visual in teaching methodology*. India: Mathourastra.

Gottlieb, R. (2005). *Science: The struggle for livable education.* Cambridge: MA: MIT Press.

Gray, T. (1980*). Foundation for educational research*. New York: McGray Hill.

Hake, J. M. (1970). Parental attitudes towards primary education in Hausa community inNorthern Nigeria, *Zaira*: Gaskiya Press.

Hinarullam, A.I. (2002). Science education: A tool for national integration and unity. *The Education Journal* Vol. 2 No. 2 Federal College of Education, Kano.

Iqbal, S., & Tayyab, R. (2014.)Effect of activity-based teaching method in science.*International Journal of Management Science*. 2 (1), 39-41.

Isola, O.M., (2010). *Effects of standardized and improvised instructional materials in students' academic achievements in secondary school physics*. An unpublished M.Ed. thesis submitted to the, University of Ibadan.

Jadal, M. (2011). A Study of effectiveness of the audio-visual aids in teaching and learning of English at primary level in Z.P. Primary Schools of Solapur District *International Journal for Social Science*: 1(7), 10-14.

Jegede, O. & Okebukola, P. (1992).Differences in social-cultural environment perception associated with gender in science classrooms. *Journal of Research in Science Teaching*.26 (7), 637-647.

Jegede, O. (1984). *Primary integrated science teaching*, MacmillanPublishers. Ilupeju Lagos, Nigeria.

Johnson, D.W., Roger, T. J.& Karl, A. S. (2006).*Active learning: Cooperation in the college classroom*, (3rd edn). Edina MN: Interaction Book Company.

Kaka, M. O. (2007). Games assisted instructional materials. A strategy for enhancing students' achievement in integrated sciences.*Journal of Research in Curriculum and Teaching*. 2(1), 120-128.

Katherine, M. (2009). *Audio-visual materials, collection development policy*. University of Northern Iowa: Rod Library.

Kaula, A.S., Peter, J.O., & Ndeke, F.N., (2014). The relationship between anxiety levels and academic achievement among students in selected secondary Schools in Lang'ata District, Kenya. *Kenya Journal of Educational and Social Research.* 4(3),Doi: 10.5901/jesr.20144v4n3p403

Kieffer, R.&Cochran, L. (1955). *Manual of audio-visual techniques.*(2nd edn.). Englewood Cliffs, NJ: Prentice-Hall Inc.

Kinder, J. S. (1959). *Audio-visual materials and techniques*.(2nd edn.). New York: American Book Co.

Krapp, A. (2003). Interest and human development and educational psychological perspective.*British Journal of Educational Psychology*, Monograph Series II, Part 2, 57-84.

Krejcie, T. &Morgan, S.P. (1970*). Table of determining sample size for research activities.* New York: Holt.Rinehart and Winston.

Lederman, N. G. Lederman, J. S. & Antik, A. (2013).Nature of science and scientific inquiry as contexts for the learning of science and achievement of scientific literacy.*International Journal of Education in Mathematics, Science and Technology,* 1(3), 138-147

Mahoney, M. J. (2004). What is constructivism and why is it growing? *Journal of Contemporary Psychology*, 49, 360-363.

Mangal, S. (2008).*Teaching of social studies*. New Delhi: PHI Learning Private Limited.

Menaught, A. (2007). *Moving images and sound: Inclusive and accessible, Moving images Knowledge and access*: *The BUFVC Handbook, London:* British Universities Film and Video Council.

Mezieobi, K. A., Fubara, V. R. & Mebiobin, S. A. (2008). *Social studies in Nigeria teaching methods, instructional materials and resources*. Owerri, Nigeria: Acadabeak Publishers.

Mgbekem, S. J. A. (2004). Acquisition of science and technology education.A Pre-requisite for national development.*Journal of Education Studies*, 1, 8-11.

Millar, R. (2004).The role of practical work in the teaching and learning of science, *Paper prepared for the Committee: High School Science Laboratories. Role andVision,* Washington DC: National Academy of Sciences.

Moeller, J., Salmela-Aro, J., Lavonen, J. & Schneider, B. (2014). Does anxiety in science classrooms impair mathematics and science motivation? *International Journal of*

Gender Science and Technology. A paper presented at the 2nd Network gender and STEM conference in Berlin, Germany

Mokiwa, H. O. (2014). Exploring the teaching of Physical Science through inquiry.*International Journal of EducationalScience*, 7(1), 21-27.

Mokiwa, H. O. (2017). Reflections on teaching periodic table concepts: A case study of selected school in South Africa. *Eurasia Journal of Mathematics, Science & Technology Education*, 13(6), 1563-1573.

Muhammad, K., Niaz, M., Maqqsood, A., Faiza, S., and Sher, A. (2012). Impact of activity-based teaching on students' academic achievement in physics at secondary level, *Academic Research Journal*, 3, 146-147.

Muhammad, M.B., & Omer, A. (2012). Test anxiety amongst students of pure science and social science. *Journal of Research on Humanities and Social Science* 3, 31.

Muhammad, R. (2007). The under-representation of females in science, technology and mathematics: Implication for the universal basic education*. Proceedings of the 50th Anniversary Conference of the Science Teachers Association of Nigeria (STAN).*Ibadan: Heinemann, 87-92.

Muhammad, Z. (2013). *Effect of inquiry teaching on academic achievement of biology class.*Unpublished PGDE thesis submitted to the Bayero University of Kano,

Muhammed, R. (2000). An empirical investigation to determine the relative effectiveness of discovery, laboratory, and expository methods of teaching chemistry concepts.*Journal of Research in Chemistry Teaching*. 20(3), 201-203.

Mundi, N. E. (2006). The state of students' academic performancein secondary school agricultural science in Kogi State.*Teacher education journal (TEJ),* 12, 14-16.

Musa, B. (2002). *The laboratory teaching method for enhancing academic performance in chemistry among senior secondary school students.*An unpublished Master's degree thesis submitted to the Ahmadu Bello University, Zaria.

Natoli, C. (2011). *The importance of audio-visual materials in teaching and learning.* Retrieved on [Accessed 12 September, 2015] from www.helium.com/channel/224-early-childhood-ed.

Ndagi, M. (2002) *Educational research for students.*Zaira: Haytee Press and Publishing

Nelson, C. (2009). *Student-centred learning: Exploration in learning*. London: Brenda Hall.

Njoku, Z.C. (2005). Levels of chemistry practical skills acquired by senior secondary school students.*Nigerian Journal of Professional Teachers*, 2 (1) 29- 3.

Njoku, Z. C. (2007). Comparison of students' achievement the three categories of questions in SSCE practical chemistry examination. *Journal of the Science Teachers Association of Nigeria*, 42(1-2), 67-72

Noehl, J. (1981). Primary Science and national curriculum policy, *Journal of STAN,* 4(2), 53-64.

Nwagbo, C.R. (2006). Effects of two teaching methods in the achievements and attitudes of biology students of different levels of scientific literacy, *International Journal of Education Research*, 45. (3), 216-229

Nworgu, B. G. (1991) *Educational research: Basic issues and methodology*. Ibadan: Oluseyi Press

Nwosu, A. A. (2004).Teachers' awareness of creativity related behaviour in the science classroom, *Journal of Science Teachers' Association of Nigeria (STAN).* 39 (1-2), 22-30.

Nzewi, U.M. (2008).Practical approach to the effective teaching of ecological concepts for sustainable development.*Science Teachers' Association of Nigeria (STAN) Biology Panel Series*, 20, 1-6.

Obeka, S.S. (2009). *EPODEWALD and power simulation games of geography and environmental educatio*n. Zaria: ABU Press

Obodo, G. (1990*).The differential effects of three teaching models on the performance of junior secondary school students in some algebraic concepts. An* unpublished Ph.D thesis, submitted to the, University of Nigeria, Nsukka.

Obuchi, M. U. (2012).Students' perception towards functional science and technology education as the bedrock for sustainable development of UBE scheme of education in Zaria Educational Zones, *Postgraduate Seminar Series*, 1. (1), 288-293, Department of Science Education, Ahmadu Bello University, Zaria.

Ofoegbu, T.O. (2009). *Teaching and learning resources.*Curriculum Theory and Practice.(131-159) Abuja.

Okam, C.C. & Umar, F.H. (2007).Some curricular issues militating against social studies education in Nigeria: Overcoming the problem through an enlargement of teachers' capacity-assets in the subject. In: The challenges of teacher education in the 21st Century Nigeria (Book of Reading).Faculty of Education, University of Abuja, Nigeria.

Okam, C.C. (2009). Science methods. A Paper presented at the occasion of staff orientation at Umaru Musa Yar'adua University, Katsina, 11thNovember, 2009.

Okam, C. C. (2012).Curriculum implementation in university teaching. A paper presented during the occasion of academic staff orientation at Umaru Musa Yar'adua University, 5-11th November, 2012.

Okeke, R. J. (1995).*Effects of two educational technology media on the performance of Jss social studies students.*Unpublished Ph.D thesis. Department of Social Studies submitted to the, University of Nigeria, Nsukka.

Oladejo, J. A., Olawuyi, S. O., and Anjorin, T. D. (2011). Analysis of women participation in agricultural production in Egbelore Local Government Area of Osun State*, Nigeria International Journal of Agriculture Economic and Rural Development* 4 (1), 32-34

Olasihende, K.J. &Olatoye, R. A. (2014).A comparative study of public and private senior secondary school achievement, Katsina State. Nigeria. *Journal of Education and Social Research*, 4, 203-205.

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O., & Isola, O. M. (2011). Instructional materials and students' academic achievement in physics: Some policy implications*. European Journal of Humanities and Social Sciences*, 2(1), ISSN 2220-9425

Olatoye, R. A. & Agbatogun, A. A. (2014).Parental involvement as correlates of pupils' achievement in mathematics and science in Ogun State, Nigeria. *Educational Research and Review,* 14, 457-459.

Oludipe, D. (2011). Cases and solutions of the negative attitudes towards integrated science, *Journal of Science Education*, 2(1), 75-81.

Onasanya, S.A. & Omosewo, E.O. (2011).Effects of improvised and standard instructional materials on secondary school students' academic performance in physics in Ilorin, Nigeria*. Singapore Journal of Scientific Research*, 1(1), 68-76.

Onasanye, S. A., Adegbija, M.V., Olurin C.O & Daramola, F. O. (2008). Education reforms and assessment of teacher competence in instructional media technology use in junior secondary schools in Kwara State.In A.E. Lawal (Ed.) *Educational reforms in Nigeria: Present, past and future.* Lagos:Stirling-Hoden Publishers pp. 259-272.

Opatoye, J. A. (2010). Effect of diagnostic adaptive testing and numerical ability on secondary school students' performance on electro-chemistry.*Journal of Research in Curriculum and Teaching*, 5(1).16-20

Oyesola, G. O. (2014).*Criteria for selecting audio-visual materials in geography teaching, in post-primary institutions in Nigeria*.

Palinscar, A. (2005). *Social constructionist perspectives on teaching and learning,* In H. Daniels (Ed.)*An introduction to Vygotsky*. London: Rutledge.

Petress, K. (2008). What is meant by "activity learning" *Education*, 128, 566-569.

Prabha, H. (2011). *Effectiveness of activity-based learning methodology for elementary schools, Coimbatore, Tamil Nadu, India.Retrieved from*http://www.ssa.mnic.in/curr/Activities.A.htm*.*

Prasad, J. (2005*). Audio-visual education*, New Delhi: Kanishka Publishers.

Richmond, P.,Buesing, L. &Giugliano M. (2011).*Democratic population decisions result in robust policy-gradient learning: A parametic study*. PLOS ONE 6(5):e18539.doi:10.1371?journal.pone.0018539

Rillero, T. (1994).Quality improvements in elementary education through pedagogical innovations.*Journal of Indian Education*, 32(1), 296-300.

Rogers, C.R. (1969). *Freedom to learn: View of what education might become:* Columbus, OH: Charles E. Morrill

Sabiru, D. Y. (2011).Effectiveness of student-centered learning as a method for teaching chemistry concepts in senior secondary schools, UMYUK.*Journal of Educational Research*, 3(1), 177-182.

Salami, S.O. (1998).The influence of casual attribution, level of academic performance and gender on academic-related behavior of science students *Journal* Research in Education. 2.2 p. 66-67

Saleh, U.M. (2017). *Impact of activity-based teaching strategy on students' academic achievement and anxiety in physics at senior secondary schools in Katsina Metropolis.* An M.Ed. thesis, Dept of Education, submitted to the Umaru Musa Yar'adua University, Katsina.

Sampath, K. Pannneerselvam, A & Santhan, S. (1998). *Introduction to educational technology*.(4threvised Edn.).New Delhi Sterling Publishers.

Samreen, A., Sufiana & Malik, K. (2012).*Use of audio-visual aids for effective teaching of biology at secondary schools level education department.*National University of Modern Languages. Islamabad, Pakistan.

Sandra, M.I. & Doorsuur, A. (2013). The use of audio-visual materials in the teaching and learning processes in college of education in Benue State, Nigeria, Benue State University, Makurdi-Nigeria. *IOSR Journal Research and Method in Education.*1, 320-737.

Sani, U. T. (2015). Effects of cooperative learning strategy on senior secondary school students' performance in quantitative chemistry in Kebbi State, Nigeria. Nigeria International Communication, *Education, Language and Social Sciences,* 9(6), 34-41.

Selvi, M. S. (2007). *Audio visual aids in education*.Retrieved from http://nursingempower.blogsport.com/2007/10/audiovisualaidsineducation.html.

Shittu, S. (2013). *Effect of guided inquiry strategy on learning outcomes of low achieving secondary school in physics students in Kaduna Metropolis, Nigeria*. Unpublished M.Ed. thesis, submitted to the, Ahmadu Belo University, Zaria, Nigeria.

Shuaibu, B. (1993). *A survey of different methods of teaching science in selected secondary schools in Zaria and Environs.* An unpublished M.Ed. thesis, submitted to Ahmadu Bello University, Zaria.

Singh, Y. K. (2005). *Instructional technology in education*. New Delhi: Darya Ganj Publishers.

Singh, Y.K. (2008). *Teaching of social studies.*New Delhi. APH Publishing Corporation.

Tanner, D. & Tanner, L.M. (2008). *Curriculum development: Theory into practice*. (5th edn.). New York: Macmillan Publishing Co. Inc.

Tapsak, A. A. (2002). The relationship between anxiety toward mathematics and achievement in mathematics, *Journal of Research in Mathematics Education*, 30, 520-522.

Theodora, O. B. (2011). Effect of group instructional strategy on students' performance in selected physics concepts.*Journal of the African Educational Research Network,* 11, 70-71.

Tobias, S. (2001). Mathematics anxiety.*Journal of Social Work Education*, 29, 270-272.

Tracy, D.M. (1990).Toy-play behaviour, sex role orientation, spatial ability and science achievement, *Journal of Research in Science Teaching*, 27(7) 59-62.

Tuckman B.W. (1975) *Measuring educational outcomes*. New York. Harcourt Brace Hovawick Inc.

Ukeje, B. O. (1979). Means of evaluating job of teaching.*A paper presented at the annual conference of boards and commissions responsible for recruitment, promotion and discipline of teachers,* Awka, Nigeria.

Ukwungwu, J. O. (2002). Enhancing girls' acquisition of science process skills in coeducation Schools.*Journal of STAN,* 37(1&2), 55-59.

Usman, I. A. (2000).The relationship between students' performance in practical activities and their academic achievement in integrated science using NISTEP mode of teaching.Unpublished PhD. dissertation, Department of Education, submitted to the Ahmadu Bello University, Zaria.

Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes.*Cambridge, MA: Harvard University press.

Weather all, M. (1968), *Scientific method*. London: The English Universities Press.

Weaver, W. (1969), Science in modern society. In H. Anderson (ed.) *Readings in science education for the secondary school.*London: The Macmillan Company.

Woodward K (2014), *The big issues*: *social sciences*: (3rd edn.).London: Routledge

Woolman, D. C. (2001). Educational reconstruction and post-colonial curriculum development: A comparative study of four African countries. *International Education Journal*, 2(5), 27-46.

Yusuf, T.Y. (2003) *Chemistry teaching in Nigeria*, Zaria: Atoto Press

Yusuf G. 2007 – Repositioning school libraries in Nigeria.The catalyst for promoting reading habits among privacy and secondary school studies.

Zephe, N. (2001). Assessment and empowerment: Some critical questions. *Assessmentand Evaluation,* 26 (4), 293- 305.

APPENDIX A

BASIC SCIENCE ACHIEVEMENT TEST (BSAT)

Instruction: Please read the instructions carefully.

1. The achievement test consists of sixty (60) questions. The test is divided into six sections, namely:

Soil erosion;

Flooding;

Bush burnings;

Deforestation;

Desertification;

Ozone layer depletion

Pollution

2. Answer all questions.

3. Answer each question by ticking the correct to the option (a - e).

4. Do not waste time on any question. If you find any difficulty, go to the others and finish them before you come back to the difficult one(s).

5. Any answer with more than one tick will be marked wrong.

QUESTIONS:

1. Which of the following is responsible for soil erosion?

   (a) Overgrazing

   (b) Planting cover crops

   (c) Building of forest reserve

   (d) Flooding

   (d) Loss of lives

2. The following causes soil erosion except.....

(a) Rainfall intensity

(b) Afforestation

(c) Climate

(d) Lack of vegetation cover

(e) Soil structure and texture

3. Soil erosion can be controlled by the following except.....

(a) Deforestation

(b) Cover crop

(c) Maintaining organic matter.

(d) Mulching

(e) Terracing

4. The following are human activities that promote soil erosion except.....

(a) Deforestation

(b) Bush-burning

(c) Poor land management by man

(d) Strip cropping

(e) Overgrazing

5. Soil erosion can be controlled by all the following except.....

(a) Afforestation

(b) Planting of cover crops

(c) Regulation against overgrazing

(d) Enlightening people on the cause of erosion

(e) Overgrazing

6. Soil erosion involves the following except.....

(a) A good vegetative cover of the land

(b) Making ridges across slopes

(c) Pronounced tillage of the ground

(d) Overgrazing of the land

(e) Lack of vegetation cover of the soil

7. Good soil management involves the following except.....

(a) Maintenance of vegetation cover over the ground

(b) Exposure of the soil surface

(c) Continuous cropping of the soil

(d) Clearing and tilling of soil

(e) Overgrazing of the land

8. Soil erosion involves the following except.....

(a) Soil removal from sloping land

(b) Washing away of soil by water

(c) Sheet erosion

(d) Mulching the soil

(e) Terracing the soil

9. The following are agents of erosion except.....

(a) Mulching

(b) Wind

(c) Water

(d) Run-offs

(e) Glacier

10. Which of the following does not cause soil erosion…….

(a) Rainfall intensity

(b) Dry climate

(c) Lack of vegetation cover

(d) Sloppy land surfaces

(e) Effective land management

11. Weathering is the breaking down of rocks into smaller pieces that are finally changed into one of the following.....

(a) Soil surface

(b) Soil liquid

(c) Soil fertility

(d) Soil erosion

(e) Soil particles

12. Flood occurs through the following avenues except.....

(a) When there is too much water in the wrong place

(b) When the volume of water in a river or stream exceeds the capacity of the channel

(c) When a river bursts its banks and the water spills into the flood plains

(d) High tides and storms cause coastal floods

(e) Terracing

13. The activities of man that cannot cause flooding is.....

(a) Deforestation

(b) Poor farming practices

(c) Poor water management

(d) Population growth

(e) Snow melt

14. Flooding could be due to the following except.....

(a) Reclaiming land from the sea

(b) Poor water management

(c) Blocking channels of water flow

(d) Excessive rainfall

(e) Building reservoirs to hold excess water

15. Flooding can be prevented by the following except.....

(a) Clearing gutters

(b) Constructing rivers

(c) Construction of drainages

(d) Construction of dams

(e) Construction of houses

16. Flooding could be due to the following except.....

(a) Constructing of dams

(b) Obstruction of channels and canals with refuse

(c) Diversion of streams and rivers

(d) Building of reservoirs to hold excess water

(e) Construction of walls around rivers and streams to keep them from over flowing

17. The beneficial effects of flooding include the following except.....

(a) Change in habitat

(b) Creating of seasonal fresh-water

(c) Loss of lives

(d) Destruction of crops

(e) Loss of property

18. The harmful effects of flooding include the following except.....

(a) Excess water provided by flooding create swamps which are used in growing crops

(b) Floods can disturb transport by cutting off roads and railways

(c) Floods create stagnant waters which can harbour disease –causing organisms

(d) Flooding can create personal tragedies when people are swept

(e) Floods create large amounts of fast flowing water which can ruin crops and destroy agricultural lands

19. The following constitute human causes of flooding except.....

(a) Deforestation

(b) Poor farming practices

(c) Creating land for swamp rice cultivation

(d) Poor water management

(e) Increased population growth

20. The following constitute natural causes of flooding except.....

(a) High rainfall

(b) Relief

(c) Coastal flooding

(d) Population growth

(e) Poor water management

21. Practices that influence bush burning include the following except.....

(a) Dropping burning cigarettes in bushing areas

(b) Dropping burning matches on dry plants

(c) Bush burning pollutes the atmosphere

(d) People set fire to cut dry woods for making charcoals

(e) People set fire on bushes in order to hunt animals

22. The following are effects of bush burning except.....

(a) Loss of wild life

(b) Global warming

(c) Change in species composition

(d) Air pollution

(e) Afforestation

23. The following are measures for controlling bush burning except.....

(a) Building of forest reserve

(b) Designing of effective forest policy and legislation to control bush burning

(c) Instituting strong penalties in form of fines for offenders

(d) Provision of enlightenment and awareness campaigns on the harmful effects of bush burning

(e) Instituting effective firefighting services for pulling off fires.

24. Environmental damages of bush burning include the following except.....

(a) Loss of bodies of water

(b) Deforestation

(c) Pollution

(d) Afforestation

(e) Atmospheric change

25. An environment is best described as the following except.....

(a) The surrounding conditions, influences or forces by which living forms are influenced and modified in their growth and development

(b) Everything surrounding us

(c) All rivers and seas

(d) Non-living things around us

(e) Mountains and hills around us.

26. The atmosphere is described as one of the following.....

(a) A layer of solid around a planet

(b) A layer of gases around a planet

(c) A layer of liquid around a planet

(d) A layer of ozone layer

(e) A layer of hydrosphere

27. The following are components of the atmosphere except.....

(a) Nitrogen

(b) Oxygen

(c) Rare gases

(d) Calcium

(e) Argon

28. Environmental sustainability involves the following except.....

(a) Renewable resources

(b) Pollution control

(c) Creativity

(d) Non-renewable resources depletion that can be continued indefinitely

(e) Smoke

29. Environmental management involves the following except.....

(a) Comprehensiveness

(b) Systematic

(c) Planned programme

(d) Documented manner

(e) Non-systematic arrangement

30. The following are effects of environmental degradation except.....

(a) Deforestation

(b) Pollution

(c) Afforestation

(d) Climatic change

(e) Atmospheric change

31. Which of the following is not an effective way of environmental management.....

(a) To have organized structural programmes

(b) Well planned structures

(c) Systematic arrangement

(d) Well documented datas

(e) Physical change

32. The following are examples of environmental sustainability concepts except.....

(a) Pollution

(b) Creation

(c) Hazard

(d) Harvest

(e) Renewable resources.

33. Which of the following is amongst the effects of environmental mismanagement.....

(a) Global warming

(b) Loss of wildlife

(c) Pollution

(d) Aforestation

(e) Human health

34. The following are effects of environmental misuse except.....

(a) Pollution

(b) Global warming

(c) Ill –health

(d) Deforestation

(e) Population density

35. Which of the following is not a product of environmental mismanagement.....

(a) Famine

(b) Global warming

(c) Construction of terraces

(d) Filling erosion gullies

(e) Aforestation

36. Environmental management is best described as.....

(a) Controlling human impact and interaction with the environment in order to preserve natural resources

(b) Preventing plant interaction with the environment in order to promote economic importance

(c) To protect animals from diseases

(d) To influence humans to contribute in the environment

(e) To protect plants and animals from sunlight

37. Environmental sustainability is best described as.....

(a) A layer of grasses surrounding a plant

(b) The rate of harvesting and conserving non-renewable and renewable resources for prolonged and indefinite availability and usage

(c) Protecting plants and animals from harmful diseases

(d) The permanent decrease in biological productivity of dry land areas

(e) Protecting everything around us

38. The term environmental management refers to.....

(a) Deforestation of the forests around

(b) The management of the resources that most of us take for granted

(c) The art of planning and effectively organizing a productive structured system

(d) The removal of forests based on ecological recommendations

(e) The clearing of land in preparation for agricultural activities

39. What is ozone layer depletion.....

(a) The reduction of thin shield of mass that prevents the intensive ultra-violet rays of the sun from reaching the earth's surface

(b) The place where chemicals are exposed in the sky

(c) Measurement of environmental activities in the society

(d) Arrangement of the planets on the earth

(e) The place where the clouds are close to the earth

40. The following are functions of the ozone layer except.....

(a) Prevents the incidence of skin cancer amongst human beings and other organisms

(b) Shields the earth from the harmful ultra violet rays of the sun

(c) Absorbs the sun's ultra-violet radiations

(d) Protects all living things on the earth by absorbing harmful ultra-violet rays of the sun

(e) It comprises the major atmospheric gases, nitrogen, oxygen and argon

41. The earth's layer where the ozone is located is the.....

(a) Atmosphere

(b) Mesosphere

(c) Hydrosphere

(d) Stratosphere

42. Forests are of importance to human through the following ways with the exception of.....

(a) Provision of edible and medicinal plants

(b) Provision of timber

(c) Soil water conservation

(d) Produces rainfall

(e) Acts as windbreaks

43. Human activities that cause deforestation include the following with the exception of.....

(a) Cattle ranching

(b) Wood and paper production

(c) Agriculture

(d) Urbanization and road construction

(e) Soil conversation

44. The following constitute a number of adverse effects of deforestation with the exception of.....

(a) Erosion

(b) Loss of plants and animals

(c) Flooding and drought

(d) Breaking of water cycle

(e) Maintain air conversation

45. The following activities, except one of them can be carried out to conserve forests, namely.....

(a) Paper recycling

(b) Using other types of fuel

(c) Tree planting

(d) Legislation

(e) Hunting

46. Water pollution is dangerous to life in the following ways except for one of these.....

(a) It reduces the activities of organisms that depend on water

(b) It causes death of organisms as polluted water contains poisonous substances

(c) It can sustain and promotes the lives of some fishes

(d) It promotes health hazards since a number of water-borne diseases are harboured in polluted water

(e) Sporting activities such as swimming and diving may become difficult in polluted water

47. Water pollution may be controlled by any of the following devices with the exception of one of them.....

(a) Reduction of foul odours

(b) Making good soak-away pit

(c) Repairing of leakages in pipe borne waters

(d) Sweeping our rooms regularly

(e) Disposal of refuse regularly

48. Solid air pollutants include the following with the exception of one of them.....

(a) Carbon dioxide

(b) Photosynthesis

(c) Lead dust

(d) Sulphur dioxide

(e) Smoke

49. Which of these is not an effect of air pollution on human beings.....

(a) Foul odours

(b) Respiratory disorders

(c) Irritation of the eyes

(d) Asthma

(e) Typhoid

50. Which one of these is not a method of refuse control?

(a) Recycling of some disposed materials

(b) Government legislation against dumping of refuse in undesignated places

(c) Regularly controlled burning of refuse

(d) Sorting of refuse items into useful and non-useful materials

(e) Regulated dumping of refuse.

51. The following are definitions of a desert with the exception.....

(a) a dry land reclaimed from the sea

(b) a dry grassland

(c) a water-logged dry land

(d) a very sunny dry land

(e) a land with scanty or no vegetation

52. Which one of the following states is not threatened by desertification.....

(a) Sokoto

(b) Zamfara

(c) Kano

(d) Katsina

(e) Borno

53. Only one of the following constitutes a natural cause of desertification.....

(a) Deforestation

(b) Overgrazing by animals

(c) Absence of underground water

(d) Erosion of water

(e) The absence of rain for a long time

54. Only one of the following constitutes an artificial cause of desertification

(a) Water-piping

(b) Water –dredging

(c) Water-logging

(d) Water-regulation

(e) Overgrazing completely

55. The following human activities can cause desertification except.....

(a) Over cropping

(b) Over grazing

(c) Deforestation

(d) Bush burning

(e) Afforestation

56. Effects of desertification on the environment include the following except.....

(a) High soil erosion

(b) Loss of soil fertility

(c) Loss of plants and animals

(d) Reduced yield of crops

(e) Mulching

57. The following measures can be used to control and check desertification with exception of.....

(a) Reduced animal grazing

(b) Mulching

(c) Tree planting and afforestation

(d) Government regulation and policy towards land degradation

(e) Indiscriminate bush burning

58. Samples of government policies relevant to combating drought and desertification include the following with the exception of.....

(a) National Police on Education

(b) National Policy on Environment

(c) National Agricultural Policy

(d) National Conservation Strategy

(e) National Forestry Policy

59. The following factors can influence the destruction of the ozone layer with the exception of.....

(a) Basin irrigation

(b) Colder temperatures

(c) Aerosols and chlorine from large explosive volcanoes

(d) Human produced chemicals

(e) Human activities that lead to air pollution

60. The effects of depletion of the ozone layer can lead to the following with the exception of.....

(a) High blood pressure

(b) Skin cancer and eye cataracts

(c) Very damaging to plants and animals

(d) Destroys fish and planktons on which fish feed inside water

APPENDIX B

UNISA university of south africa

COLLEGE OF EDUCATION RESEARCH ETHICS REVIEW COMMITTEE

16 November 2016

Ref : **2016/11/16/57635080/08/MC**
Student : Mrs EU Agbenyeku
Student Number : 57635080

Dear Mrs Agbenyeku,

Decision: Approved

Researcher: Mrs EU Agbenyeku
Tel: +2781 377 09093
Email: eeeagbe@gmail.com

Supervisor: Dr HO Mokiwa
College of Education
Department of Science and Technology Education
Tel: +2712 429 6562
Email: mokiwho@unisa.ac.za

Proposal: "Using Activity-Based Method in Learning Science in Junior Secondary Schools in Katsina Metropolis, Katsina State, Nigeria"

Qualification: D Ed in Science and Technology Education

Thank you for the application for research ethics clearance by the College of Education Research Ethics Review Committee for the above mentioned research. Final approval is granted for the duration of the research.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the College of Education Research Ethics Review Committee on 16 November 2016.

The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the College of Education Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*

Note:

The reference number **2016/11/16/57635080/08/MC** *should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the College of Education RERC.*

Kind regards,

Dr M Claassens
CHAIRPERSON: CEDU RERC
mcdtc@netactive.co.za

Prof VI McKay
EXECUTIVE DEAN

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX C

The Director
Ministry of Education
Zonal Quality Assurance Office
Katsina, Katsina State
Nigeria.

10th October, 2016.

Dear Sir,

Letter for Permission to Conduct Research in eleven (11) Junior Secondary Schools in Katsina Metropolis

I, Elizabeth Umoh Agbenyeku student researcher, am doing research with Dr. HO Mokiwa, a senior lecturer in the Department of Science and Technology Education towards a doctoral degree at the University of South Africa.

The title of the study is "Using Activity Based Method in learning Science in Junior Secondary Schools in Katsina Metropolis, Katsina State, Nigeria".

The aim of the study is meant to increase the level of awareness among students in education regarding the efficacy of activity based approach for teaching and learning of Basic Science.

The study entails the use of activity based learning methodology in teaching Basic Science at Junior Secondary School level.

The benefit of this study is to help students to recognize their responsibilities in promoting and achieving mastery in learning.

The students shall take part in answering Basic Science Achievement Test of 20 objective questions which is selected from previous Junior Secondary Schools III examination question papers in Basic Science.

Students will also take part in group interview which will be video-taped by a field worker when the students are responding to the discussions.

Any information that is obtained in connection with this study and can be identified with the name of a student or the school will remain confidential.

Student participation in this study is voluntary and student may decline to participate or to withdraw from participation at anytime.

The foreseeable risk is from the stressful commitment of the students to learning.

The eleven (11) institutions selected for the study are as follows:-

1) Government Junior Secondary School KofarKaura, Katsina
2) Government Junior Secondary School KofarYandaka, Katsina
3) Government Junior Secondary School Kofar, Katsina
4) Government Junior Secondary School Batagarawa, Katsina
5) Government Junior Secondary School Natsinta, Katsina
6) Government Junior Secondary School Dandagoro, Katsina
7) Government College Katsina (Junior) Katsina
8) Government Junior Secondary School Kambarawa, Katsina
9) Government Junior Secondary School Dutsin Safe, Katsina
10) Family Support Junior Secondary School, Katsina
11) Katsina College Junior, Katsina.

I will come back to inform you of the final research finding.

I would be grateful if this letter will meet your approval, please.

Your Sincerely,

Elizabeth Umoh Agbenyeku
Chief Lecturer
Federal College of Education
Katsina.
GSM:- 08137709093
E-mail:- eeeagbe@gmail.com

APPENDIX D

Letter from Ministry of Education to the Principals

The Principal,
Katsina, Katsina State
Nigeria

3rd October, 2016

Dear Sir/Madam

RE: REQUEST TO CONDUCT RESEARCH IN ELEVEN (11) JUNIOR SECONDARY SCHOOLS IN KATSINA METROPOLIS

Mrs Elizabeth Umoh Agbenyeku is a Chief Lecturer with Federal College of Education Katsina, a student researcher, doing research with Dr. H.O Mokiwa a Senior Lecturer, in the Department of Science and Technology Education towards a doctoral degree at the University of South Africa.

The title of the research is "Using Activity Based Method in Learning Science in Junior Secondary School in Katsina Metropolis in Katsina, Katsina State, Nigeria".

Your School is among the eleven (11) selected schools to participate in the study.

The aim of the study is meant to increase the level of awareness among students and teachers in education regarding the efficacy of Activity Based approach for effective teaching and learning of Basic Science.

The benefit of the study is to help students to recognize their responsibility in promoting of effective learning of science.

Students shall take part in answering Basic Science Achievement Test of 20 objective questions which are selected from previous JSS III Examination Question papers in Basic Science.

Students will also take part in group interview which will be videoedtaped by the field workers when the students are responding to the discussions.

Any information that is obtained in connection with the study and can be identified with the name of a student or the school will remain confidential.

Student participation in the study is voluntary and the student may decline to participate or to withdraw from participation at anytime.

The foreseeable risk in the study will emanate from the stressful commitment of the student to learning.

If you have any questions regarding this study, please contact Mrs Elizabeth Umoh Agbenyeku on 08137709093 or e-mail at eeeagbe@gmail.com

Yours sincerely

AlhajiUmarAliyu
Director
Ministry of Education
Katsina.

APPENDIX E

Letter to Principals to Participate in an Interview

The Principal,
Junior Secondary School,
Katsina, Katsina State,
Nigeria.

10th October, 2016

Dear Sir/Madam

I am Elizabeth Umoh Agbenyeku from Federal College of Education, Katsina a research student, doing research with Dr. HO Mokiwa a senior lecturer in the Department of Science and Technology Education towards a doctoral degree at the University of South Africa. The title of the study is "Using Activity based method in Learning Science in Junior Secondary Schools" in Katsina Metropolis, Katsina State Nigeria.

I am inviting you to participate in this interview to have your views and opinions on activity based method in learning science in Junior Secondary Schools.

Your participation in this study is voluntary. It will involve an interview of approximately 45 minutes at your office and at the time convenient to you. You may decline to answer any of the interview questions if you so wish.

Furthermore, you may decide to withdraw from this study at any time without any negative consequences.

With your kind permission, the interview will be video taped to facilitate collection of accurate information and later transcribed for analysis. Shortly after the transcription has been completed, I will send a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or to clarify any points.

All information you provide is considered completely confidential. Your name and the name of the school will not appear in any publication resulting from this study and any identified information will be omitted from the report. However, with your permission, anonymous quotations may be used.

Data collected during this study will be retained on a password computer for 5years in my locked office. There are no known or anticipated risk to you as a participant in this study.

If you have questions regarding this study, or would like additional information to assist you in reaching a decision about participation please contact me on 08137709093 or by e-mail at eeeagbe@gmail.cm

I look forward to speaking with you very much and thank you in advance for your assistance in this project. If you accept my invitation to participate, I will request you to sign the consent form.

Yours Sincerely

Elizabeth Umoh Agbenyeku
Chief Lecturer
Federal College of Education

APPENDIX F (i)

Letter Requesting assent from learners in Junior Secondary School III to participate in Research Project

Title of Study:- "Using Activity Based Method in Learning Science in Junior Secondary Schools in Katsina Metropolis, Katsina State, Nigeria".

Dear Learner,

I am carrying out a study titled "Using Activity Based Method in learning science" as part of my study at the University of South Africa. Your principal has given me permission to do this study in your school. I would like to invite you to be a very special participant in my study. I am doing this study so that I can find ways to help you learn science better. This will help you and many other learners of your age in different schools.

This letter may explain to you what I would like you to do. There may be some words you are ignorant in this letter. You may ask me or any other adult to explain any of these words that you do not recognize or understand. You may take a copy of this letter home to think about my invitation and talk to your parents about this before you decide if you want to be in this study.

If you decide to be in this study I would ask you to answer 20 questions on Basic Science Achievement Test; you will be involved in focus group interview; (the group of 10 to 12 participants). Your answering of questions and discussion in the focus group will not take longer than 45 minutes.

I will write a report on the study but I will not use your name in the report or say anything that will let people know who you are. You do not have to be part of this study if you don't want to take part. If you choose to be in the study, you may stop taking part at any time. You may tell me if you do not wish to answer any of my questions. No one will blame or criticize you. When I am finished with my study, I shall return to your school to give a short talk about some of the helpful things I found out in my study. I shall invite you to come and listen to my talk.

If you decide to be part of my study, you will be asked to sign a form on the next page. If you have other questions about this study you can talk to me or you can have your parents or another adult to call me at 08137709093. Do not sign the form until you have all your questions answered and understand what I would like you to do.

Researcher …… phone Number…….....

Do not sign written assent form if you have any questions. Ask your questions first and ensure that someone answers those questions

WRITTEN ASSENT

I have read this letter which asks me to be part of a study at my school. I have understood the information about my study and I know what I will be asked to do. I am willing to be in the study.

…… ..…….…… ……

Leaner's Name (print): Learner's Signature: Date:

…… ..…….…… ……

Witness's Name (print): Witness's Signature: Date:

…… ..…….…… ……

Parent/guardian's Name (print): Parent/guardian's Signature: Date:

…… ..…….…… ……

Researcher's Name (print): Researcher's Signature: Date:

APPENDIX F (ii)

LETTER OF CONSENT TO PARTICIPANTS

Dear Participants,

I am a Chief Lecturer from the Federal College of Education, Katsina, Katsina State, a Research Student of University of South Africa (UNISA). My research topic is "Using Activity Based Method in learning Science in Junior Secondary School in Katsina Metropolis, Katsina, Katsina State, Nigeria". I would like to request your participation in this study.

The process will involve your completing a questionnaire which seeks your views and ideas about using activity based method in learning science in your school.

This will take about 20 minutes. Any information collected will be coded so that participants cannot be identified in any report about this research. If at any time you wish to withdraw from the study, you are free to do so.

Also any questions regarding this research can be directed to me or my supervisor through the following contacts:

1. Elizabeth Umoh Agbenyeku (Mrs)
   Federal College of Education, Katsina, Nigeria
   GSM: 08137709093
   E-Mail: eeeagbe@gmail.com

2. Dr. H.O Mokiwa (Supervisor)
   University of South Africa (UNISA)
   Department of Science and Technology
   Tel: 012 – 4296562
   E-mail: mokiwho@unisa.ac.za

Truly,

Elizabeth Umoh Agbenyeku (Mrs)

APPENDIX G

Focus Group Interview

Dear Respondents,

I am Elizabeth Umoh Agbenyeku from Federal College of Education, Katsina a research student, doing research with Dr. H.O Mokiwa, a Senior Lecturer in the Department of Science and Technology Education towards a doctoral degree at the University of South Africa.

The title of the study is “Using Activity Based Method in Learning Science” in Junior Secondary Schools in Katsina Metropolis, Katsina State, Nigeria”.

The study is to establish that the use of activity based methodology is more efficacious to making student work and perform better in science. The benefit is to increase the interest of the learners for effective work in science.

You are required to indicate your group, gender and school. All information obtained from this interview will be used for research purposes only and will remain confidential.

Your participation in this study is voluntary and you have the right to withdraw at any time without any penalty.

I will be grateful if you can respond to the following items.

Thank you.

SECTION A

Group.....

Gender:.....

No. of Respondents.....

School.....

SECTION B

Please respond to the following items:

1. What do you consider to be the term “erosion”
2. What is your opinion about the following causes of erosion:

a. Wind
b. Rainfall
c. Action of Man

3. In your own opinion, what are the adverse effect of erosion to the following:

   a. Food production

   b. Health

   c. Environment

   d. Transportation

   e. Attending to school

4. What measures do you think we can employ in checking erosion?
5. What is pollution in your own words?
6. What are the pollutants and their sources in your community?
7. What effect does pollution have on the environment?
8. What measures can you apply in checking the following:

   i. Air pollution

   ii. Water pollution

   iii. Land pollution

   iv. Noise pollution

9. How do you dispose of waste materials?
10. Are there any effects of indiscriminate refuse disposal?
11. What can be done to check indiscriminate refuse disposal?
12. What factors lead to land degradation?
13. What in your own opinion, are the effects of land degradation?

14. What are the proper ways of checking for land degradation?

15. How can the following contribute to the desertification?

    a) Weather/ climate
    b) Deforestation
    c) Soil erosion
    d) Drought

Thank you.

APPENDIX H

INTERVIEW SCHEDULE FOR TEACHERS

1. What will you do to establish and communicate:
   - Learning goals,
   - Track student progress, and
   - Celebrate success?

2. What will you do to help learners effectively interact with new knowledge?

3. What will you do to help learners practice and deepen their understanding of new knowledge in a Basic Science classroom.

4. What will you do to help learners generate and test hypotheses about new knowledge?

5. What will you do to engage Basic Science learners?

6. What will you do to establish or maintain Basic Science classroom rules and procedures?

7. What will you do to recognize and acknowledge adherence and lack of adherence to Basic Science classroom rules and procedures?

8. What will you do to establish and maintain effective relationships with Basic Science learners?

9. What will you do to communicate high expectations for all Basic Science learners?

10. What will you do to develop effective lessons organized into a cohesive unit?

APPENDIX I

OBSERVATION /CHECKLIST OF STUDENTS' PERFORMANCE IN ENVIRONMENTAL CONCEPTS

S.No	ITEMS	5	4	3	2	1
1	Observation techniques of Erosion and pollution					
2	Recording of environmental phenomenon					
3	Skills in comprehending Basic Environmental concept					
4	Skills in synthesizing differences in environmental phenomenon					
5	Retention rate in causes of land degradation					
6	Skills in evaluating the effect of land degradation on environment.					
7	Reporting skills					
8	Technique of Analysis to control pollution					
9	Skill in application of control measures of environmental degradation					

Key

5- Excellent

4- V. Good

3- Good

2- Fair

1- Poor

APPENDIX J

LESSON PLAN

EXPERIMENTAL GROUP: LESSON 1

Week;	One
Class:	JSS III
Average Age:	13 years
Teaching Method:	Questioning method and discovery method
Duration:	40 minutes
Sex:	Male and Female
Topic:	Soil Erosion: Causes, Types and Control.

Teaching Aids: Cardboard paper showing drawings of soil erosion sites, rill erosion sites, gully erosion sites, textbook showing differentiated erosion sites, and pictures of terraced site of erosion, reduction and prevention.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Identifying the causes of soil erosion.

Explain the types of erosion.

Suggest ways by which erosion can be checked and stopped.

Previous knowledge: Students were taught about some natural phenomena such as rain water, running – water, and air movement which can generate some force that can cause destruction in a given environment.

Introduction: The teacher introduces the lesson by asking students the following questions based on their previous knowledge:

Who has sensed the movement of wind?

Who has witnessed the force of running water?

Presentation: The teacher presents the lessons in terms of these steps:

Step One: The teacher presents the topics to students and explains that soil erosion is a form of environmental hazards. He reflects that erosion is the washing or blowing away of soil by water and wind. Teacher explains, the erosion becomes a problem when human activities cause it to occur much faster than under natural conditions.

Step Two: Teacher introduces the three types of erosion including sheet erosion, rill erosion, and gully erosion.

Step Three: Teacher explains that there are a number of ways of controlling and managing erosion, these ways are written down on the board including the following: cover cropping, maintaining organic matter matching, trees and grasses, planting, making ridges across slopes, terracing and reduced tillage.

Step Four: Teachers explains all the major concept and terms that have become associated with the lessons topic.

Step Five: Teacher assumes the role of a facilitator and refers to the various teaching aids featuring in the lesson. He interacts with the students in relationship with the respective teaching aids and resources materials. The meaning of the various concepts are identified in terms of these teaching aids and resources.

Step Six: Teacher – students' interactions are intensified while questions are entertained from students, and the teacher addresses and answers them.

Evaluation: Teacher evaluates the lesson by asking the following questions:

What is soil erosion?

Offer explanations for the types of erosion.

Identify the ways and meaning through which soil erosion can be controlled and checked?

LESSON PLAN

EXPERIEMNTAL GROUP: LESSON II

Week: Two

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussion

Duration: 40 minutes

Sex: Males and females

Topic: Flooding, definition of flooding, causes of flooding, effects of flooding, and prevention of flooding.

Teaching Aids: Cardboard paper showing drawings of flooded sites, textbooks displaying differentiated flooded sites and drawings of overflows of river banks.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Definition of flooding;

State the causes of flooding;

Discuss the effects of flooding;

Explain how flooding can be checked and prevented.

Previous Knowledge: Students were taught about some natural phenomena such as the occurrence of heavy rainfalls, which can generate large volumes of water, these large volumes of water can generate floods; these floods can burst the banks of rivers causing destruction.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have witnessed the occurrence of heavy down pours of rainfall?

How many of you have witnessed the force of flood waters by the banks of rivers?

Presentation: Teacher presents the lessons in terms of these steps.

Step One: Teacher presents the lesson to students by explaining that flood is an environmental hazard that occurs after a heavy rainfall. He explains that most floods occur when the volume of water in a river or stream exceeds the capacity of the channel. Teacher expatiates further that flooding also takes place along the banks of lakes and coastal shorelines.

Step Two: Teacher also introduces the two major causes of flooding, these include natural causes and human causes. The natural causes may not be controlled by humans, and they include: (a) high or heavy rainfall; (b) relief or areas; (c) coastal flooding; and (d) snow-melt. The teacher expatiates further that human causes of flooding include:

Desertification

Poor farming practices; and

Poor water management

Step Three: Teacher explains the effects of flooding, these effects may be classified into two, useful effects and harmful effects. He explains further that the useful effects of flooding include: (a) increment in soil fertility; (b) the creation of swamps which may be used in growing crops such as rice, bananas and plantains. Teacher expatiates that the harmful effects of flooding can be very dangerous. He lists them as follows: (a) disruption of transport and communication; (b) creating health hazards; (c) destruction of crops, buildings and properties; and (d) loss of human lives.

Step Four: Teacher explains that there are a number of ways of controlling and preventing flooding; these ways are written down on the chalkboard and they include the following:

(a) construction of dams; (b) construction of walls and embankments along river banks; (c) provision of canals and channels to drain off excess water (d) diversion of streams and rivers; (e) keeping channels and canals clean from refuse, and (f) planting of trees and building of reservoirs to hold excess water.

Step Five: Teacher explains all the major concepts and terms that are associated with the lesson topic.

Step Six: Teacher assumes the role of a facilitator and refers to the various teaching aids that have featured in the lesson. He interacts and discusses with the students in relationship with the respective teaching aids and resource materials. The meanings and relevance of the various concepts are identified in terms of these teaching aids and resources.

Step Seven: Teacher-student interactions and discussions are intensified while questions are entertained from students, and the teacher addresses and answers them.

Evaluation: Teacher evaluates the lesson by asking the following questions which students are expected to answer namely:

What is flooding?

Offer explanations for the different causes of flooding.

Examine some of the useful and harmful effects of flooding.

Identify the ways and means through which flooding can be controlled and checked.

LESSON PLAN

EXPERIMENTAL GROUP: LESSON III

Week: Three

Class: JSS III

Average Age: 13 years.

Teaching Methods: Questioning method, discovery methods and discussion.

Duration: 40 minutes

Sex: Males and females.

Topic: Bush burning; causes of bush burning, effects of bush burning; and prevention and control of bush burning.

Teaching Aids: Text books displaying bush burning sites, pictures and photographs displaying bush burning sites.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Stating the causes of bush burning.

Discuss the effects of bush burning.

Explain how bush burning can be checked and controlled.

Previous Knowledge: It was assumed that students had encountered a number of natural phenomena such as bush burning and forest fires was entertained that a good deal of these fires were often accidentally or deliberately hit by human beings.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have witnessed the occurrence of bush fires of forest fires?

How many of you can explain to us the effects of bush burning?

How many of you can explain to us how bush burning can be controlled and checked.

Presentation: The teacher presents the lessons in terms of these steps.

Step One: Teacher presents the lessons to students by explaining that bush burning constitutes a crude activity that farmers often use to clear vegetable to prepare land for cultivation. He expatiates that most bush burnings are often accidentally or deliberately lit by human beings. He elaborates further that bush burning can be a public nuisance because it can create damages as well as leading to pollution and other negative effects that are not helpful to human beings.

Step Two: Teacher also introduces a number of practices which influence bush burning. Teacher lists down some of these practices and activities which cause bush burning as follows: (a) dropping of burning cigarettes on dry grasses or plants; (b) use of fires of light off insects and harmful pests and ticks from animal houses by cattle raisers; (c) fires are also set on dry wood for making charcoals for raising money; and (d) hunters often set fires into bushes in order to kill bush animals.

Step Three: Teacher explains and summarizes the effects of bush burnings as follows: (a) destruction of plants in the area affected; (b) destruction of wild life; (c) destruction of soil nutrients; (d) increases the tendency of soil erosion in an area; (e) causes environmental pollution and creates risks of health hazards; (h) hampering of visibility and can constitute danger to airports; and (g) causes and destruction of human lives and property.

Step Four: Teacher explains that there are a number of ways of putting checked and control on bush burning practices; these devices are written down on the chalkboard as follows: (a) designing of effective forest policy and legislation for controlling bush burning; (b) setting up strong penalties for offenders; (c) setting- up enlightenment and awareness campaigns on the harmful effects of bush burning; (d) setting - up effective firefighting services; and (e) setting - up a task force or committee to ensure compliance with legislation.

Step Five: Teachers explains all the major concepts and terms that are associated with the lesson topic.

Step Six: Teacher assumes the role of a facilitator and refers to the various teaching aids that have featured in the lesson. He interacts and discusses with the students in

relationship with the respective teaching aids and resources. The meanings, relevance and implications of the various concepts are identified in terms of these teaching aids and resources.

Step Seven: Teacher-student interactions and discussions are intensified while questions are entertained from the students and the teacher addresses and answers them.

Evaluation: Teacher evaluates the lessons by asking the following questions while students are expected to answer them, namely:

Give reasons why people carryout bush burning.

Discuss human activities that can influence bush burning.

Discuss effects of bush burning.

Discuss the devices by which bush burning can be checked and controlled.

LESSON PLAN

EXPERIMENTAL GROUP: LESSON IV

Week: Four

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussions.

Duration: 40 minutes.

Sex: Males and females.

Topic: Deforestation: causes of deforestation, different effects of deforestation on plants and animals, control of deforestation including the use of regulatory measures against deforestation.

Teaching Aids: Textbooks displaying forest sites, pictures and photographs displaying forest sites; pictures and photograph showing deforested sites.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

List the causes of deforestation.

Discuss the different effects of deforestation on plants and animals.

Suggest ways and means of conserving forests to prevent deforestation.

Previous Knowledge: Students recognize the presence of vegetation covering the ground and soil naturally; they also recognize fully grown vegetation with big trees which make up forests; they also realize that forests are very important to human beings as they serve many useful purposes.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have seen forms of vegetation covering the ground or soil naturally?

How many of you have witnessed fully grown vegetation with big trees which make up forests?

Explain ways through which forests are important to human beings.

Presentation: Teacher presents the lesson in terms of the following steps.

Step One: Teacher presents the topic to students and explains that different forms of vegetation cover the soil naturally. He expatiates that fully grown vegetation with large or big trees make up forests. He explains further that these forests are very important to human beings because they serve many useful purposes. He elaborates that forests are often cleared for different reasons. He reflects that the process of removing the vegetation that covers the soil is called deforestation. Teacher warns that deforestation has a lot of bad effects on the environment, the soil, plants and animals. He also cautions that it has become necessary for us to learn how to conserve forests by preventing deforestation.

Step Two: Teacher introduces a number of causes of deforestation and lists them as follows: (a) logging for making planks; (b) provision for fuel and charcoal; (c) clearing for cattle ranching; (d) wood for paper production; (e) clearing of forests for agriculture; (f) clearing of forests for urbanization and road construction; (g) clearing of forests for industrialization; and (h) forest fires which are caused by human activities.

Step Three: Teacher explains a number of adverse effects of deforestation. He lists these effects on the chalkboard as follows: (a) soil erosion; (b) breaking of the water cycle; (c) loss of plants and animals; (d) adverse climatic changes; (e) flooding and drought; and (f) damaging of the environment, plants and animals.

Step Four: Teacher explains that there are a number of ways through which forests can be conserved; these ways are written as follows: (a) paper recycling for reducing the demand for lumber; (b) use of other types of fuel such as gas, kerosene and electricity; (c) use of awareness campaigns and education to spread information about dangers of deforestation; (d) formulation of policies and law through legislation that will control the destruction of forests; and (e) tree planting.

Step Five: Teacher explains all the major concepts and terms that have featured in the lesson topic.

Step Six: Teacher assumes the role of a facilitator and refers to the various teaching aids and features in the lesson. He interacts and discusses with students in relationship with the respective teaching aids and resource materials. The meanings and implications of the various terms and concepts are identified and discussed in terms of these teaching aids and resources.

Step Seven: Teacher-student interactions and discussions are intensified while questions are entertained from students; and the teacher addresses and answers them.

Evaluation: Teacher evaluates the lesson by asking the following questions:

What is deforestation?

List ten ways in which forests are useful to human beings.

State five causes of deforestation.

Describe five effects of deforestation on plants, animals and the environment.

State five ways by which forests can be conserved.

LESSON PLAN

EXPERIMENTAL GROUP: LESSON V

Week: Five

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussions.

Duration: 40 minutes

Sex: Males and females.

Topic: Desertification - causes of desertification, effects of desertification, and control of desertification.

Teaching Aids: Textbooks displaying desert sites, pictures and photographs displaying desert sites.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Define desertification.

Identify areas that are prone to desertification.

Describe the causes and human practices that lead to desertification.

Identify the effects of desertification.

Discuss the various methods for the control of desertification.

Previous Knowledge: Students are already familiar with the knowledge that some areas are referred to as deserts; they recognize that they are regions that have long periods of drought and scanty rainfall. Students also recognize that temperatures are very high during the day in these regions; these deserts areas usually have little or no vegetation.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

Define the concept of desertification.

Identify the geographical locations that are prone to desertification.

Describe the causes of desertification.

What human practices lead to desertification?

What are the effects of desertification?

Identify the various methods for controlling and checking desertification?

Presentation: Teacher presents the lesson in terms of the following steps.

Step One: Teacher presents the topic to students and explains that deserts are regions that have long periods of drought and scanty rainfall; he explains that temperatures in these areas are very high during the day. He explains further that the areas usually have little or no vegetation.

Teacher expatiates further that it is possible for grassland or dry lands to be converted into deserts through climatic changes through destructive human activities such as excessive resources and abusive land- use practices.

Step Two: Teacher introduces the lesson by locating the states in Nigeria that are prone to desertification. He itemizes these states as: Kebbi, Sokoto, Katsina, Yobe and Borno. The teacher locates these areas on a map of Nigeria. Teacher describes the characteristics of the areas as possessing the following: (a) low vegetation; (b) very few and scanty trees; (c) dry environment; and (d) very little rainfall.

Step Three: Teacher identifies the causes of desertification as follows: (a) drought conditions; (b) over cultivation; (b) over grazing; (d) deforestation; (e) construction and cutting of trees for firewood; (f) bush burning; and (g) poor irrigation practices.

Step Four: Teacher leads a discussion on the effects of desertification in terms of the following: (a) high soil erosion; (b) loss of soil fertility; (c) loss of plants and animals; (d) reduced yield of crops; and (e) reduced capacity of the area for human habitation and for animal husbandry.

Step Five: Teacher explains that there are number of ways of controlling and managing desertification; these devices are written down on the chalkboard as follows: (a) reduction

of number of animals that are grazing; (b) mulching; (c) tree planting and afforestation; (d) mobilization of the community in the task of afforestation; and (e) instituting government regulation and policy framework towards land degradation generally.

Step Six: Teacher explains all the major concepts and terms that have bearing on the lesson topic.

Step Seven: Teacher assumes the role of a facilitator and refers to the various teaching aids and resources featuring in the lesson. He interacts and discusses with students the relevance of the teaching aids and resources in reference to enhancing their mastery in respect of the issues raised in the lesson. The meanings and implications of the various concepts and terms identified in the lesson are explained in relationship to the various teachings aids and resources that were featured.

Step Eight: Teacher – student interactions and discussions on the issues at stake in the lesson are intensified which questions are entertained from students; and the teacher address and answers them.

Evaluation: Teacher evaluates the lesson by asking the following questions:

Define desertification

Identify geographical zones in Nigeria that are prone to desertification.

Describe the causes of desertification.

Examine human activities that lead to desertification.

Discuss the effects of desertification.

Identify the various devices for controlling and managing desertification.

LESSON PLAN

EXPERIMENTAL GROUP: LESSON VI

Week: Six

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussions.

Duration: 40 minutes.

Sex: Males and females.

Topic: Ozone layer depletion: description of the ozone layer; location of the ozone layer; importance of the ozone layer; hazards of the ozone layer, depletion to the environment, control measures against the depletion of the ozone layer.

Teaching Aids: Card board papers showing drawings of the layers of the atmosphere including the location of the ozone layer; textbooks showing the location of the ozone layer and the other adjoining locations of the other layers of the atmosphere

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Describing the ozone layer effectively.

Identifying where the ozone layer is located in the atmosphere.

Stating the importance of the ozone layer.

Stating the hazards of the depletion of the ozone to the environment.

Mentioning control measures against depletion of the ozone layer.

Previous Knowledge: Students have heard about the importance and usefulness of a number of gases such as oxygen, carbon dioxide and water vapour in a given

environment, they have also heard about the importance of the ozone. Students generally recognize that all these gases are located in the atmosphere; and they all perform important functions which human beings need in a given environment.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

What is the meaning of the ozone layer?

Where is the ozone layer located?

Describe the importance of the ozone layer.

Presentation: Teacher presents the lesson in terms of the following steps:

Step One: Teacher presents the topic to students and explains that the ozone layer is located high up in the atmosphere, between 20 and 50 kilometres above the earth's surface. The teacher explains that ozone plays a beneficial role in shielding living things from the sun's harmful ultraviolet radiations; it absorbs about 97 – 99% of the ultra-violet radiation of the sun.

Teacher elaborates further that the ozone plays an important role in the temperature regulation of the earth's atmosphere, making it conducive for human habitation.

Step Two: The teacher reflects that the ozone layer is continuously depleted by a variety of human activities. Teacher expatiates that these human activities lead to air pollution through the release of gases that destroy the quality of the atmosphere.

Teacher illustrates that the burning oil, coal, petroleum, wood, petrol releases large amounts of carbon dioxide and carbon monoxide. He reflects further that other industrial gas wastes include carbon dioxide and nitrous oxide, which also contribute in diminishing the ozone layer.

Step Three: Teacher explains a number of effects of the depletion of the ozone layer. He expounds that when the ozone layer is depleted, many effects of the depletion

emerge. More ultraviolet rays (UVR) of the sun can pass into the lower atmosphere where living things are found and cause a number of hazards include: (a) skin cancer, eye cataracts and immune suppression in both animals and humans (b) destruction of fish and planktons on which fish feed inside water; (c) it can cause poor plant growth and leaf development; (d) it cause damage to hard wood forests; and (e) bringing about reduction in food availability.

Teacher expatiates further that ozone depletion brings about global warming; this phenomenon increases the incidence of water-borne and infectious diseases.

Step Four: Teacher explains that the control measures for reducing the rate of depletion of the ozone layer bear on: reduction of air pollution by gases from burning fuel; chimneys and industries.

Teacher expatiates that there is need for the reduction of human-produced chemicals which are responsible for a large amount of ozone depletion.

Step Five: Teacher explains all the major concepts and terms that have featured in the lesson.

Step Six: Teacher assumes the role of a facilitator and refers to the teaching aids that featured in the lesson. He discusses with the students regarding the relationship of the teaching resources in reference to the issues at stake in the lesson. The meanings and implications of the various concepts and terms are identified in terms of the teaching aids and resources used in the lesson.

Step Seven: Teacher – student interaction and discussions are intensified while questions are entertained from students, and the teacher addresses and answers them.

Evaluation: Teacher evaluates the lesson by asking the following questions:

What is ozone layer?

Identify where the ozone layer is located in the atmosphere.

State the importance of ozone layer.

State the hazards of the depletion of the ozone layer to the environment.

Suggest control measures against depletion of the ozone layer.

LESSON PLAN

EXPERIMENTAL GROUP: LESSON VII

Week: Seven

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning methods, discovery method and discussions.

Duration: 40 minutes

Sex: Males and females

Topic: Environmental pollution (air and water) causes of air and water pollution and control of air and water pollution.

Teaching Aids: Textbooks displaying sites of polluted air and water.

Objectives: At the end of the lesson, students should be able to address and provide answer to the following:

Definition of air and water pollution;

Identification of air and water pollutants and their effects;

List causes of air and water pollution.

Explaining how air and water pollution can be controlled.

Previous Knowledge: Students are already aware that the environment constitutes our surroundings. Human beings engage in daily activities in their various environments. These activities require the use of water, air and land. Students recognize that air is an important component of the environment and that most living organisms need air for their survival.

Students are also aware that human beings are committed to a variety of activities such as cooking, washing, farming, transportation, manufacturing, building and many others; these activities require the use of large quantities of air and water. These activities often lead to the production of some waste products, which are discharged directly or indirectly into the environment. Students are also aware that these waste products could constitute pollutants and could lead to environmental pollution.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have had the occasion to see a polluted stream or river?

How many of you have witnessed polluted air, as happens when tires are being burnt?

Presentation: Teacher presents the lesson in terms of the following steps:

Step One: Teacher presents the lesson to students by explaining that the discharge of waste substances into the environment in quantities hat are harmful to human beings is called pollution.

Teacher further explains that these waste substances could be discharged both in the air and in the water.

Teacher expatiates that these waste substances, which cause the pollution, are called pollutants.

Teacher explains further that the increase in human activities in the environment have also led to increase in the production of pollutants both in the air and water.

Teacher expatiates that these waste substances, which causes the pollution, are called pollutants.

Teacher explains further that the increase in human activities in the environment have also led to increase in the production of pollutants both in the air and water.

Teacher warns that unless we use our knowledge to control pollution and pollutants, our environment may become dangerous for human beings.

Step Two: Teacher introduces the major causes of both water and air pollution. Teacher explains that water pollution.

Teacher explains that water pollution is caused through domestic wastes and industrial wastes.

Teacher lists the domestic wastes as follows: (a) soaps and detergent water which are thrown into water sources; (b) oils such as vegetable oil, kerosene, engine oil which are allowed to flow into sources of water supply; (c) refused dumps which are emptied into rivers; (d) dungs from animals which are washed by rain-water into rivers; and (e) human faces which may also be washed into rivers.

Teacher identified that industrial waste substances which may be channeled into source of water supply include: (a) acids; (b) soaps and detergents used for washing; (c) alcohol from breweries; oils such as crude oil, vegetable oil, engine oil and petrol may be spilled from industries into water sources; and (c) chemical compounds such as lead, sulphate, sulphuric acid, which constitute industrial waste may be washed into sources of water.

Teacher classifies air pollutants into two broad categories: (a) solid air pollutants and gaseous air pollutants. Teacher lists examples of solid air pollutants as: (a) wood particles; (b) dust particles; (c) rock particles; (d) lead dust; (e) smoke and soot.

Teacher lists the gaseous air particles and classifies them as follows: (a) ammonia; (b) carbon dioxide; (c) carbon monoxide; (d) sulphur dioxide; (e) nitrogen dioxide; (f) hydrogen sulphide; (f) insecticides; and (g) smoke

Step Three: Teacher explains the effects of both water pollution and air pollution. Teacher lists these effects as follows: (a) reduced activity of organisms which depend on live in water; (b) death of organisms; (c) prevention of sporting activities in rivers and streams; (d) health hazards; (e) pose adverse effects on the economy.

Teacher explains that the most common effect of air pollution is the irritation of the respiratory track and eyes.

Step Four: Teacher explains a number of ways of controlling water pollution as follows: (a) controlling of the discharge of both domestic and industrial waste substances; (b) waste substances must be properly disposed of so that they do not enter nearby streams or rivers.

With regard to control of air pollution, teacher explains that solid air pollutants can be controlled by: shielding the factories that produce them and preventing the particles from escaping into the open air.

Step Five: Teacher explains all the major concepts and terms that are established in the lesson topic.

Step Six: Teacher assumes the role of a facilitator and refers to the various teaching aids that have featured in the lesson. He interacts and discusses with the students in relationship with the respective teaching aids and resource materials. The meanings and relevance of the various concepts are identified in terms of these teaching materials and resources.

Step Seven: Teacher- student interaction and discussions are intensified while questions are entertained from students and the teacher addresses and answers them.

Evaluation: Teacher evaluates the lesson by asking the following questions which students are expected to address and answer namely:

Define water and air pollution.

Name six water pollutants.

Name four gaseous air pollutants

Explain the effects of water pollutant on:

i. the environment;
ii. human beings;
iii. the economy;

Discuss the effects of air pollutants on people.

State four ways of controlling air pollution.

Describe four measures that can be used in controlling water pollution.

APPENDIX K

LESSON PLAN

CONTROL GROUP: LESSON 1

Week;	One
Class:	JSS III
Average Age:	13 years
Teaching Method:	Questioning method
Duration:	40 minutes
Sex:	Male and Female
Topic:	Soil Erosion: Causes, Types and Control.
Teaching Aids:	Chalk board

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Identifying the causes of soil erosion.

Explain the types of erosion.

Suggest ways by which erosion can be checked and stopped.

Previous knowledge: Students were taught about some natural phenomena such as rain water, running – water, and air movement which can generate some force that can cause destruction in a given environment.

Introduction: The teacher introduces the lesson by asking students the following questions based on their previous knowledge:

Who has sensed the movement of wind?

Who has witnessed the force of running water?

Presentation: The teacher presents the lessons in terms of these steps:

Step One: The teacher presents the topics to students and explains that soil erosion is a form of environmental hazards. He reflects that erosion is the washing or blowing away of soil by water and wind. Teacher explains, the erosion becomes a problem when human activities cause it to occur much faster than under natural conditions.

Step Two: Teacher introduces the three types of erosion including sheet erosion, rill erosion, and gully erosion.

Step Three: Teacher explains that there are a number of ways of controlling and managing erosion, these ways are written down on the board including the following: cover cropping, maintaining organic matter matching, trees and grasses, planting, making ridges across slopes, terracing and reduced tillage.

Step Four: Teachers explains all the major concept and terms that have become associated with the lessons topic.

Evaluation: Teacher evaluates the lesson by asking the following questions:

What is soil erosion?

Offer explanations for the types of erosion.

Identify the ways and meaning through which soil erosion can be controlled and checked?

LESSON PLAN

CONTROL GROUP: LESSON II

Week: Two

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussion

Duration: 40 minutes

Sex: Males and females

Topic: Flooding, definition of flooding, causes of flooding, effects of flooding, and prevention of flooding.

Teaching Aids: Chalkboard.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Definition of flooding;

State the causes of flooding;

Discuss the effects of flooding;

Explain how flooding can be checked and prevented.

Previous Knowledge: Students were taught about some natural phenomena such as the occurrence of heavy rainfalls, which can generate large volumes of water, these large volumes of water can generate floods; these floods can burst the banks of rivers causing destruction.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have witnessed the occurrence of heavy down pours of rainfall?

How many of you have witnessed the force of flood waters by the banks of rivers?

Presentation: Teacher presents the lessons in terms of these steps.

Step One: Teacher presents the lesson to students by explaining that flood is an environmental hazard that occurs after a heavy rainfall. He explains that most floods occur when the volume of water in a river or stream exceeds the capacity of the channel. Teacher expatiates further that flooding also takes place along the banks of lakes and coastal shorelines.

Step Two: Teacher also introduces the two major causes of flooding; these include natural causes and human causes. The natural causes may not be controlled by humans, and they include: (a) high or heavy rainfall; (b) relief or areas; (c) coastal flooding; and (d) snow-melt. The teacher expatiates further that human causes of flooding include:

Desertification

Poor farming practices; and

Poor water management

Step Three: Teacher explains the effects of flooding, these effects may be classified into two, useful effects and harmful effects. He explains further that the useful effects of flooding include: (a) increment in soil fertility; (b) the creation of swamps which may be used in growing crops such as rice, bananas and plantains. Teacher expatiates that the harmful effects of flooding can be very dangerous. He lists them as follows: (a) disruption of transport and communication; (b) creating health hazards; (c) destruction of crops, buildings and properties; and (d) loss of human lives.

Step Four: Teacher explains that there are a number of ways of controlling and preventing flooding; these ways are written down on the chalkboard and they include the following: (a) construction of dams; (b) construction of walls and embankments along river banks; (c) provision of canals and channels to drain off excess water (d) diversion of streams and rivers; (e) keeping channels and canals clean from refuse, and (f) planting of trees and building of reservoirs to hold excess water.

Step Five: Teacher explains all the major concepts and terms that are associated with the lesson topic.

Evaluation: Teacher evaluates the lesson by asking the following questions which students are expected to answer namely:

What is flooding?

Offer explanations for the different causes of flooding.

Examine some of the useful and harmful effects of flooding.

Identify the ways and means through which flooding can be controlled and checked.

LESSON PLAN

CONTROL GROUP: LESSON III

Week: Three

Class: JSS III

Average Age: 13 years.

Teaching Methods: Questioning method, discovery methods and discussion.

Duration: 40 minutes

Sex: Males and females.

Topic: Bush burning; causes of bush burning, effects of bush burning; and prevention and control of bush burning.

Teaching Aids: Chalkboard.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Stating the causes of bush burning.

Discuss the effects of bush burning.

Explain how bush burning can be checked and controlled.

Previous Knowledge: It was assumed that students had encountered a number of natural phenomena such as bush burning and forest fires was entertained that a good deal of these fires were often accidentally or deliberately hit by human beings.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have witnessed the occurrence of bush fires of forest fires?

How many of you can explain to us the effects of bush burning?

How many of you can explain to us how bush burning can be controlled and checked.

Presentation: The teacher presents the lessons in terms of these steps.

Step One: Teacher presents the lessons to students by explaining that bush burning constitutes a crude activity that farmers often use to clear vegetable to prepare land for cultivation. He expatiates that most bush burnings are often accidentally or deliberately lit by human beings. He elaborates further that bush burning can be a public nuisance because it can create damages as well as leading to pollution and other negative effects that are not helpful to human beings.

Step Two: Teacher also introduces a number of practices which influence bush burning. Teacher lists down some of these practices and activities which cause bush burning as follows: (a) dropping of burning cigarettes on dry grasses or plants; (b) use of fires of light off insects and harmful pests and ticks from animal houses by cattle raisers; (c) fires are also set on dry wood for making charcoals for raising money; and (d) hunters often set fires into bushes in order to kill bush animals.

Step Three: Teacher explains and summarizes the effects of bush burnings as follows: (a) destruction of plants in the area affected; (b) destruction of wild life; (c) destruction of soil nutrients; (d) increases the tendency of soil erosion in an area; (e) causes environmental pollution and creates risks of health hazards; (h) hampering of visibility and can constitute danger to airports; and (g) causes and destruction of human lives and property.

Step Four: Teacher explains that there are a number of ways of putting checked and control on bush burning practices; these devices are written down on the chalkboard as follows: (a) designing of effective forest policy and legislation for controlling bush burning; (b) setting up strong penalties for offenders; (c) setting- up enlightenment and awareness campaigns on the harmful effects of bush burning; (d) setting – up effective firefighting services; and (e) setting – up a task force or committee to ensure compliance with legislation.

Step Five: Teachers explains all the major concepts and terms that are associated with the lesson topic.

Evaluation: Teacher evaluates the lessons by asking the following questions while students are expected to answer them, namely:

Give reasons why people carryout bush burning.

Discuss human activities that can influence bush burning.

Discuss effects of bush burning.

Discuss the devices by which bush burning can be checked and controlled.

LESSON PLAN

CONTROL GROUP: LESSON IV

Week: Four

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussions.

Duration: 40 minutes.

Sex: Males and females.

Topic: Deforestation: causes of deforestation, different effects of deforestation on plants and animals, control of deforestation including the use of regulatory measures against deforestation.

Teaching Aids: Chalkboard.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

List the causes of deforestation.

Discuss the different effects of deforestation on plants and animals.

Suggest ways and means of conserving forests to prevent deforestation.

Previous Knowledge: Students recognize the presence of vegetation covering the ground and soil naturally; they also recognize fully grown vegetation with big trees which make up forests; they also realize that forests are very important to human beings as they serve many useful purposes.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have seen forms of vegetation covering the ground or soil naturally?

How many of you have witnessed fully grown vegetation with big trees which make up forests?

Explain ways through which forests are important to human beings.

Presentation: Teacher presents the lesson in terms of the following steps.

Step One: Teacher presents the topic to students and explains that different forms of vegetation cover the soil naturally. He expatiates that fully grown vegetation with large or big trees make up forests. He explains further that these forests are very important to human beings because they serve many useful purposes. He elaborates that forests are often cleared for different reasons. He reflects that the process of removing the vegetation that covers the soil is called deforestation. Teacher warns that deforestation has a lot of bad effects on the environment, the soil, plants and animals. He also cautions that it has become necessary for us to learn how to conserve forests by preventing deforestation.

Step Two: Teacher introduces a number of causes of deforestation and lists them as follows: (a) logging for making planks; (b) provision for fuel and charcoal; (c) clearing for cattle ranching; (d) wood for paper production; (e) clearing of forests for agriculture; (f) clearing of forests for urbanization and road construction; (g) clearing of forests for industrialization; and (h) forest fires which are caused by human activities.

Step Three: Teacher explains a number of adverse effects of deforestation. He lists these effects on the chalkboard as follows: (a) soil erosion; (b) breaking of the water cycle; (c) loss of plants and animals; (d) adverse climatic changes; (e) flooding and drought; and (f) damaging of the environment, plants and animals.

Step Four: Teacher explains that there are a number of ways through which forests can be conserved; these ways are written as follows: (a) paper recycling for reducing the demand for lumber; (b) use of other types of fuel such as gas, kerosene and electricity; (c) use of awareness campaigns and education to spread information about dangers of deforestation; (d) formulation of policies and law through legislation that will control the destruction of forests; and (e) tree planting.

Step Five: Teacher explains all the major concepts and terms that have featured in the lesson topic.

Evaluation: Teacher evaluates the lesson by asking the following questions:

What is deforestation?

List ten ways in which forests are useful to human beings.

State five causes of deforestation.

Describe five effects of deforestation on plants, animals and the environment.

State five ways by which forests can be conserved.

LESSON PLAN

CONTROL GROUP: LESSON V

Week: Five

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussions.

Duration: 40 minutes

Sex: Males and females.

Topic: Desertification - causes of desertification, effects of desertification, and control of desertification.

Teaching Aids: Chalkboard.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Define desertification.

Identify areas that are prone to desertification.

Describe the causes and human practices that lead to desertification.

Identify the effects of desertification.

Discuss the various methods for the control of desertification.

Previous Knowledge: Students are already familiar with the knowledge that some areas are referred to as deserts, they recognize that they are regions that have long periods of drought and scanty rainfall. Students also recognize that temperatures are very high during the day in these regions; these desert areas usually have little or no vegetation.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

Define the concept of desertification.

Identify the geographical locations that are prone to desertification.

Describe the causes of desertification.

What human practices lead to desertification?

What are the effects of desertification?

Identify the various methods for controlling and checking desertification?

Presentation: Teacher presents the lesson in terms of the following steps.

Step One: Teacher presents the topic to students and explains that deserts are regions that have long periods of drought and scanty rainfall, he explains that temperatures in these areas are very high during the day. He explains further that the areas usually have little or no vegetation.

Teacher expatiates further that it is possible for grassland or dry lands to be converted into deserts through climatic changes through destructive human activities such as excessive resources and abusive land use practices.

Step Two: Teacher introduces the lesson by locating the states in Nigeria that are prone to desertification. He itemizes these states as: Kebbi, Sokoto, Katsina, Yobe and Borno. The teacher locates these areas on a map of Nigeria. Teachers describes the characteristics of the areas as possessing the following: (a) low vegetation; (b) very few and scanty trees; (c) dry environment; and (d) very little rainfall.

Step Three: Teacher identifies the causes of desertification as follows: (a) drought conditions; (b) over cultivation; (b) over grazing; (d) deforestation; (e) construction and cutting of trees for firewood; (f) bush burning; and (g) poor irrigation practices.

Step Four: Teacher leads a discussion on the effects of desertification in terms of the following: (a) high soil erosion; (b) loss of soil fertility; (c) loss of plants and animals; (d) reduced yield of crops; and (e) reduced capacity of the area for human habitation and for animal husbandry.

Step Five: Teacher explains that there are number of ways of controlling and managing desertification; these devices are written down on the chalkboard as follows: (a) reduction of number of animals that are grazing; (b) mulching; (c) tree planting and afforestation; (d) mobilization of the community in the task of afforestation; and (e) instituting government regulation and policy framework towards land degradation generally.

Step Six: Teacher explains all the major concepts and terms that have bearing on the lesson topic.

Evaluation: Teacher evaluates the lesson by asking the following questions:

Define desertification

Identify geographical zones in Nigeria that are prone to desertification.

Describe the causes of desertification.

Examine human activities that lead to desertification.

Discuss the effects of desertification.

Identify the various devices for controlling and managing desertification.

LESSON PLAN

CONTROL GROUP: LESSON VI

Week: Six

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning method, discovery method and discussions.

Duration: 40 minutes.

Sex: Males and females.

Topic: Ozone layer depletion: description of the ozone layer; location of the ozone layer; importance of the ozone layer; hazards of the ozone layer, depletion to the environment, and control measures against the depletion of the ozone layer.

Teaching Aids: Chalkboard.

Objectives: At the end of the lesson, students should be able to address and provide answers to the following:

Describing the ozone layer effectively.

Identifying where the ozone layer is located in the atmosphere.

Stating the importance of the ozone layer.

Stating the hazards of the depletion of the ozone to the environment.

Mentioning control measures against depletion of the ozone layer.

Previous Knowledge: Students have heard about the importance and usefulness of a number of gases such as oxygen, carbon dioxide and water vapour in a given environment, they have also heard about the importance of the ozone. Students generally recognize that all these gases are located in the atmosphere; and they all perform important functions which human beings need in a given environment.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

What is the meaning of the ozone layer?

Where is the ozone layer located?

Describe the importance of the ozone layer.

Presentation: Teacher presents the lesson in terms of the following steps:

Step One: Teacher presents the topic to students and explains that the ozone layer is located high up in the atmosphere, between 20 and 50 kilometers above the earth's surface. The teacher explains that ozone plays a beneficial role in shielding living things from the sun's harmful ultraviolet radiations; it absorbs about 97 – 99% of the ultra-violet radiation of the sun.

Teacher elaborates further that the ozone plays an important role in the temperature regulation of the earth's atmosphere, making it conducive for human habitation.

Step Two: The teacher reflects that the ozone layer is continuously depleted by a variety of human activities. Teacher expatiates that these human activities lead to air pollution through the release of gases that destroy the quality of the atmosphere.

Teacher illustrates that the burning oil, coal, petroleum, wood, petrol releases large amounts of carbon dioxide and carbon monoxide. He reflects further that other industrial gas wastes include carbon dioxide and nitrous oxide, which also contribute in diminishing the ozone layer.

Step Three: Teacher explains a number of effects of the depletion of the ozone layer. He expounds that when the ozone layer is depleted, many effects of the depletion emerge. More ultraviolet rays (UVR) of the sun can pass into the lower atmosphere where living things are found and cause a number of hazards include: (a) skin cancer, eye cataracts and immune suppression in both animals and humans (b) destruction of fish and planktons on which fish feed inside water; (c) it can cause poor plant growth and leaf development; (d) it cause damage to hard wood forests; and (e) bringing about reduction in food availability.

Teacher expatiates further that ozone depletion brings about global warming; this phenomenon increases the incidence of water-borne and infections diseases.

Step Four: Teacher explains that the control measures for reducing the rate of depletion of the ozone layer bear on: reduction of air pollution by gases from burning fuel; chimneys and industries.

Teacher expatiates that there is need for the reduction of human-produced chemicals which are responsible for a large amount of ozone depletion.

Step Five: Teacher explains all the major concepts and terms that have featured in the lesson.

Evaluation: Teacher evaluates the lesson by asking the following questions:

What is ozone layer?

Identify where the ozone layer is located in the atmosphere.

State the importance of ozone layer.

State the hazards of the depletion of the ozone layer to the environment.

Suggest control measures against depletion of the ozone layer.

LESSON PLAN

CONTROL GROUP: LESSON VII

Week: SEVEN

Class: JSS III

Average Age: 13 years

Teaching Methods: Questioning methods, discovery method and discussions.

Duration: 40 minutes

Sex: Males and females

Topic: Environmental pollution (air and water) causes of air and water pollution and control of air and water pollution.

Teaching Aids: Chalkboard.

Objectives: At the end of the lesson, students should be able to address and provide answer to the following:

Definition of air and water pollution;

Identification of air and water pollutants and their effects;

List causes of air and water pollution.

Explaining how air and water pollution can be controlled.

Previous Knowledge: Students are already aware that the environment constitutes our surroundings. Human beings engage in daily activities in their various environments. These activities require the use of water, air and land. Students recognize that air is an important component of the environment and that most living organisms need air for their survival.

Students are also aware that human beings are committed to a variety of activities such as cooking, washing, farming, transportation, manufacturing, building and many others; these activities require the use of large quantities of air and water. These activities often lead to the production of some waste products, which are discharged directly or indirectly into the environment. Students are also aware that these waste products could constitute pollutants and could lead to environmental pollution.

Introduction: Teacher introduces the lesson by asking students the following questions based on their previous knowledge:

How many of you have had the occasion to see a polluted stream or river?

How many of you have witnessed polluted air, as happens when tyres are being burnt?

Presentation: Teacher presents the lesson in terms of the following steps:

Step One: Teacher presents the lesson to students by explaining that the discharge of waste substances into the environment in quantities hat are harmful to human beings is called pollution.

Teacher further explains that these waste substances could be discharged both in the air and in the water.

Teacher expatiates that these waste substances, which cause the pollution, are called pollutants.

Teacher explains further that the increase in human activities in the environment have also led to increase in the production of pollutants both in the air and water.

Teacher expatiates that these waste substances, which causes the pollution, are called pollutants.

Teacher explains further that the increase in human activities in the environment have also led to increase in the production of pollutants both in the air and water.

Teacher warns that unless we use our knowledge to control pollution and pollutants, our environment may become dangerous for human beings.

Step Two: Teacher introduces the major causes of both water and air pollution. Teacher explains that water pollution.

Teacher explains that water pollution is caused through domestic wastes and industrial wastes.

Teacher lists the domestic wastes as follows: (a) soaps and detergent water which are thrown into water sources; (b) oils such as vegetable oil, kerosene, engine oil which are allowed to flow into sources of water supply; (c) refused dumps which are emptied into rivers; (d) dungs from animals which are washed by rain-water into rivers; and (e) human faeces which may also be washed into rivers.

Teacher identified that industrial waste substances which may be channelled into source of water supply include: (a) acids; (b) soaps and detergents used for washing; (c)

alcohol from breweries; oils such as crude oil, vegetable oil, engine oil and petrol may be spilled from industries into water sources; and (c) chemical compounds such as lead, sulphate, sulphuric acid, which constitute industrial waste may be washed into sources of water.

Teacher classifies air pollutants into two broad categories: (a) solid air pollutants and gaseous air pollutants. Teacher lists examples of solid air pollutants as: (a) wood particles; (b) dust particles; (c) rock particles; (d) lead dust; (e) smoke and soot.

Teacher lists the gaseous air particles and classifies them as follows: (a) ammonia; (b) carbon dioxide; (c) carbon monoxide; (d) sulphurdioxide; (e) nitrogen dioxide; (f) hydrogen sulphide; (f) insecticides; and (g) smoke

Step Three: Teacher explains the effects of both water pollution and air pollution. Teacher lists these effects as follows: (a) reduced activity of organisms which depend on live in water; (b) death of organisms; (c) prevention of sporting activities in rivers and streams; (d) health hazards; (e) pose adverse effects on the economy.

Teacher explains that the most common effect of air pollution is the irritation of the respiratory track and eyes.

Step Four: Teacher explains a number of ways of controlling water pollution as follows: (a) controlling of the discharge of both domestic and industrial waste substances; (b) waste substances must be properly disposed of so that they do not enter nearby streams or rivers.

With regard to control of air pollution, teacher explains that solid air pollutants can be controlled by: shielding the factories that produce them and preventing the particles from escaping into the open air.

Step Five: Teacher explains all the major concepts and terms that are established in the lesson topic.

Evaluation: Teacher evaluates the lesson by asking the following questions which students are expected to address and answer namely:

Define water and air pollution.

Name six water pollutants.

Name four gaseous air pollutants

Explain the effects of water pollutant on:

(i) the environment;
(ii) human beings;
(iii) the economy;

Discuss the effects of air pollutants on people.

State four ways of controlling air pollution.

Describe four measures that can be used in controlling water pollution.

APPENDIX L

EXPERIMENTAL GROUP: LESSON NOTE

LESSON I

WEEK ONE

SOIL EROSION

Soil erosion is a form of environmental hazard which washes or blows away soil by water and wind. It becomes a problem when human activities causes it to occur much faster than under natural conditions.

Types of Erosion

There are three types of erosion including sheet erosion, rill erosion and gully erosion.

Ways of controlling and managing erosion

These ways include the following: cover cropping, maintaining organic matter, including planting of trees and grasses, making ridges across slopes, terracing and reduced tillage.

EXPERIMENTAL GROUP: LESSON NOTES

LESSON II

WEEK TWO

FLOODING

Flooding is an environmental hazard that occurs after a heavy rainfall causing the volume of water in a river or stream to exceed the capacity of the channel. Flooding also takes places along the banks of lakes and coastal shorelines.

Major causes of flooding include natural causes and human causes. The natural causes may not be controlled by humans which include:

Heavy rainfall

Coastal flooding.

And snow-melt.

Human causes of flooding include:

(a) Desertification.

(b) Poor water management

(c) Poor farming practices.

EFFECTS OF FLOODING

Effect of flooding is classified into two: useful effects and harmful effects.

Useful effects of flooding include:

(a) Increment in soil fertility.

(b) The creation of swamps which may be used in growing crops such as rice, bananas and plantains.

Harmful effects of flooding include:

Creation of health hazards;

Destruction of crops, buildings and properties;

Loss of human lives;

Disruption of transport and communication.

Controlling preventing flooding:

(a) Construction of dams

(b) Constructions of wells and embankment along banks

(c) Provision of Canals and channels to drain off excess rivers;

(d) Diversion of streams and rivers;

Keeping channels and canals clean from refuse;

Planting of trees and building of reservoirs to hold excess water.

EXPERIMENTAL GROUP: LESSON NOTE

LESSON III

WEEK 3

BUSH BURNING

This is a crude activity that farmers use to clear vegetation to prepare land for cultivation.

Most bushes are often accidentally or deliberately lit by human beings. This is a public nuisance because it can create damage as well as leading to pollution and other negative effects that are not helpful to human beings.

Causes of bush burning include:

Dropping of burning cigarettes on dry grasses or plants.

Use of fires to fight off insects and harmful pests and ticks from animals houses by cattle raisers;

Fires are also set on dry wood for making charcoals for raising money;

Hunters often set fires into bushes in order to kill bush animals.

Effects of bush burning as follows:

Destruction of plants in the area affected;

Destruction of soil nutrients;

Destruction of wild life;

Increases the tendency of soil erosion in an area;

Causes environmental pollution and creates risks of health hazards;

Hampering of visibility and can constitute danger to airports; and

Causes destruction of human lives and property.

Checks and control on bush burning:

Designing of effective forest policy and legislation for controlling bush burning;

Setting up strong penalties for offenders;

Setting – up enlightenment and awareness campaigns on the harmful effects of bush burning;

Setting – up effective firefighting services; and

Setting- up a task force or committee to ensure compliance with legislation.

EXPERIMENTAL GROUP: LESSON NOTE

LESSON IV

WEEK 4

DEFORESTATION

Different forms of vegetation cover the soil naturally. Fully grown vegetation with large or big trees make up forests. These forest are very important to human beings because they serve many useful purposes.

Forest are often cleared for different reasons. The process of removing the vegetation that covers the soil is called deforestation. This has a lot of bad effects on the environments, the soil, plants and animals. It is therefore necessary for us to learn how to conserve forests by preventing deforestation.

Causes of deforestation includes:

Provision for fuel and charcoal;

Clearing for cattle ranching;

Wood for paper production;

Clearing of forest for agriculture;

Clearing of forest for urbanization;

Logging for making planks for furniture, making building etc.

Cleaning of forest for industrialization.

Adverse effects of deforestation includes:

Likely increase in occurrence of erosion;

Breaking of the water cycle;

Loss of plants and animals;

Adverse climatic changes;

Flooding and drought;

Damaging of the environment, plants and animals.

Conservation of forest includes:

Encourage tree planting and follow up to keep them alive.

Paper recycling for reducing the demand for timber;

Use of other types of fuel such as gas, kerosene and electricity;

Use of awareness campaigns and education to spread information about dangers of deforestation;

Formulation of policies and law through legislation that will control the destruction of forests.

EXPERIMENTAL GROUP: LESSON NOTE V

WEEK 5

DESERTIFICATION

Deserts are regions that have long periods of drought and scanty rainfall. Temperatures in these areas are very high during the day and they have little or no vegetation.

It is possible for grasslands or dry lands to be converted into deserts through climatic changes and through destructive human activities such as excessive resource use and abusive land-use practices.

States in Nigeria that are prone to desertification include Kebbi, Sokoto, Katsina, Yobe and Borno.

These areas possess:

Low vegetation;

Very few and scanty trees;

Dry environment;

Very little rainfall.

Causes of Desertification

Drought conditions;

Over cultivation;

Over grazing;

Deforestation;

Construction and cutting of trees for firewood;

Bush burning;

Poor irrigation practices.

Effects of Desertification

High soil erosion;

Loss of soil fertility;

Loss of plants and animals;

Reduced yield of crops;

Reduced capacity of the area for human habitation and animal husbandry.

Control and Management of Desertification

Reduction of the number of animals that are grazing;

Tree planting and afforestation;

Mobilization of the community in the task of afforestation;

Mulching;

Instituting government regulation and policy framework towards land degradation generally.

EXPERIMENTAL GROUP: LESSON NOTE VI

LESSON VI

WEEK 6

OZONE LAYER DEPLETION

The ozone layer is located high up in the atmosphere, between 20 and 50 kilometres above he earth's surface.

Ozone (03) plays a beneficial role in shielding living things from the suns, harmful ultraviolet rays, it absorbs about 97 – 99% of the ultra-violet radiation of the sun. The ozone plays an important role in the temperature regulation of the earth's atmosphere, making it conducive for human habitation.

The ozone layer is continuously depleted by a variety of human activities which lead to air pollution through the release of gases that destroy the quality of the atmosphere.

The burning of oil, coal, petroleum, wood, petrol releases large amounts of carbon (IV) oxide (CO2), carbon monoxide (CO), and nitrous oxide (NO) and industrial gas which also contribute in diminishing the ozone layer.

Effects of the Depletion of the Ozone Layer

This include: more ultra violet rays (UVR) of the sun can pass into the lower atmosphere where living things are found and cause a number of hazards including:

skin cancer, eye cataract and immune suppression in both animals and humans;

destruction of fish and planktons on which fish feed inside water;

it can cause poor plant growth and leaf development;

it cause damage to hard wood forests; and

brings about reduction in food availability. Ozone depletion brings about global warming; this phenomenon increases the incidence of water borne and infectious diseases.

Control measure include:

Reduction of air pollution by gases from burning fuel, chimneys and industries an also reduction of human produced chemicals which are responsible for a large amount of ozone depletion.

EXPERIMENTAL GROUP: LESSON NOTE VII

LESSON VII

WEEK 7

ENVIRONMENTAL POLLUTION (AIR AND WATER)

The discharge of waste substances into the environment in quantities that are harmful to human beings is called pollution. The waste substances which cause the pollution are called pollutants. The increase in human activities in the environment have also led to increase in the production of pollutants both in the air and water.

We should therefore use the knowledge we are acquiring to control pollutions, otherwise our environment may become dangerous for human beings.

Major causes of both water and air pollution

Water pollution: This is caused through domestic wastes and industrial wastes.

Domestic waste: include (a) soaps and detergent water which are thrown into water sources (b) oils such as vegetable oils, kerosene, engine oil which are allowed to flow into sources of water supply (c) refuse which are emptied into rivers; (d) animals dung which are washed by rain-water into rivers; and (e) human faeces which may also be washed into rivers.

Industrial waste: Industrial waste substances which may be channelled into sources of water supply including: (a) acids; (b) soap and detergents used for washing; (c) alcohol from breweries; oils such as crude oil and petrol may be spilled from industries into water sources and (d) chemical compounds such as lead, sulphate, sulphuric acid, which constitute industrial wastes may be washed into sources of water.

Air pollutants may be classified into (a) solid air pollutants and (b) gaseous air pollutants.

Examples of solid air pollutants are (a) wood particles; (b) dust particles; (c) rock particles; (d) lead dust; (e) smoke and soot.

Examples: Gaseous air particles: these include ammonia; (b) carbon (iv) oxide (CO_2) (NH_3), (c) carbon monoxide (CO) (d) sulphur-dioxide (SO_2) (e) Nitrogen dioxide (NO_2); (f) hydrogen sulphide (H_2S), (g) Insecticides and (h) smoke.

Effects of both water and air pollution:

Reduce activity of organisms which depend on live in water;

Cause death of organisms;

Prevention of sporting activities in rivers and streams.

Causes health hazards; and

Expose adverse effects on the economy.

The most common effect of air pollution is the irritation of the respiratory track and eyes.

Control of water (H_2) pollution: (a) Controlling the discharge of both domestic and industrial waste substances; (b) waste substances must be properly disposed of so that they do not enter nearby streams, lakes or rivers.

Control of Air Pollution

Solid air pollutants can be controlled by shielding the factories that produce them and preventing the particles from escaping into the open air.

APPENDIX M

CONTROL GROUP:LESSON NOTE

LESSON I

WEEK ONE

SOIL EROSION

Soil erosion is a form of environmental hazard which washes or blows away soil by water and wind. It becomes a problem when human activities causes it to occur much faster than under natural conditions.

Types of Erosion

There are three types of erosion including sheet erosion, rill erosion and gully erosion.

Ways of controlling and managing erosion

These ways include the following: cover cropping, maintaining organic matter, including planting of trees and grasses, making ridges across slopes, terracing and reduced tillage.

CONTROL GROUP: LESSON NOTES

LESSON II

WEEK TWO

FLOODING

Flooding is an environmental hazard that causes the volume of water capacity of the channel. Flooding also takes places along the banks of lakes and coastal shorelines.

Major causes of flooding include natural causes and human causes. The natural causes may not be controlled by humans which include:

Heavy rainfall

Coastal flooding.

And snow-melt.

Human causes of flooding include:

(a) Desertification.

(b) Poor water management

(c) Poor farming practices.

EFFECTS OF FLOODING

Effect of flooding is classified into two: useful effects and harmful effects.

Useful effects of flooding include:

(a) Increment in soil fertility.

(b) The creation of swamps which may be used in growing crops such as rice, bananas and plantains.

Harmful effects of flooding include:

Creation of health hazards;

Destruction of crops, buildings and properties;

Loss of human lives;

Disruption of transport and communication.

Keeping channels and canals clean from refuse;

Planting of trees and building of reservoirs to hold excess water.

CONTROL GROUP: LESSON NOTE

LESSON III

WEEK 3

BUSH BURNING

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Causes of bush burning include:

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Use of fires to fight off insects and harmful pests and ticks from animals houses by cattle raisers;

Fires are also set on dry wood for making charcoals for raising money;

Hunters often set fires into bushes in order to kill bush animals.

Effects of bush burning as follows:

Destruction of plants in the area affected;

Destruction of soil nutrients;

Destruction of wild life;

Increases the tendency of soil erosion in an area;

Causes environmental pollution and creates risks of health hazards;

Hampering of visibility and can constitute danger to airports; and

Causes destruction of human lives and property.

Checks and control on bush burning:

Designing of effective forest policy and legislation for controlling bush burning;

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Setting – up enlightenment and awareness campaigns on the harmful effects of bush burning;

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CONTROL GROUP: LESSON NOTE

LESSON IV

WEEK 4

DEFORESTATION

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Forest are often cleared for different reasons. The process of removing the vegetation that covers the soil is called deforestation. This has a lot of bad effects on the environments, the soil, plants and animals. It is therefore necessary for us to learn how to conserve forests by preventing deforestation.

Causes of deforestation includes:

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Clearing for cattle ranching;

Wood for paper production;

Clearing of forest for agriculture;

Clearing of forest for urbanization;

Logging for making planks for furniture, making building etc.

Cleaning of forest for industrialization.

Adverse effects of deforestation includes:

Likely increase in occurrence of erosion;

Breaking of the water cycle;

Loss of plants and animals;

Adverse climatic changes;

Flooding and drought;

Damaging of the environment, plants and animals.

Conservation of forest includes:

Encourage tree planting and follow up to keep them alive.

Paper recycling for reducing the demand for timber;

Use of other types of fuel such as gas, kerosene and electricity;

Use of awareness campaigns and education to spread information about dangers of deforestation;

Formulation of policies and law through legislation that will control the destruction of forests.

CONTROL GROUP: LESSON NOTE V

WEEK 5

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Drought conditions;

Over cultivation;

Over grazing;

Deforestation;

Construction and cutting of trees for firewood;

Bush burning;

Poor irrigation practices.

Effects of Desertification

High soil erosion;

Loss of soil fertility;

Loss of plants and animals;

Reduced yield of crops;

Reduced capacity of the area for human habitation and animal husbandry.

Control and Management of Desertification

Reduction of the number of animals that are grazing;

Tree planting and afforestation;

Mobilization of the community in the task of afforestation;

Mulching;

Instituting government regulation and policy framework towards land degradation generally.

CONTROL GROUP: LESSON NOTE VI

WEEK 6

OZONE LAYER DEPLETION

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The burning of oil, coal, petroleum, wood, petrol releases large amounts of carbon (IV) oxide (CO_2), carbon monoxide (CO), and nitrous oxide (NO) and industrial gas which also contribute in diminishing the ozone layer.

Effects of the Depletion of the Ozone Layer

This include: more ultra violet rays (UVR) of the sun can pass into the lower atmosphere where living things are found and cause a number of hazards including:

skin cancer, eye cataract and immune suppression in both animals and humans;

destruction of fish and planktons on which fish feed inside water;

it can cause poor plant growth and leaf development;

it cause damage to hard wood forests; and

brings about reduction in food availability. Ozone depletion brings about global warming; this phenomenon increases the incidence of water borne and infectious diseases.

Control measure include:

Reduction of air pollution by gases from burning fuel, chimneys and industries an also reduction of human produced chemicals which are responsible for a large amount of ozone depletion.

CONTROL GROUP: LESSON NOTE

LESSON 7

WEEK SEVEN

ENVIRONMENTAL POLLUTION (AIR AND WATER)

The discharge of waste substances into the environment in quantities that are harmful to human beings is called pollution. The waste substances which cause the pollution are called pollutants. The increase in human activities in the environment have also led to increase in the production of pollutants both in the air and water.

We should therefore use the knowledge we are acquiring to control pollutions, otherwise our environment may become dangerous for human beings.

Major causes of both water and air pollution

Water pollution: This is caused through domestic wastes and industrial wastes.

Domestic waste: include (a) soaps and detergent water which are thrown into water sources (b) oils such as vegetable oils, kerosene, engine oil which are allowed to flow into sources of water supply (c) refuse which are emptied into rivers; (d) animals dung which are washed by rain-water into rivers; and (e) human faeces which may also be washed into rivers.

Industrial waste: Industrial waste substances which may be channelled into sources of water supply including: (a) acids; (b) soap and detergents used for washing; (c) alcohol from breweries; oils such as crude oil and petrol may be spilled from industries into water sources and (d) chemical compounds such as lead, sulphate, sulphuric acid, which constitute industrial wastes may be washed into sources of water.

Air pollutants may be classified into (a) solid air pollutants and (b) gaseous air pollutants.

Examples of solid air pollutants are (a) wood particles; (b) dust particles; (c) rock particles; (d) lead dust; (e) smoke and soot.

Examples: Gaseous air particles: these include ammonia; (b) carbon (iv) oxide (CO_2) (NH_3), (c) carbon monoxide (CO) (d) sulphur-dioxide (SO_2) (e) Nitrogen dioxide (NO_2); (f) hydrogen sulphide (H_2S), (g) Insecticides and (h) smoke.

Effects of both water and air pollution:

Reduce activity of organisms which depend on live in water;

Cause death of organisms;

Prevention of sporting activities in rivers and streams.

Causes health hazards; and

Expose adverse effects on the economy.

The most common effect of air pollution is the irritation of the respiratory track and eyes.

Control of water (H_2) pollution: (a) Controlling the discharge of both domestic and industrial waste substances; (b) waste substances must be properly disposed of so that they do not enter nearby streams, lakes or rivers.

Control of Air Pollution

Solid air pollutants can be controlled by shielding the factories that produce them and preventing the particles from escaping into the open air.

APPENDIX N

Test and re-test of basic Science Achievement Test (BAST)

S/NO	TEST	RE-TEST	XY	X2	Y2
1	11	17	187	121	289
2	15	15	225	225	225
3	19	22	418	361	484
4	18	21	378	324	441
5	19	19	361	361	361
6	14	17	238	196	289
7	15	15	225	225	225
8	17	18	306	289	324
9	18	25	450	324	625
10	24	22	528	576	484
11	16	15	240	256	225
12	9	12	108	81	144
13	21	17	357	441	289
14	14	18	252	196	324
15	17	16	272	289	256
16	12	13	156	144	169
17	15	21	315	225	441
18	16	19	304	256	361
19	14	16	224	196	256
20	20	18	360	400	324
21	22	25	550	484	625
22	15	18	270	225	324
23	21	23	483	441	529
24	24	26	624	576	676
25	23	24	552	529	576
26	21	26	546	441	676
27	8	12	96	64	144
28	24	21	504	576	441
29	20	22	440	400	484
30	15	20	300	225	400
31	11	14	154	121	196
32	18	14	252	324	196
33	15	13	195	225	169
34	15	17	255	225	289

35	16	18	288	256	324
36	12	19	228	144	361
37	16	20	320	256	400
38	13	18	234	169	324
39	10	16	160	100	256
40	21	16	336	441	256
41	14	17	238	196	289
42	35	36	1260	1225	1296
43	28	28	784	784	784
44	19	17	323	361	289
45	18	20	360	324	400
46	12	15	180	144	225
47	28	29	812	784	841
48	16	21	336	256	441
49	13	19	247	169	361
50	11	12	132	121	144
TOTAL	858	952	17363	16072	19252

APPENDIX O (i)

PRE-TEST AND POST-TEST

EXPERIMENTAL GROUP ZONE A

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	17	29	28.33	48.33
2	18	26	30.00	43.33
3	13	20	21.67	33.33
4	17	25	28.33	41.67
5	18	30	30.00	50.00
6	23	24	38.33	40.00
7	16	27	26.67	45.00
8	18	30	30.00	50.00
9	20	20	33.33	33.33
10	16	34	26.67	56.67
11	17	28	28.33	46.67
12	17	30	28.33	50.00
13	20	24	33.33	40.00
14	18	32	30.00	53.33
15	10	25	16.67	41.67
16	14	22	23.33	36.67
17	14	26	23.33	43.33
18	17	27	28.33	45.00
19	18	35	30.00	58.33
20	31	35	51.67	58.33
21	11	18	18.33	30.00
22	13	24	21.67	40.00
23	20	30	33.33	50.00
24	13	19	21.67	31.67
25	14	24	23.33	40.00
26	33	40	55.00	66.67
27	18	22	30.00	36.67
28	16	21	26.67	35.00
29	16	23	26.67	38.33
30	13	32	21.67	53.33
31	13	26	21.67	43.33
32	10	26	16.67	43.33
33	7	29	11.67	48.33

34	10	16	16.67	26.67
35	14	27	23.33	45.00
36	11	23	18.33	38.33
37	13	19	21.67	31.67
38	17	19	28.33	31.67
39	9	21	15.00	35.00
40	17	17	28.33	28.33
41	13	20	21.67	33.33
42	11	23	18.33	38.33
43	11	20	18.33	33.33
44	16	27	26.67	45.00
45	13	21	21.67	35.00
46	13	15	21.67	25.00
47	16	25	26.67	41.67
48	13	32	21.67	53.33
49	4	21	6.67	35.00
50	27	39	45.00	65.00
51	14	24	23.33	40.00
52	13	11	21.67	18.33
53	15	21	25.00	35.00
54	15	30	25.00	50.00
55	12	27	20.00	45.00
TOTAL	846	1381	1,410.00	2,301.67

APPENDIX O (ii)

PRE-TEST AND POST-TEST

EXPERIMENTAL GROUP (ZONE B)

S/N	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	20	30	33.33	50.00
2	17	29	28.33	48.33
3	15	25	25.00	41.67
4	21	25	35.00	41.67
5	20	30	33.33	50.00
6	24	31	40.00	51.67
7	18	27	30.00	45.00
8	18	29	30.00	48.33
9	16	17	26.67	28.33
10	19	33	31.67	55.00
11	16	27	26.67	45.00
12	17	28	28.33	46.67
13	24	22	40.00	36.67
14	18	31	30.00	51.67
15	12	28	20.00	46.67
16	12	21	20.00	35.00
17	20	35	33.33	58.33
18	16	21	26.67	35.00
19	19	35	31.67	58.33
20	31	33	51.67	55.00
21	12	38	20.00	63.33
22	24	22	40.00	36.67
23	20	30	33.33	50.00
24	14	25	23.33	41.67
25	16	26	26.67	43.33
26	30	45	50.00	75.00
27	16	32	26.67	53.33
28	21	30	35.00	50.00
29	18	26	30.00	43.33
30	31	36	51.67	60.00
31	10	13	16.67	21.67
32	13	20	21.67	33.33
33	15	39	25.00	65.00

34	20	26	33.33	43.33
35	20	26	33.33	43.33
36	18	37	30.00	61.67
37	16	29	26.67	48.33
38	21	22	35.00	36.67
39	30	37	50.00	61.67
40	17	39	28.33	65.00
41	9	15	15.00	25.00
42	7	29	11.67	48.33
43	20	30	33.33	50.00
44	22	20	36.67	33.33
45	23	21	38.33	35.00
46	31	33	51.67	55.00
47	15	30	25.00	50.00
48	19	29	31.67	48.33
49	11	13	18.33	21.67
50	15	24	25.00	40.00
51	12	24	20.00	40.00
52	10	18	16.67	30.00
53	12	25	20.00	41.67
54	10	28	16.67	46.67
55	19	20	31.67	33.33
TOTAL	990	1,514	1,650.00	2,523.33

APPENDIX O (iii)

PRE-TEST AND POST-TEST

EXPERIMENTAL GROUPS: ZONE C

S/N	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	15	18	25.00	30.00
2	12	21	20.00	35.00
3	11	19	18.33	31.67
4	15	17	25.00	28.33
5	12	21	20.00	35.00
6	16	16	26.67	26.67
7	13	17	21.67	28.33
8	12	19	20.00	31.67
9	10	16	16.67	26.67
10	12	16	20.00	26.67
11	11	13	18.33	21.67
12	8	10	13.33	16.67
13	15	19	25.00	31.67
14	19	13	31.67	21.67
15	16	22	26.67	36.67
16	13	17	21.67	28.33
17	16	15	26.67	25.00
18	14	16	23.33	26.67
19	10	15	16.67	25.00
20	16	22	25.00	36.67
22	16	18	26.67	30.00
23	13	20	21.67	33.33
24	9	13	15.00	21.67
25	11	17	18.33	28.33
26	21	22	35.00	36.67
27	19	23	31.67	38.33
28	18	13	30.00	21.67
29	15	18	25.00	30.00
30	13	13	21.67	21.67
31	14	19	23.33	31.67
32	12	22	20.00	36.67
33	11	16	18.33	26.67
34	23	35	38.33	58.33

35	21	33	35.00	55.00
36	19	23	31.67	38.33
37	12	16	20.00	26.67
38	13	19	21.67	31.67
39	21	24	35.00	40.00
40	19	21	31.67	35.00
41	15	18	25.00	30.00
42	20	20	33.33	33.33
43	10	12	16.67	20.00
44	16	24	26.67	40.00
45	10	13	16.67	21.67
46	9	10	15.00	16.67
47	21	21	35.00	35.00
48	14	18	23.33	30.00
49	11	17	18.33	28.33
50	11	19	18.33	31.67
51	16	24	26.67	40.00
52	10	13	16.67	21.67
53	12	15	20.00	25.00
54	18	25	30.00	41.67
55	14	30	23.33	50.00
TOTAL	788	1025	1,313.33	1,708.33

APPENDIX P (i)

PRE-TEST AND POST-TEST

CONTROL GROUP ZONE A

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	14	20	23.33	33.33
2	16	19	26.67	31.67
3	13	16	21.67	26.67
4	20	22	33.33	36.67
5	13	14	21.67	23.33
6	10	18	16.67	30.00
7	7	7	11.67	11.67
8	11	12	18.33	20.00
9	14	21	23.33	35.00
10	13	16	21.67	26.67
11	12	19	20.00	31.67
12	16	15	26.67	25.00
13	17	19	28.33	31.67
14	20	25	33.33	41.67
15	17	20	28.33	33.33
16	13	17	21.67	28.33
17	11	16	18.33	26.67
18	22	22	36.67	36.67
19	14	14	23.33	23.33
20	11	15	18.33	25.00
21	14	11	23.33	18.33
22	16	12	26.67	20.00
23	12	10	20.00	16.67
24	21	22	35.00	36.67
25	16	24	26.67	40.00
26	17	15	28.33	25.00
27	20	20	33.33	33.33
28	14	17	23.33	28.33
29	17	19	28.33	31.67
30	11	15	18.33	25.00
31	23	25	38.33	41.67
32	11	11	18.33	18.33
33	20	22	33.33	36.67

34	14	15	23.33	25.00
35	17	27	28.33	45.00
36	21	22	35.00	36.67
37	31	35	51.67	58.33
38	21	23	35.00	38.33
39	13	22	21.67	36.67
40	17	17	28.33	28.33
41	17	17	28.33	28.33
42	14	20	23.33	33.33
43	18	18	30.00	30.00
44	16	17	26.67	28.33
45	14	17	23.33	28.33
46	26	30	43.33	50.00
47	11	14	18.33	23.33
48	28	30	46.67	50.00
49	33	35	55.00	58.33
50	13	24	21.67	40.00
51	17	24	28.33	40.00
52	8	15	13.33	25.00
53	14	18	23.33	30.00
54	17	22	28.33	36.67
55	13	13	21.67	21.67
TOTAL	889	1045	1,481.67	1,741.67

APPENDIX P (ii)

PRE-TEST AND POST-TEST

CONTROL GROUPS ZONE B

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	21	33	35.00	55.00
2	18	29	30.00	48.33
3	17	27	28.33	45.00
4	19	20	31.67	33.33
5	20	22	33.33	36.67
6	13	27	21.67	45.00
7	31	32	51.67	53.33
8	19	22	31.67	36.67
9	18	30	30.00	50.00
10	19	24	31.67	40.00
11	16	23	26.67	38.33
12	15	23	25.00	38.33
13	22	30	36.67	50.00
14	21	29	35.00	48.33
15	18	32	30.00	53.33
16	17	27	28.33	45.00
17	16	24	26.67	40.00
18	18	28	30.00	46.67
19	25	37	41.67	61.67
20	20	20	33.33	33.33
21	12	25	20.00	41.67
22	17	21	28.33	35.00
23	18	29	30.00	48.33
24	21	24	35.00	40.00
25	18	25	30.00	41.67
26	23	23	38.33	38.33
27	20	26	33.33	43.33
28	19	25	31.67	41.67
29	17	24	28.33	40.00
30	19	22	31.67	36.67
31	20	18	33.33	30.00
32	19	22	31.67	36.67
33	21	22	35.00	36.67

34	31	35	51.67	58.33
35	16	26	26.67	43.33
36	14	38	23.33	63.33
37	10	20	16.67	33.33
38	28	30	46.67	50.00
39	14	27	23.33	45.00
40	16	17	26.67	28.33
41	14	24	23.33	40.00
42	18	18	30.00	30.00
43	20	31	33.33	51.67
44	14	27	23.33	45.00
45	14	28	23.33	46.67
46	17	24	28.33	40.00
47	11	25	18.33	41.67
48	19	21	31.67	35.00
49	22	23	36.67	38.33
50	15	25	25.00	41.67
51	16	20	26.67	33.33
52	13	22	21.67	36.67
53	21	22	35.00	36.67
54	13	28	21.67	46.67
55	15	15	25.00	25.00
TOTAL	998	1391	1,663.33	2,318.33

APPENDIX P (iii)

PRE-TEST AND POST-TEST

CONTROL GROUP ZONE C

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	11	18	18.33	30.00
2	14	16	23.33	26.67
3	10	18	16.67	30.00
4	16	17	26.67	28.33
5	12	20	20.00	33.33
6	14	20	23.33	33.33
7	17	17	28.33	28.33
8	13	15	21.67	25.00
9	10	19	16.67	31.67
10	12	16	20.00	26.67
11	8	9	13.33	15.00
12	11	11	18.33	18.33
13	9	12	15.00	20.00
14	15	20	25.00	33.33
15	16	21	26.67	35.00
16	14	18	23.33	30.00
17	19	12	31.67	20.00
18	16	19	26.67	31.67
19	15	14	25.00	23.33
20	13	14	21.67	23.33
21	12	14	20.00	23.33
22	11	17	18.33	28.33
23	16	15	26.67	25.00
24	12	15	20.00	25.00
25	16	19	26.67	31.67
26	14	16	23.33	26.67
27	10	14	16.67	23.33
28	13	15	21.67	25.00
29	12	17	20.00	28.33
30	10	12	16.67	20.00
31	11	13	18.33	21.67
32	18	12	30.00	20.00
33	19	20	31.67	33.33

34	15	21	25.00	35.00
35	20	21	33.33	35.00
36	21	23	35.00	38.33
37	19	20	31.67	33.33
38	16	17	26.67	28.33
39	23	25	38.33	41.67
40	22	26	36.67	43.33
41	11	14	18.33	23.33
42	12	18	20.00	30.00
43	10	11	16.67	18.33
44	15	15	25.00	25.00
45	13	16	21.67	26.67
46	14	16	23.33	26.67
47	15	17	25.00	28.33
48	20	19	33.33	31.67
49	18	19	30.00	31.67
50	11	21	18.33	35.00
51	19	12	31.67	20.00
52	19	14	31.67	23.33
53	10	13	16.67	21.67
54	12	19	20.00	31.67
55	21	31	35.00	51.67
TOTAL	795	933	1,325.00	1,555.00

APPENDIX Q (i)

PRE-TEST AND POST-TEST

ZONE A: EXPERIMENTAL (GIRLS)

S/NO	PRE-TEST	POST -TEST	PRE-TEST %	POST-TEST %
1	17	29	28.33	48.33
2	18	26	30.00	43.33
3	17	25	28.33	41.67
4	18	30	30.00	50.00
5	23	24	38.33	40.00
6	16	27	26.67	45.00
7	20	20	33.33	33.33
8	16	34	26.67	56.67
9	17	28	28.33	46.67
10	17	30	28.33	50.00
11	20	24	33.33	40.00
12	18	32	30.00	53.33
13	10	25	16.67	41.67
14	14	22	23.33	36.67
15	14	26	23.33	43.33
16	17	27	28.33	45.00
17	31	35	51.67	58.33
18	20	30	33.33	50.00
19	13	19	21.67	31.67
20	14	24	23.33	40.00
21	33	40	55.00	66.67
22	18	22	30.00	36.67
23	16	23	26.67	38.33
24	13	32	21.67	53.33
25	14	24	23.33	40.00
26	13	11	21.67	18.33
27	15	21	25.00	35.00
28	15	30	25.00	50.00
TOTAL	487	740	811.67	1,233.33

APPENDIX Q (ii)

PRE-TEST AND POST-TEST

ZONE A: EXPERIMENTAL (BOYS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	13	20	21.67	33.33
2	18	30	30.00	50.00
3	18	35	30.00	58.33
4	11	18	18.33	30.00
5	13	24	21.67	40.00
6	16	21	26.67	35.00
7	13	26	21.67	43.33
8	10	26	16.67	43.33
9	7	29	11.67	48.33
10	10	16	16.67	26.67
11	14	27	23.33	45.00
12	11	23	18.33	38.33
13	13	19	21.67	31.67
14	17	19	28.33	31.67
15	9	21	15.00	35.00
16	17	17	28.33	28.33
17	13	20	21.67	33.33
18	11	23	18.33	38.33
19	11	20	18.33	33.33
20	16	27	26.67	45.00
21	13	21	21.67	35.00
22	13	15	21.67	25.00
23	16	25	26.67	41.67
24	13	32	21.67	53.33
25	4	21	6.67	35.00
26	27	39	45.00	65.00
27	12	27	20.00	45.00
TOTAL	359	641	598.33	1,068.33

APPENDIX R (i)

PRE- TEST AND POST TEST

ZONE B: EXPERIMENTAL GROUPS (GIRLS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	16	17	26.67	28.33
2	19	33	31.67	55.00
3	16	27	26.67	45.00
4	17	28	28.33	46.67
5	12	38	20.00	63.33
6	24	22	40.00	36.67
7	20	30	33.33	50.00
8	14	25	23.33	41.67
9	16	26	26.67	43.33
10	21	30	35.00	50.00
11	18	26	30.00	43.33
12	30	37	50.00	61.67
13	17	39	28.33	65.00
14	9	15	15.00	25.00
15	7	29	11.67	48.33
16	23	21	38.33	35.00
17	31	33	51.67	55.00
18	15	30	25.00	50.00
19	19	29	31.67	48.33
20	11	13	18.33	21.67
21	15	24	25.00	40.00
22	12	24	20.00	40.00
23	10	18	16.67	30.00
24	12	25	20.00	41.67
TOTAL	404	639	673.33	1,065.00

APPENDIX R (ii)

PRE-TEST AND POST-TEST

ZONE B: EXPERIMENTAL GROUPS (BOYS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	20	30	33.33	50.00
2	17	29	28.33	48.33
3	15	25	25.00	41.67
4	21	25	35.00	41.67
5	20	30	33.33	50.00
6	24	31	40.00	51.67
7	18	27	30.00	45.00
8	18	29	30.00	48.33
9	24	22	40.00	36.67
10	18	31	30.00	51.67
11	12	28	20.00	46.67
12	12	21	20.00	35.00
13	20	35	33.33	58.33
14	16	21	26.67	35.00
15	19	35	31.67	58.33
16	31	33	51.67	55.00
17	30	45	50.00	75.00
18	16	32	26.67	53.33
19	31	36	51.67	60.00
20	10	13	16.67	21.67
21	13	20	21.67	33.33
22	15	39	25.00	65.00
23	20	26	33.33	43.33
24	20	26	33.33	43.33
25	18	37	30.00	61.67
26	16	29	26.67	48.33
27	21	22	35.00	36.67
28	20	30	33.33	50.00
29	22	20	36.67	33.33
30	10	28	16.67	46.67
31	19	20	31.67	33.33
TOTAL	586	875	976.67	1,458.33

APPENDIX S (i)

PRE- TEST AND POST-TEST

ZONE C: EXPERIMENTAL GROUPS (GIRLS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	15	18	25.00	30.00
2	12	21	20.00	35.00
3	11	19	18.33	31.67
4	15	17	25.00	28.33
5	12	21	20.00	35.00
6	16	16	26.67	26.67
7	13	17	21.67	28.33
8	12	19	20.00	31.67
9	10	16	16.67	26.67
10	12	16	20.00	26.67
11	11	13	18.33	21.67
12	8	10	13.33	16.67
13	15	19	25.00	31.67
14	19	13	31.67	21.67
15	16	22	26.67	36.67
16	13	17	21.67	28.33
17	16	15	26.67	25.00
18	14	16	23.33	26.67
19	10	15	16.67	25.00
20	16	19	26.67	31.67
21	15	22	25.00	36.67
22	16	18	26.67	30.00
23	13	20	21.67	33.33
24	16	24	26.67	40.00
25	10	13	16.67	21.67
26	14	18	23.33	30.00
27	11	17	18.33	28.33
	361	471	601.67	785.00

APPENDIX S (ii)

PRE-TEST AND POST-TEST

ZONE C: EXPERIMENTAL GROUPS (BOYS)

S/N	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	9	13	15.00	21.67
2	11	17	18.33	28.33
3	21	22	35.00	36.67
4	19	23	31.67	38.33
5	18	13	30.00	21.67
6	15	18	25.00	30.00
7	13	13	21.67	21.67
8	14	19	23.33	31.67
9	12	22	20.00	36.67
10	11	16	18.33	26.67
11	23	35	38.33	58.33
12	21	33	35.00	55.00
13	19	23	31.67	38.33
14	12	16	20.00	26.67
15	13	19	21.67	31.67
16	21	24	35.00	40.00
17	19	21	31.67	35.00
18	15	18	25.00	30.00
19	20	20	33.33	33.33
20	10	12	16.67	20.00
21	9	10	15.00	16.67
22	21	21	35.00	35.00
23	11	19	18.33	31.67
24	16	24	26.67	40.00
25	10	13	16.67	21.67
26	12	15	20.00	25.00
27	18	25	30.00	41.67
28	14	30	23.33	50.00
	427	554	711.67	923.33

APPENDIX T (i)

PRE-TEST AND POST-TEST

ZONE A: CONTROL GROUPS (GIRLS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	22	22	36.67	36.67
2	14	14	23.33	23.33
3	11	15	18.33	25.00
4	14	11	23.33	18.33
5	16	12	26.67	20.00
6	12	10	20.00	16.67
7	21	22	35.00	36.67
8	16	24	26.67	40.00
9	17	15	28.33	25.00
10	20	20	33.33	33.33
11	14	17	23.33	28.33
12	17	27	28.33	45.00
13	21	22	35.00	36.67
14	31	35	51.67	58.33
15	21	23	35.00	38.33
16	13	22	21.67	36.67
17	17	17	28.33	28.33
18	17	17	28.33	28.33
19	14	20	23.33	33.33
20	18	18	30.00	30.00
21	16	17	26.67	28.33
22	14	17	23.33	28.33
23	26	30	43.33	50.00
24	11	14	18.33	23.33
25	28	30	46.67	50.00
26	33	35	55.00	58.33
27	13	24	21.67	40.00
28	17	24	28.33	40.00
29	14	18	23.33	30.00
	518	592	863.33	986.67

APPENDIX T (ii)

PRE-TEST AND POST-TEST

ZONE A: CONTROL GROUPS (BOYS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	14	20	23.33	33.33
2	16	19	26.67	31.67
3	13	16	21.67	26.67
4	20	22	33.33	36.67
5	13	14	21.67	23.33
6	10	18	16.67	30.00
7	7	7	11.67	11.67
8	11	12	18.33	20.00
9	14	21	23.33	35.00
10	13	16	21.67	26.67
11	12	19	20.00	31.67
12	16	15	26.67	25.00
13	17	19	28.33	31.67
14	20	25	33.33	41.67
15	17	20	28.33	33.33
16	13	17	21.67	28.33
17	11	16	18.33	26.67
18	17	19	28.33	31.67
19	11	15	18.33	25.00
20	23	25	38.33	41.67
21	11	11	18.33	18.33
22	20	22	33.33	36.67
23	14	15	23.33	25.00
24	8	15	13.33	25.00
25	17	22	28.33	36.67
26	13	13	21.67	21.67
	371	453	618.33	755.00

APPENDIX U (i)

PRE-TEST AND POST-TEST

ZONE B: CONTROL GROUP (GIRLS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	15	23	25.00	38.33
2	22	30	36.67	50.00
3	21	29	35.00	48.33
4	18	32	30.00	53.33
5	17	27	28.33	45.00
6	16	24	26.67	40.00
7	18	28	30.00	46.67
8	25	37	41.67	61.67
9	20	20	33.33	33.33
10	12	25	20.00	41.67
11	17	21	28.33	35.00
12	18	29	30.00	48.33
13	21	24	35.00	40.00
14	18	25	30.00	41.67
15	23	23	38.33	38.33
16	20	26	33.33	43.33
17	19	25	31.67	41.67
18	17	24	28.33	40.00
19	19	22	31.67	36.67
20	20	18	33.33	30.00
21	21	22	35.00	36.67
22	31	35	51.67	58.33
23	16	26	26.67	43.33
24	10	20	16.67	33.33
25	28	30	46.67	50.00
26	14	27	23.33	45.00
27	16	17	26.67	28.33
28	14	24	23.33	40.00
29	18	18	30.00	30.00
30	14	27	23.33	45.00
	558	758	930.00	1,263.33

APPENDIX U (ii)

PRE-TEST AND POST-TEST

ZONE B: CONTROL GROUP (BOYS)

S/NO	PRE TEST	POST TEST	PRE-TEST %	POST-TEST %
1	21	33	35.00	55.00
2	18	29	30.00	48.33
3	17	27	28.33	45.00
4	19	20	31.67	33.33
5	20	22	33.33	36.67
6	13	27	21.67	45.00
7	31	32	51.67	53.33
8	19	22	31.67	36.67
9	18	30	30.00	50.00
10	19	24	31.67	40.00
11	16	23	26.67	38.33
12	19	22	31.67	36.67
13	14	38	23.33	63.33
14	20	31	33.33	51.67
15	14	28	23.33	46.67
16	17	24	28.33	40.00
17	11	25	18.33	41.67
18	19	21	31.67	35.00
19	22	23	36.67	38.33
20	15	25	25.00	41.67
21	16	20	26.67	33.33
22	13	22	21.67	36.67
23	21	22	35.00	36.67
24	13	28	21.67	46.67
25	15	15	25.00	25.00
TOTAL	440	633	733.33	1,055.00

APPENDIX V (i)

PRE-TEST AND POST-TEST

ZONE C: CONTROL GROUPS (GIRLS)

S/NO	PRE-TEST	POST-TEST	PRE-TEST%	POST-TEST %
1	11	18	18.33	30.00
2	14	16	23.33	26.67
3	10	18	16.67	30.00
4	16	17	26.67	28.33
5	12	20	20.00	33.33
6	14	20	23.33	33.33
7	17	17	28.33	28.33
8	13	15	21.67	25.00
9	10	19	16.67	31.67
10	12	16	20.00	26.67
11	8	9	13.33	15.00
12	11	11	18.33	18.33
13	9	12	15.00	20.00
14	15	20	25.00	33.33
15	16	21	26.67	35.00
16	14	18	23.33	30.00
17	19	12	31.67	20.00
18	16	19	26.67	31.67
19	15	14	25.00	23.33
20	13	14	21.67	23.33
21	12	14	20.00	23.33
22	11	17	18.33	28.33
23	16	15	26.67	25.00
24	12	15	20.00	25.00
25	16	19	26.67	31.67
26	14	16	23.33	26.67
27	10	14	16.67	23.33
TOTAL	356	436	593.33	726.67

APPENDIX V (ii)

PRE-TEST AND POST-TEST

ZONE C: CONTROL GROUPS (BOYS)

S/N	PRE-TEST	POST-TEST	PRE-TEST %	POST-TEST %
1	13	15	21.67	25.00
2	12	17	20.00	28.33
3	10	12	16.67	20.00
4	11	13	18.33	21.67
5	18	12	30.00	20.00
6	19	20	31.67	33.33
7	15	21	25.00	35.00
8	20	21	33.33	35.00
9	21	23	35.00	38.33
10	19	20	31.67	33.33
11	16	17	26.67	28.33
12	23	25	38.33	41.67
13	22	26	36.67	43.33
14	11	14	18.33	23.33
15	12	18	20.00	30.00
16	10	11	16.67	18.33
17	15	15	25.00	25.00
18	13	16	21.67	26.67
19	14	16	23.33	26.67
20	15	17	25.00	28.33
21	20	19	33.33	31.67
22	18	19	30.00	31.67
23	11	21	18.33	35.00
24	19	12	31.67	20.00
25	19	14	31.67	23.33
26	10	13	16.67	21.67
27	12	19	20.00	31.67
28	21	31	35.00	51.67
	439	497	731.67	828.33

APPENDIX W

T-Test analysis

```
GET
  FILE='C:\Users\Abdullahi\Desktop\Exp. & Contr. Data.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
T-TEST GROUPS=grp(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=scores
  /CRITERIA=CI(.95).
```

T-Test

```
[DataSet1] C:\Users\Abdullahi\Desktop\Exp. & Contr. Data.sav
```

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Scores	exp	165	43.9091	4.90497	.38185
	ctrl	165	39.8182	2.40242	.18703

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
Scores	Equal variances assumed	85.208	.000	9.621	328
	Equal variances not assumed			9.621	238.404

Independent Samples Test

		t-test for Equality of Means			
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence ... Lower
Scores	Equal variances assumed	.000	4.09091	.42519	3.25446
	Equal variances not assumed	.000	4.09091	.42519	3.25329

Independent Samples Test

		t-test for Equality of ... 95% Confidence ... Upper
Scores	Equal variances assumed	4.92736
	Equal variances not assumed	4.92853

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APPENDIX X

T-test analysis

```
GET
  FILE='C:\Users\Abdullahi\Desktop\Gender Data.sav'.
DATASET NAME DataSet2 WINDOW=FRONT.
T-TEST GROUPS=gender(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=scores
  /CRITERIA=CI(.95).
```

T-Test

[DataSet2] C:\Users\Abdullahi\Desktop\Gender Data.sav

Group Statistics

	Gender (Males & Females)	N	Mean	Std. Deviation	Std. Error Mean
Scores	Male	86	42.5465	2.38454	.25713
	Female	79	39.0127	.94045	.10581

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
Scores	Equal variances assumed	37.365	.000	12.319	163
	Equal variances not assumed			12.709	112.702

Independent Samples Test

		t-test for Equality of Means			
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence ... Lower
Scores	Equal variances assumed	.000	3.53385	.28686	2.96741
	Equal variances not assumed	.000	3.53385	.27805	2.98297

Independent Samples Test

		t-test for Equality of ... 95% Confidence ... Upper
Scores	Equal variances assumed	4.10030
	Equal variances not assumed	4.08474

Page 1

TABLE 6

Table for Determining Sample Size from a Given Population

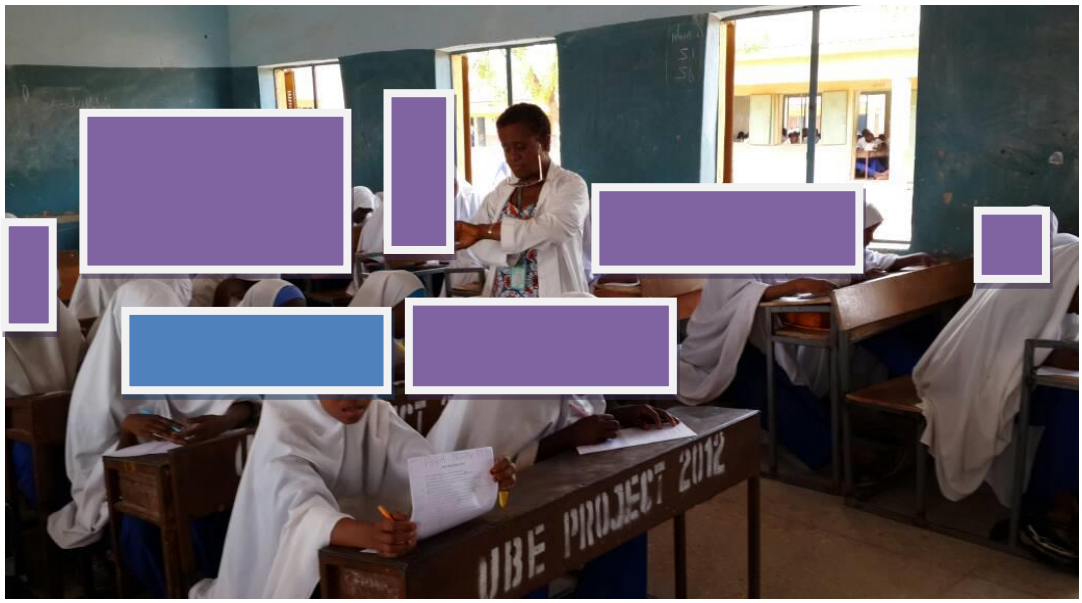
N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1001	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	110	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	308	9000	368
60	52	210	32	4 6 0	210	1600	310	10,000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	44	550	225	1900.	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	37	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

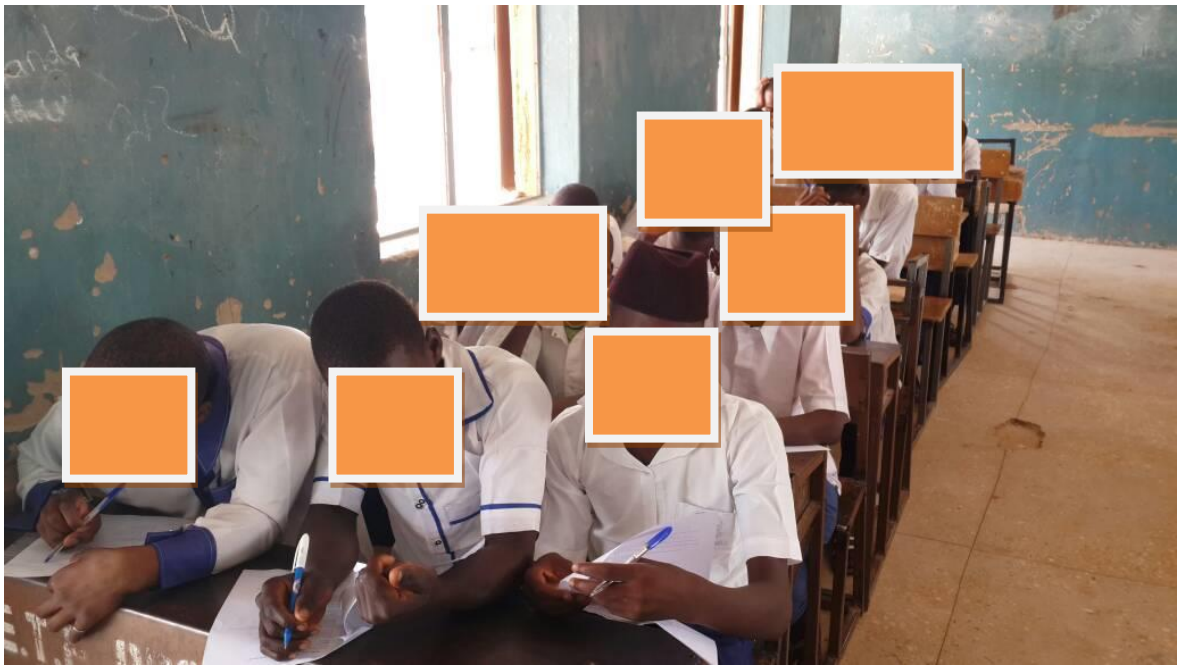
Source: Krejcie, Robert V., Morgan, Dary W., (1970)

Note: “N” is population size

“S” is sample size

Pictures taken during Experimental group exercises using ABTM.


UBE PROJECT 2012



CURRICULUM VITAE

PERSONAL DATA

SURNAME	Agbenyeku
OTHER NAMES	Umoh Elizabeth
DATE OF BIRTH	25th August, 1953
PLACE OF BIRTH	Kaduna, Kaduna State
NATIONALITY	Nigerian
LOCAL GOVERNMENT	Etinan
PERMANENT HOME ADDRESS	IkotEkan P.A. IkotIseyen
STATE	AkwaIbom
MARITAL STATUS	Married
NEXT OF KIN	Sir. Emmanuel Agbenyeku

SCHOOLS ATTENDED WITH DATES

- Army Children School, Kaduna 1959 -1966
- Queen Of Apostles College, Kaduna 1967 -1968
- St. Theresa's Secondary School, EdemEkpat, Etinan - 1968-1971
- Federal Advance Teacher's College, Yola (ABU) 1976-1978
- Ahmadu Bello University, Zaria 1986-1989
- University of Jos, Jos 2002 - 2006

QUALIFICATIONS OBTAINED WITH DATES

- First School Leaving Certificate 1966
- West African Examination Council 1971
- Nigerian Certificate Of Education 1978
- B.SC. ED. (BIO) 1989
- Certificate In Computer Application And Appreciation 2004
- M.SC. ED. (BIO) 2006

Working Experience from 1979 to Date

13 Journals and Articles Published

1. Agbenyeku, E.U. (2014), 'Women Education in Nigeria: An Instrument of Empowerment Towards Sustainable National Growth and Development in a Publication of the National Association of Women in Colleges of Education (WICE), Page 223-237. Venue: Sheridan Suite, 37 Oldham Road, M408EA, Manchester England, United Kingdom. Date: 7th – 11th July, 2014.
2. Agbenyeku, E.U. (2012) "Enhancing Standards in Educational Research: ScienceEducation in Focus", ***Bakatsina Journals of Education***FCE Katsina.

19 Conference Papers Presented

1. Agbenyeku, E.U. (2010) ***Vision 20:2020 the Role of the Science Women Academia.*** Being a Paper Presented at the Annual Conference of Association of Women in Colleges of Education (WICE), FCEAsaba. 11th to 15th October, 2010.
2. Agbenyeku, E.U. (2010)***Library as a Tool for Qualitative Science in NigeriaProblems and Prospects***. Being a Paper Presented at the First National Conference of the Academic Staff Union (COEASU) FCE, Katsina. 17th to 21st May, 2010.

2 Text Books Produced **2012**

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03 September 2017

Dear Dr Mokiwa

This serves to confirm that the doctoral thesis by Ms E U Agbenyeku has been submitted to me for language editing.

While I have suggested various changes, I cannot guarantee that these have been implemented nor can I take responsibility for any other subsequent changes or additions that may have been made.

Yours faithfully

Renée van der Merwe